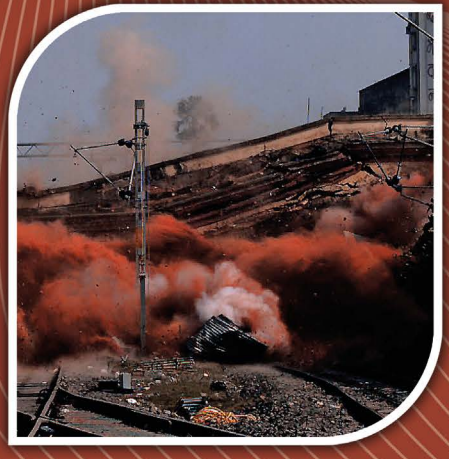
वार्षिक प्रतिवेदन
Annual Report
2020-21





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75
संकल्प - आत्मनिर्भर भारत
Building Self Reliant India

सीएसआईआर - केंद्रीय खनन एवं ईंधन अनुसंधान संस्थान
(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद्)
CSIR - CENTRAL INSTITUTE OF MINING AND FUEL RESEARCH
(COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH)

On the occasion of Inauguration of Summit on Women in **Technology-Role of Women in Sustainable Technology and Climate Change** on 08.03.2021. On the dias (L to R) Dr. V. Anguselvi, Smt. Usha Singh, Dr. Sridevi Annapurna Singh, Director, CFTRI, Mysore, Dr. Gautam Banerjee and Dr. (Mrs.) Babli Prasad

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निदेशक की कलम से

सीएसआईआर-केन्द्रीय खनन एवं ईंधन अनुसंधान संस्थान, धनबाद के वर्ष 2020-21 का वार्षिक प्रतिवेदन प्रस्तुत करने में मुझे अपार हर्ष हो रहा है। उक्त रिपोर्ट में संस्थान द्वारा उल्लिखित वर्ष के दौरान खनन, ईंधन तथा संबद्ध क्षेत्रों में किए गए समस्त अनुसंधान एवं विकास कार्यों एवं प्रदान की गई अवसंरचनात्मक तकनीकी सेवाओं को संक्षेप में दर्शाया गया है।

मुझे उन उल्लेखनीय योगदानों को लिपिबद्ध करने में हर्षानुभव हो रहा है, जो संस्थान के ***विज़न*** - *खनन एवं ईंधन अनुसंधान के क्षेत्र में अंतर्राष्ट्रीय ख्याति प्राप्त शोध संस्थान होना* एवं ***मिशन*** - *अत्याधुनिक प्रौद्योगिकियों को सतत विकसित करना एवं सामाजिक उत्थान तथा औद्योगिक विकास में उन्हें प्रयुक्त करना,* के अनुरूप है।

इस वर्ष के दौरान संस्थान द्वारा प्रौद्योगिकियों के विकास एवं हस्तांतरण में प्रभावी योगदान दिया गया। जैसे कि डिजिटल माइन यूजिंग इंटरनेट ऑफ थिंग्ज़ (ऑडियो-विजुअल वार्निंग डिवाइस, सेंसर मॉड्यूल, माइनर्स ट्रैकिंग डिवाइस ऐंड वायरलेस कम्युनिकेशन डिवाइस) तीन कंपनियों यथा (क) मेसर्स नॉलेज लेंस प्राइवेट लिमिटेड, बेंगलुरु; (ख) मेसर्स कोरेसोनेंट सिस्टेम्स प्राइवेट लिमिटेड, सिकंदराबाद; और (ग) मेसर्स ऑप्टिमाइज्ड सॉल्यूशंस लिमिटेड, अहमदाबाद को हस्तांतरित किया गया। इसी तरह इम्प्रूव्ड सॉफ्ट कोक मेकिंग टेकनोलॉजी 3 कंपनियों यथा (क) मेसर्स शारदापुंज फ्युएल कोक प्राइवेट लिमिटेड, मुगलसराय; (ख) मेसर्स कहकशां एंटरप्राइजेज, हजारीबाग; और (ग) मेसर्स गणपति एंटरप्राइजेज, कैमूर को हस्तांतरित किया गया। बायोमेट्रिक

बेस्ड एक्सप्लोडर मेसर्स प्रणय एंटरप्राइजेज, हैदराबाद को तथा कॉनटैक्टलेस ऑटो यूवी डिज़िन्फेक्ट यूनिट ऑर चेम्बर फॉर टच स्क्रीन, थम्ब ऑर फिंगर स्कैनर्स और कीपैड्स ऑफ बायोमेट्रिक आईडेंटिफिकेशन डिवाइसेस एवं अन्य साधन या सिस्टेम मेसर्स आस्था टेक ऑटोमेशन प्राइवेट लिमिटेड को हस्तांतरित किया गया। ग्रामीण उत्पादों (कृषि उत्पादों, हस्तशिल्प वस्तुओं, हर्बल उत्पादों/ औषधियों आदि) के विक्रय के लिए किसानों, शिल्पकारों, उत्पादकों तथा विक्रेताओं के बीच संबंध स्थापित करने के लिए एक ई-कॉमर्स पोर्टल का विकास किया गया है। मेक इन इंडिया" और ग्रामीण उत्पादों की बिक्री हेतु https://graminebazar.in वेबसाइट एवं मोबाइल ऐप विकसित किया गया है। उक्त विकसित प्रणाली मेसर्स एजफोर्स सॉल्यूशंस प्राइवेट लिमिटेड, हैदराबाद को हस्तांतरित की गई है।

यह बताते हुए अत्यंत प्रसन्नता हो रही है कि संस्थान द्वारा वर्ष के दौरान बाह्य नकदी प्रवाह में महत्वपूर्ण योगदान दिया गया है, जो इस तथ्य से स्पष्ट है कि संस्थान ने बाह्य वित्तपोषित परियोजनाओं, रॉयल्टी और अन्य तकनीकी सेवाओं के माध्यम से बाह्य नकदी प्रवाह के रूप में 883.91 करोड़ रुपए (सार्वजनिक क्षेत्र से 741.57 करोड़ रुपए, निजी क्षेत्र से 137.45 करोड़ रुपए, सरकारी निधि से 4.67 करोड़ रुपए और विदेशी एजेंसियों से 0.22 करोड़ रुपए) अर्जित किए हैं। संस्थान ने इस वर्ष के दौरान करारों/ समझौता ज्ञापनों पर हस्ताक्षर करने की दिशा में अपनी एक अलग पहचान बनाई है। उल्लेखनीय है कि रिपोर्टाधीन अवधि के दौरान सीएसआईआर-सिम्फर ने पचहत्तर करारों/ समझौता ज्ञापनों पर हस्ताक्षर किए हैं। अंतर्राष्ट्रीय जर्नलों में तिरासी शोध पत्र, राष्ट्रीय जर्नलों में सत्ताईस शोध पत्र और सात पुस्तक अध्याय प्रकाशित हुए हैं। उक्त अवधि के दौरान बौद्धिक संपदा के एक भाग के रूप में ग्यारह पेटेंट दायर तथा तीन पेटेंट स्वीकृत किए गए एवं सत्रह कॉपीराइट दर्ज और पंजीकृत किए गए।

सीएसआईआर-सिम्फर ने कोयला तथा खनिजों के निष्कर्षण, सुरंगों, महानगरों और रेलवे के लिए सिविल निर्माण के प्रभावी प्रबंधन, हवाई अड्डे के विकास, संरचनाओं के विध्वंस आदि हेतु विभिन्न नव तकनीकों के माध्यम से खनन, ईंधन और संबद्ध विज्ञान के क्षेत्र में एक विशिष्ट स्थान बनाया है।

इस संस्थान द्वारा कोयला गुणवत्ता मूल्यांकन, कोयला बेनिफिसियेशन, कार्बनीकरण, दहन, गैसीकरण, द्रवण से संबंधित मुद्दों को संबोधित करते हुए कोयला एवं ऊर्जा के क्षेत्रों में भी सराहनीय योगदान दिया गया। खनिज निष्कर्षण के कारण उत्पन्न होने वाली समस्याओं के निवारण के लिए पर्यावरण प्रबंधन एवं पर्यावरण प्रभाव मूल्यांकन अध्ययन भी किए गए।

आशा है कि खनन, ईंधन एवं संबद्ध क्षेत्र से जुड़ी निजी और सार्वजनिक कंपनियों एवं भारत सरकार के विभिन्न मंत्रालयों के सहयोग से यह संस्थान उन सभी खनन तथा ईंधन उद्योगों की सहायता करने में सफल होगा, जो वर्तमान में इस क्षेत्र में अपना स्थान बनाने तथा वैश्विक प्रतिस्पर्धा का मजबूती से सामना करने के लिए कठिन संघर्ष कर रहे हैं।

प्रोफेसर शुद्धसत्व बसु

निदेशक, सीएसआईआर-सिम्फर, धनबाद

From Director's Desk

I am delighted to present the Annual Report of CSIR-Central Institute of Mining and Fuel Research (CSIR-CIMFR), Dhanbad for the year 2020-21 which highlights in brief the overview of all the R&D activities which embrace the fields of mining, fuel and allied sciences as well as infrastructural technical services rendered by the institute during the year. Due to Covid - 19 pandemic the Annual Report is published little late.

I am glad to set down the noteworthy contributions which were in tune with the vision (to be an Internationally Acclaimed Mining and Fuel Research Organisation) and mission (to Develop and Deliver Sustainable Cutting Edge Technologies for the Social Upliftment and Industrial Advancement) of the institute.

Effective contributions were made by the institute during the year in the development and transfer of technologies. Several technologies such as Audio-visual warning device, Sensor modules, Miner's tracking device and Wireless communication device were transferred to 3 firms namely: (i) M/s Knowledge Lens Pvt. Ltd., Bengaluru; (ii) M/s Coresonant Systems Pvt. Ltd., Secunderabad; and (iii) M/s Optimized Solutions Limited, Ahmedabad. Likewise: Emulsion explosive Emulcoal-100 was transferred to M/s. IDL Explosives Ltd., Hyderabad; Biometric Based Exploder was transferred to M/s Pranay Enterprises, Hyderabad; Dust Suppression Chemical was transferred to M/s Syntron Industries Pvt. Ltd., Ahmedabad; Dry Fog Dust Suppression System for Crushing, Screening and Loading Plants & Mining Areas was transferred to M/s Control System & Solutions, Kolkata; Improved Soft Coke Making Technology was transferred to M/s Shardapunj Fuel Coke Pvt. Ltd., Mughalsarai, U.P, M/s. Kahkasha Enterprises, Hazaribag & M/s Ganpati Enterprises, Kaimur, Bihar and Contactless Auto UV Disinfect Unit or Chamber for Touch Screens,

Thumb or Finger Scanners and Keypads of Biometric Identification Devices and Other Devices or Systems was transferred to M/s Ashta Tech Automation Pvt. Ltd., Nagpur

Selling of village products (agricultural products, handicraft items, herbal products /medicine, etc.) through e-commerce portal to establish link between farmers and sellers accomplished. A website (https://graminebazar.in) and mobile App has been developed for selling of "Make in India" and rural products. The developed knowhow has been transferred to M/s Edgeforce Solutions Pvt. Ltd., Hyderabad.

It is gratifying to note that the institute has made significant contributions in external cash flow during the year. It is evident from the fact that the institute has earned Rs.883.91 Crore (Rs.741.57Crore from Public Sector, Rs.137.45 Crore from Private Sector, Rs.4.67 Crore from Government fund and Rs.0.22 Crore from Foreign agencies) as external cash from the externally funded projects, royalty and other technical services. The institute has made a mark in the areas of signing Agreements / MOUs during the year. It is heartening to note that the CSIR-CIMFR has signed seventy five Agreements / MOUs. Eighty three research papers in International Journals, twenty seven in National Journals and seven chapters in Books have been published. Eleven patents were filed, 3 were granted and 17 copyrights were filed and registered during the period as a part of intellectual property.

CSIR-CIMFR has been carved a niche in the fields of mining, fuel and allied sciences by introducing different techniques for extraction of coal & minerals, effective management of civil construction for tunnels, metros & railways, airport development, structures demolition, etc.

Remarkable contributions were also made in the field of coal and energy sectors by addressing coal quality assessment, coal beneficiation, carbonization, combustion, gasification, liquefaction and associated issues which were appreciable. The environmental management and environmental impact assessment studies were also undertaken to overcome the problems caused due to mineral extraction.

It is hoped that with the co-operation of mining, fuel and allied sector companies both private and public and various Ministries of the Govt. of India, CSIR-CIMFR will be able to help the mining and fuel based industries which are at present struggling hard to come of the age and gear up and face the global competition fairly and firmly.

Prof. Suddhasatwa Basu, **FNASc, FNAE, FRSC, FICS, FIAAM**
Director, CSIR-CIMFR, Dhanbad

CONTENTS

वार्षिक प्रतिवेदन का हिंदी सारांश

खान यांत्रिकीकरण एवं प्रौद्योगिकी विकास अनुसंधान समूह

खान यांत्रिकीकरण एवं प्रौद्योगिकी विकास अनुसंधान समूह के **इंटेलिजेंट खनन प्रणालियाँ अनुभाग** द्वारा इलेक्ट्रॉनिकी और सूचना प्रौद्योगिकी मंत्रालय द्वारा प्रायोजित निम्न अनुसंधान एवं विकास परियोजना कार्य किए –

इंटरनेट ऑफ थिंग्स का प्रयोग करते हुए डिजिटल खदान का विकास: इस महत्वपूर्ण अनुसंधान एवं विकास परियोजना को भारत सरकार के इलेक्ट्रॉनिकी और सूचना प्रौद्योगिकी मंत्रालय द्वारा प्रायोजित किया गया है। इसके अंतर्गत भूमिगत खानों में सुरक्षा और उत्पादकता में सुधार करने के उद्देश्य से खानों में होने वाले खतरों की निगरानी और भविष्यवाणी करने के लिए एक डिजिटल खान प्रणाली विकसित की गई है। यह प्रणाली इंटरनेट ऑफ थिंग्स (IoT)-सक्षम सेंसर और नियंत्रण यूनिटों, फ्लेमप्रूफ और इंग्रेस रक्षित उपकरणों और डेटा ऐक्विज़िशन ऐंड प्रेडिक्शन सॉफ्टवेयर का उपयोग करती है।

धूमिल मौसम के लिए दृष्टि संवर्धन प्रणाली का विकास: उक्त परियोजना के अंतर्गत विकसित की गई दृष्टि संवर्धन प्रणाली धूमिल मौसम के दौरान परिवहन मार्ग और साथ ही साथ लोडिंग/ अनलोडिंग क्षेत्रों के प्रभावी विज़ुआलाइजेशन हेतु एक इंटेलिजेंट ड्राइवर ऐसिस्टेंस तकनीक है। यह सिस्टम रडार और जीएनएसएस का इस्तेमाल करते हुए वास्तविक काल वीडियो प्रसंस्करण, फ्लीट प्रबंधन, ऑब्जेक्ट डिटेक्शन के लिए उन्नत एनालिटिक्स, कृत्रिम बुद्धिमत्ता और इमेज प्रोसेसिंग तकनीकों का उपयोग करता है।

झारखंड राज्य में अनुसूचित जाति के लोगों के जीवन को सशक्त बनाने के लिए सूचना और सुविधा केंद्र की स्थापना: इस परियोजना के अंतर्गत विशेष रूप से अनुसूचित जाति एवं अनुसूचित जनजाति की मूलभूत आवश्यकताओं को ध्यान में रखते हुए ग्रामीण सुविधा केंद्र की स्थापना की गई है, जहाँ उनके उत्थान के लिए सेंसर युक्त यंत्र दवारा मिट्टी एवं पानी की जांच करना, धनोपार्जन हेतु सूचना प्रौद्योगिकी और इंटरनेट ऑफ थिंग्स से संबंधित प्रशिक्षण प्रदान करना, सरकार द्वारा संचालित विभिन्न योजनाओं एवं सरकारी संस्थानों के लिए नामांकन करना एवं रोजगार की जानकारी देना, आयुर्वेदिक औषधियों के उत्पादन हेतु उन्हें प्रेरित करना, ग्रामीणों द्वारा उत्पादित फसलों तथा उनके द्वारा निर्मित हस्तशिल्प की समुचित बिक्री हेतु सुविधाएँ उपलब्ध कराना तथा अन्य कार्यों का संचालन सुनिश्चित किया जाएगा। इस संबंध में https://graminebazar.in वेबसाइट एवं मोबाइल ऐप भी विकसित किया गया है।

इलेक्ट्रॉनिक्स और सूचना प्रौद्योगिकी उत्पादों के लिए सुरक्षा परीक्षण प्रयोगशाला की स्थापना: एक इलेक्ट्रॉनिक्स और सूचना प्रौद्योगिकी उत्पाद सुरक्षा परीक्षण प्रयोगशाला (ईआईएसटीएल) की स्थापना की गई है, जहाँ विभिन्न हितधारकों के लाभ के लिए भिन्न-भिन्न इलेक्ट्रॉनिक्स और आईटी उत्पादों का आईएस/आईईसी मानकों के अनुसार परीक्षण किया जा रहा है। संस्थान की यह प्रयोगशाला एनएबीएल द्वारा मान्यता प्राप्त होने के साथ-साथ भारतीय मानक ब्यूरो (बीआईएस) द्वारा पंजीकृत है।

खान यांत्रिकीकरण एवं प्रौद्योगिकी विकास अनुसंधान समूह के **स्वचालन एवं उत्पाद विकास अनुभाग** द्वारा निम्न परियोजनाओं पर कार्य प्रारंभ किए गए हैं –

भूमिगत खानों में मानव सुरक्षा के लिए अल्ट्रासोनिक निर्देशित तरंगों के माध्यम से स्वस्थाने रॉक बोल्टिंग का आकलन: सीएसआईआर, मुख्यालय द्वारा प्रायोजित इस फोकस बेस्ड रिसर्च (एफबीआर) परियोजना का उद्देश्य स्वस्थाने ग्राउटेड स्थिति में रूफ बोल्टों के परीक्षण के लिए अल्ट्रासाउंड निर्देशित तरंग तकनीक को स्थापित और मानकीकृत करना है। इसके परिणामस्वरूप स्वस्थाने ग्राउटेड स्थिति में रूफ बोल्टों के परीक्षण के लिए दिशानिर्देश तैयार करने के साथ-साथ कोरोज़न

पैच, नेकिंग, बेंडिंग, सिमेंट/ रेज़िन एनकैप्सुलेशन के ह्रास के संदर्भ में उनकी अखंडता, अवशिष्ट बोल्ट सामर्थ्य और स्थिति का आकलन करने में सहायता मिलेगी।

प्रोटोटाइप स्टील चॉक्स की भौतिक-यांत्रिक विशेषताओं का अध्ययन: मेसर्स टाटा स्टील लिमिटेड, जमाडोबा, धनबाद द्वारा प्रायोजित उक्त परियोजना के तहत खान सुरक्षा महानिदेशालय के परिपत्र सं. DGMS (Tech)(S&T)/Cir/No.1, 2007 के अनुसार प्रोटोटाइप स्टील चॉक्स की भौतिक-यांत्रिक विशेषताओं का अध्ययन किया गया है।

शैल उत्खनन अभियांत्रिकी अनुसंधान समूह

अप्रैल 2020 से मार्च 2021 की अवधि के दौरान, शैल उत्खनन अभियांत्रिकी अनुसंधान समूह द्वारा भारत-चीन और भारत-पाक सीमाओं के निकट रणनीतिक महत्ता की सड़कों के निर्माण के लिए सुरक्षित एवं कुशल विस्फोटन तकनीकों के विकास हेतु महत्वपूर्ण राष्ट्रीय परियोजनाओं पर कार्य किए गए। सीएसआईआर-सिम्फर एवं रक्षा मंत्रालय, भारत सरकार के सीमा सड़क संगठन (बीआरओ) के बीच समझौता ज्ञापनों पर हस्ताक्षर किए गए हैं, जिसके अंतर्गत सिम्फर भारतीय सीमाओं के पास विभिन्न रणनीतिक रूप से महत्वपूर्ण डिफेंस सड़क निर्माण स्थलों में शैल उत्खनन कार्यों की गति में तेजी लाने के लिए तकनीकी जानकारी प्रदान करता है।

नवी मुंबई अंतरराष्ट्रीय हवाई अड्डे (एनएमआईए) की ग्रीनफील्ड परियोजना के लिए भूमि विकास कार्य के एक भाग के रूप में नियंत्रित विस्फोट का उपयोग करते हुए उल्वे पहाड़ी को समतल करने का कार्य जून 2016 से जारी है। इसी तरह, एक 2 x 660 मेगावॉट ओबरा-सी थर्मल पावर प्लांट के निर्माण के लिए भूमि विकास कार्य को अनुसंधान समूह की देखरेख में ड्रिलिंग और ब्लास्टिंग तकनीकों का उपयोग करते हुए किया गया है। इस वर्ष के दौरान ताप विद्युत संयंत्रों की विभिन्न संरचनाओं की नींव के लिए नियंत्रित विस्फोटन कार्य सफलतापूर्वक पूरे कर लिए गए हैं।

इस अनुसंधान समूह ने नियंत्रित विस्फोटन का उपयोग करते हुए चट्टानों के सुरक्षित उत्खनन के लिए (क) कोंकण रेलवे के रत्नागिरी क्षेत्र में बोर्डावे, उक्षी यार्ड, एगेव और शिरसावन कटिंग (ख) बेतवा नदी पर झांसी-बीना के तीसरे रेलवे लाइन के लिए पुल के निर्माण (ग) दक्षिण पूर्व रेलवे के हटिया-बोंडामुंडा क्षेत्र के बीच कोयल नदी पर दूसरे रेलवे लाइन के लिए पुल के निर्माण (घ) पूर्व मध्य रेलवे (ईसीआर) के धनबाद मंडल के तहत करैला-अनपरा क्षेत्र के करैला रोड-शक्तिनगर परियोजना के दोहरीकरण (ङ) सैनवोर्डेम यार्ड (दक्षिण पश्चिम रेलवे के कुलेम-मडगांव क्षेत्र), आरवीएनएल, गोवा में मौजूदा रेल ट्रैक और अन्य संरचनाओं के आस-पास दूसरी लाइन बिछाने जैसे कई महत्वपूर्ण रेलवे परियोजनाओं पर भी कार्य किए हैं।

देश के विभिन्न हिस्सों में स्थित विभिन्न ओपेनकास्ट खानों जैसे (1) मेसर्स एनटीपीसी लिमिटेड, हजारीबाग की पाकरी बरवाडीह कोयला खान परियोजना; (2) मगध ओपेनकास्ट परियोजना, सीसीएल; (3) मेसर्स डी. सी. जैन, ओडिशा के दलपहाड़ आयरन और मैंगनीज खदानें; (4) मेसर्स श्री मेटालिक्स लिमिटेड, ओडिशा के खानबंध लौह अयस्क खान; (5) मेसर्स अल्ट्राटेक सीमेंट लिमिटेड, शंभूपुरा, चित्तौड़गढ़ का आदित्य चूना पत्थर खान; (6) मेसर्स अल्ट्राटेक सीमेंट लिमिटेड (इकाई: सीधी सीमेंट वर्क्स) के बडगौना और मझगवां चूना पत्थर खान; (7) सिद्धी सीमेंट वर्क्स के अरगट चूना पत्थर खान; (8) चोरमारी और देगढ़हट चूना पत्थर खान, जेयपी रीवा संयंत्र; (9) मेसर्स न्यूवोको विस्टास कार्पोरेशन लिमिटेड के सोनाडीह चूना पत्थर खान (10) मेसर्स प्रिज्म जॉनसन लिमिटेड के बघई चूना पत्थर खान आदि के आस-पास के आवासीय घरों/संरचनाओं को प्रभावित किए बिना सुरक्षित और कुशल ब्लास्टिंग संचालन करने के लिए नियंत्रित-विस्फोट डिजाइन पैटर्न सफलतापूर्वक विकसित किए गए।

इस अनुसंधान समूह ने कायड, रामपुरअगुचा, सिंधेसर-खुर्द, राजपुरा-दरीबा और जावर जैसे हिंदुस्तान जिंक लिमिटेड के विभिन्न भूमिगत खानों में और उसके आस-पास की सतही संरचनाओं की सुरक्षा और स्थिरता को ध्यान में रखते हुए निर्धारित सीमा के भीतर विस्फोट से प्रेरित जमीनी कंपन को नियंत्रित करने के लिए विस्फोट डिजाइन मापदंडों के अनुकूल एक अध्ययन भी किया है।

इनके अलावा उक्त अनुसंधान समूह द्वारा विस्फोटकों के विकास के लिए अनुसंधान एवं विकास कार्य भी किए गए, जिनमें जल प्रतिरोधी एएनएफओ विस्फोटक, एएनएफओ विस्फोटकों में प्रयुक्त तेलों के साथ ईंधन तेल का प्रतिस्थापन आदि शामिल हैं। मेसर्स राजस्थान स्टेट माइन्स एंड मिनरल्स लिमिटेड (आरएसएमएमएल) के झामरकोटरा रॉक फॉस्फेट खान जैसे ओपेनकास्ट खानों और मेसर्स टाटा स्टील लिमिटेड के विभिन्न लौह अयस्क खानों में विभिन्न विस्फोटक कंपनियों द्वारा आपूर्ति किए जा रहे विस्फोटकों और ब्लास्टिंग ऐक्सेसरीज का परीक्षण और मूल्यांकन किया गया। इसी तरह, कई कंपनियों के सिस्मोग्राफ के विश्वसनीय संचालन और सटीक कंपन रिकॉर्डिंग करने के लिए तकनीकी पहलुओं पर सलाह के लिए सिस्मोग्राफ का अध्ययन और मूल्यांकन किया गया।

खनन विधियाँ एवं भू-यांत्रिकी अनुसंधान समूह

अप्रैल 2020 से मार्च 2021 तक की अवधि के दौरान, खनन विधियाँ एवं भू-यांत्रिकी अनुसंधान समूह के **भू-यांत्रिकी एवं संख्यात्मक अनुभाग** तथा **भूमिगत खनन विधियाँ अनुभाग** द्वारा संयुक्त रूप से एक सीएसआईआर प्रायोजित एफबीआर/एनसीपी परियोजना, 17 विभिन्न अनुसंधान एवं विकास और उद्योग-प्रायोजित परियोजनाएं शुरू की गईं और पिछले वर्ष की परियोजनाओं को संपन्न किया गया। इन अनुभागों के क्लायंट पोर्टफोलियो में एचजेडएल, जरीवाव मार्बल माइन, अंबाजी, गुजरात, जीसीपीएल, जीएमएमसीओ, सीएमएटी, सीएमएटीपीएल, मेसर्स हिंडाल्को इंडस्ट्रीज लिमिटेड, ईसीएल, एसईसीएल, एमसीएल, एससीसीएल आदि शामिल हैं। उद्योग के अलावा, भूमिगत खनन विधियाँ अनुभाग विभिन्न शोध परियोजनाओं के लिए एलटीयू, स्वीडन, आईआईटी, खड़गपुर जैसे संस्थानों से भी जुड़ा था। दोनों अनुभागों की कुछ महत्वपूर्ण परियोजनाएं निम्न प्रकार हैं:

भिन्न-भिन्न भूखनन परिस्थितियों के तहत खान रोडवेज चौराहे के लिए रूफ रॉक रीइन्फोर्समेंट सिस्टम (R3S) - यह एक सीएसआईआर एनसीपी-एफबीआर परियोजना है। इस परियोजना का उद्देश्य विभिन्न भू-खनन स्थितियों के तहत सड़क के चौराहों के प्रभावी स्थिरीकरण के लिए रूफ रॉक रीइन्फोर्समेंट सिस्टम को अनुकूलित करने के लिए मानक दिशानिर्देश विकसित करना है।

जरीवाव मार्बल खदान, अंबुजा, गुजरात में गैलरी ओपेनिंग और स्तंभों के उपयुक्त क्रॉस-सेक्शन के साथ संगमरमर के भूमिगत खनन की व्यवहार्यता पर सलाह: यह भारत में पहला भूमिगत संगमरमर की खदान होगा।

रामपुरा अगुचा भूमिगत खान, एचजेडएल में इंस्ट्रूमेंटेशन के विश्लेषण के लिए भू नियंत्रण प्रबंधन योजना की तैयारी तथा स्टॉपिंग ऑपरेशन के दौरान स्ट्रेटा मॉनिटरन पर सलाह - इन दो परियोजनाओं का उद्देश्य भू नियंत्रण, इंस्ट्रूमेंटेशन के विश्लेषण और स्टॉपिंग ऑपरेशन के दौरान स्ट्रेटा मॉनिटरन के लिए एक व्यवस्थित दृष्टिकोण तैयार करना तथा रामपुरा अगुचा भूमिगत खान में पेस्ट भरण विधि के साथ अंडरहैंड (टॉप-डाउन) लॉन्ग होल ओपन स्टॉपिंग (एलएचओएस) की समीक्षा करना है।

इंक्लाइंड कोयला संस्तरों में समचतुर्भुज स्तंभ का डिजाइन - इंक्लाइंड कोयला स्तंभों के सामर्थ्य का अनुमान लगाने के लिए विफलता तंत्र का अध्ययन किया गया एवं इंक्लाइंड कोयला संस्तरों में समचतुर्भुज स्तंभ डिजाइन करने के लिए उपयुक्त पद्धति विकसित की गई।

कोयला खान के कार्यस्थल में विभिन्न खनन विधियों के लिए स्तंभों की डिजाइन और स्थिरता - कोयला मंत्रालय द्वारा वित्त पोषित इस परियोजना का उद्देश्य 300 मीटर से अधिक की गहराई पर विभिन्न भूमिगत खनन विधियों के लिए स्तंभों के डिजाइन के लिए दिशानिर्देश विकसित करना है।

मोबाइल मशीनरी के लागत प्रभावी सुरक्षित संचालन के लिए रीयल-टाइम प्रॉग्नोसिस सिस्टम (आरटीपीएस) का विकास और ऐडॉप्शन: डम्पर फ्लीट का शो-केस्ड प्रदर्शन - कोल इंडिया लिमिटेड के अनुसंधान एवं विकास बोर्ड द्वारा वित्त पोषित इस परियोजना को सिम्फर, आईआईटी खड़गपुर और LTU, स्वीडन संयुक्त रूप में निष्पादित कर रहे हैं। इस परियोजना का मुख्य उद्देश्य एक उन्नत रियल टाइम प्रग्नॉस्टिक सिस्टम का विकास और प्रदर्शन करना है ताकि कहीं से भी ओपेनकास्ट कोयला खदानों में मशीनरी की स्थिति का मॉनीटरन किया जा सके। साथ ही किसी प्रकार की समस्या होने से पहले ही रखरखाव के लिए ध्यानाकर्षण हेतु डिग्रेडेशन लेवल का पता लगाकर Remaining Useful Life (RUL) को बढ़ाया जा सके।

कंटीन्यूअस माइनर (सीएम) प्रौद्योगिकी का उपयोग करते हुए निष्कर्षण पद्धति का डिजाइन - सिंगरेनी कोलियरीज कंपनी लिमिटेड (एससीसीएल) के वीके -7 इन्क्लाइन खान में सीम का उपयोग करते हुए क्वीन सीम (टॉप सीम) के गोफ के नीचे किंग सीम में विकसित कोयला स्तंभों का निष्कर्षण किया जा रहा है। ऐसा ही एक और उल्लेखनीय शोध कार्य है चर्चा खान (आरओ), एसईसीएल में विशाल कॉम्पिटेंट डोलराइट सिल के नीचे कोयला संस्तर की निष्कर्षण विधि का डिजाइन तैयार करना। यहाँ गंभीर साइड स्पैलिंग जैसे भूनियंत्रण समस्याओं के समाधान के लिए 'टी-स्प्लिट मेथड' का एक अभिनव डिजाइन तैयार किया गया है।

इनके अलावा झांजरा प्रोजेक्ट कोलियरी, ईसीएल के 3 और 4 इंक्लाइन में कम ऊंचाई वाले कंटीन्यूअस माइनर का उपयोग करते हुए R-VII और R-VIIA संस्तर के सेक्टर एफ के विकास और विस्तंभन के लिए निष्कर्षण पद्धति के डिजाइन हेतु सलाह प्रदान की गई।

रिपोर्टाधीन अवधि के दौरान, खनन विधियाँ एवं भू-यांत्रिकी अनुसंधान समूह के **शैलसंहति अभिलक्षणन एवं नवोन्मेषी खनन विधियाँ अनुभाग** द्वारा शैलसंहति अभिलक्षणन, अवलंब डिजाइन के लिए आरएमआर (रॉक मास रेटिंग) के निर्धारण, दीर्घाओं और उनके चौकोर एवं साथ ही समचतुर्भुज आकार के स्तंभों के लिए अवलंब प्रणाली के डिजाइन, भू-नियंत्रण तथा अवलंब प्रणाली के मूल्यांकन से संबंधित विभिन्न उद्योग प्रायोजित एवं परामर्शी परियोजना कार्य किए गए। लाभान्वित ग्राहकों में मेसर्स ट्राइडेंट एंड ऑरो माइनिंग एलएलपी, मेसर्स एसएमएस लिमिटेड कोंडापुरम, मेसर्स ईस्टर्न कोलफील्ड्स लिमिटेड (ईसीएल), मेसर्स वेस्टर्न कोलफील्ड्स लिमिटेड (डब्लूसीएल), मेसर्स सिंगरेनी कोलियरीज कंपनी लिमिटेड (एससीसीएल), मेसर्स भारत कोकिंग कोल लिमिटेड, मेसर्स इंडियन मेटल एंड फेरो अलॉयज लिमिटेड (आईएमएफए), ओडिशा, मेसर्स टेक्नो-ब्लास्ट प्राइवेट लिमिटेड, छत्तीसगढ़, स्टील अथॉरिटी ऑफ इंडिया लिमिटेड (सेल) की जितपुर कोलियरी , हिंदुस्तान सॉल्ट लिमिटेड (एचएसएल) और भारतीय रेलवे शामिल हैं।

खान पृष्ठभरण अनुसंधान समूह

इस अवधि के दौरान, उक्त समूह द्वारा उड़नशील राख एवं उपरिभार (ओबी) का उपयोग करते हुए ओपेनकास्ट फिलिंग से संबंधित उद्योग प्रायोजित परियोजनाएँ आरंभ की गई हैं, विशेष रूप से सीएसपीजीएल से राख का उपयोग करते हुए जिंदल स्टील एंड पावर लिमिटेड (जेएसपीएल) के तमनार, गिधुमुरी और पटुरिया ओपनकास्ट खानों के फिलिंग का कार्य आरंभ किया गया। भूमिगत खदान के वॉएड को भरने हेतु कोयला राख के उपयोग की जांच के लिए प्रयोगशाला और फील्ड स्तर पर विभिन्न जांच की गई। इनमें वेदांता पावर के झारसुगुडा कैप्टिव पावर प्लांट से उत्पन्न कोयला राख का भूमिगत खानों में भरने में उपयोग; सेल के जितपुर

कोलियरी में बॉटम ऐश स्टोइंग का प्रयोगशाला और फील्ड प्रयोग एवं सेल के चासनाला कोलियरी में स्टोइंग के लिए बॉटम ऐश का उपयोग शामिल हैं। एमसीएल के तालचेर क्षेत्र स्थित हांडीधुआ और देउलबेरा कोलियरी के दुर्गम भूमिगत वॉयडों को स्थिरता प्रदान करने के लिए विभिन्न ब्लाइंड बैकफिल डिजाइन प्रस्तावित किए गए। इसके अलावा एमसीएल के लिंगराज क्षेत्र में नए डीएवी स्कूल के निर्माण के लिए उस स्थल की स्थिरता के विश्लेषण से संबंधित एक और महत्वपूर्ण कार्य भी किया गया। महागिरी खान, आईएमएफए में सीमेंटेड हाइड्रॉलिक फिलिंग को उन्नत किया गया है और उच्च फिलिंग दर हासिल किया गया है। आसन्न गौण स्टोप के निष्कर्षण के बाद महागिरी खान, आईएमएफए के भूमिगत स्टोपों के उचित पृष्ठभरण के परिणामस्वरूप एक फ्री स्टैंडिंग बैकफिल वॉल तैयार हो गया। इसके अलावा बैरिकेडों पर पड़ने वाले बैकफिल प्रेशर के मॉनिटरन के लिए फील्ड इंस्ट्रूमेंटेशन भी किए गए। हिंदुस्तान जिंक लिमिटेड (एचज़ेडएल) के ज़वरमाला, मोचिया और राजपुरा दरीबा भूमिगत खान के लिए फाइबर रेइनफोर्स्ड शॉटक्रीट (एफआरसी) बैरिकेड के साथ विकसित किया गया बैकफ़िल बल्कहेड डिज़ाइन अनन्य प्रकृति का है। इस बल्कहेड डिजाइन से पोरिंग दर में वृद्धि सुनिश्चित हुई है और साथ ही माइनिंग साइकल समय भी कम हुआ है। इसके अलावा, एचजेडएल के उल्लिखित तीनों भूमिगत खदानों में वैज्ञानिक रूप से किए गए बैकफिल इंस्ट्रूमेंटेशन से बैकफिल बैरिकेडों की सुरक्षा सुनिश्चित हुई है।

ढलान स्थिरता एवं भूस्खलन प्रबंधन अनुसंधान समूह

ढलान स्थिरता एवं भूस्खलन प्रबंधन अनुसंधान समूह द्वारा विभिन्न खुली खदानों और डंप के डिजाइन एवं अवलोकन पर विभिन्न कार्य किए गए हैं। इस अवधि के दौरान, ढलान स्थिरता एवं भूस्खलन प्रबंधन विभाग द्वारा सेंट्रल कोलफील्ड लिमिटेड (सीसीएल), ईस्टर्न कोलफील्ड लिमिटेड (ईसीएल), भारत कोकिंग कोल लिमिटेड (बीसीसीएल), राजस्थान राज्य खान और खनिज, गुजरात इंडस्ट्रीज पावर कॉर्पोरेशन लिमिटेड, स्टील अथॉरिटी ऑफ इंडिया लिमिटेड, नेशनल मिनरल डेवलपमेंट कॉरपोरेशन, नेशनल थर्मल पावर कॉर्पोरेशन, सेंट्रल वॉटर कमीशन, हिंडाल्को इंडस्ट्रीज लिमिटेड आदि के खदान और डंप के डिज़ाइन की विभिन्न परियोजनाएँ शुरू की गईं।

इस अनुसंधान समूह ने बीसीसीएल के एना कोलियरी, राजापुर ओपन कास्ट प्रोजेक्ट, गोंदुडीह खास, बासुदेवपुर कोलियरी के खदानों और डंप के इष्टतम डिजाइन के लिए अध्ययन का कार्य पूरा किया है। सीसीएल की रजरप्पा खुली खदान परियोजना, कारो खुली खदान परियोजना, एएडीओसीएम और रेलिगारा कोलियरी के लिए ढलान के डिजाइन का कार्य किया गया। कजोरा खुली खदान परियोजना और भनोरा वेस्ट हायर खुली खदान परियोजना, ईसीएल के लिए डिजाइन का कार्य पूरा किया गया। मेसर्स कपरम बगरोडिया प्रा. लिमिटेड में ढलान की ऊंची भित्ति खदान परियोजना के डिज़ाइन का काम पूरा किया। आरएसएमएमएल, बाड़मेर के कासनौ-मातासुख लिग्नाइट खदान के लिए ढलानों के डिजाइन के लिए ढलान स्थिरता कार्य पूरा किया गया था। बिड़ला सीमेंट्स लिमिटेड, चित्तौड़गढ़, का भेरदा लाईममस्टोन खदान और एनएमडीसी (डोनिमलाई लौह अयस्क खदान और कुमारस्वामी लौह अयस्क खदान) के लौह अयस्क खदानों के लिए भी काम किया गया है। वर्ष 2020-21 के दौरान मेसर्स एनटीपीसी के पकरी बरवाडीह और केरंडारी ओपन कास्ट खान में ढलान स्थिरता का काम भी पूरा कर लिया गया है।

इनके अलावा मेसर्स हिंडाल्को मुरी, झारखंड की मिट्टी और लाल मिट्टी के विभिन्न इंजीनियरिंग गुणों का भी मूल्यांकन किया गया। केंद्रीय जल आयोग ने खुदिया, जमुनिया और बिरमती में मिली निर्माण सामग्री की स्थिरता और इंजीनियरिंग गुणों के मूल्यांकन का काम सौंपा। इस काम को निर्धारित समय अवधि के भीतर सफलतापूर्वक पूरा कर लिया गया है।

खान योजना एवं इकोनोमिक्स, धँसान तथा सर्वेक्षण अनुसंधान समूह

खान योजना एवं इकोनोमिक्स, धँसान तथा सर्वेक्षण अनुसंधान समूह के **खान योजना एवं इकोनॉमिक्स अनुभाग** द्वारा वर्ष के दौरान अत्याधुनिक सॉफ्टवेयरों का उपयोग करते हुए विभिन्न पोखरिया एवं भूमिगत कोयला और गैर-कोयला खानों के लिए खनन योजना और डिजाइनिंग एवं इसके समीक्षा, सत्यापन तथा पुनरीक्षण का कार्य किया गया। अनुभाग ने सुरंग के उत्खनन तथा स्तंभन डिजाइन और इसके अनुवीक्षण के साथ ही औद्योगिक स्वचालन उपकरणों पर भी अनुसंधान कार्य किए हैं।

इस अनुभाग के प्रमुख कार्यों में कोयला और गैर-कोयला खदानों के लिए खान योजना और खदान बंद करने की योजना तैयार करना, विभिन्न खानों की व्यवहार्यता रिपोर्ट और खान योजनाओं की जांच, प्रस्तावित नई सुरंग की खुदाई और स्तंभन प्रभावकारिता (स्पोर्ट एफ़िकेसी) का सफल डिजाइन और मॉनिटरन, मशीन स्वास्थ्य निगरानी, एर्गोनॉमिक्स अध्ययन और खनन के साथ-साथ अन्य औद्योगिक उपकरणों का डिजाइन और विकास कार्य शामिल हैं।

रिपोर्टाधीन अवधि के दौरान प्रायोजित परियोजनाओं पर कार्य किए गए, यथा - रतनपुर और जमालपुर स्टेशनों के बीच प्रस्तावित नई रेलवे सुरंग के लिए सुरक्षित उत्खनन एवं स्तंभन प्रणाली का डिजाइन; रतनपुर और जमालपुर के बीच प्रस्तावित नई सुरंग के लिए उत्खनन और स्तंभन प्रभावकारिता की निगरानी; हिमाचल प्रदेश में इंडियन साल्ट्स लिमिटेड के द्रंग (मोहल भटोग) सेंधा नमक खदान के लिए व्यवहार्यता रिपोर्ट तैयार करना; महानदी कोलफ़ील्ड लिमिटेड के बसुंधरा क्षेत्र में मनोहरपुर तथा मनोहरपुर के निचले भाग में भूवैज्ञानिक मॉडल की समीक्षा तथा वार्षिक उत्पादन योजना का सत्यापन; अरुणाचल प्रदेश में तलिहा ग्रेफाइट डिपॉजिट की खनन योजना के पुनरीक्षण पर सलाह; अरुणाचल प्रदेश में ला-लामदाक क्षेत्र की खनन योजना के पुनरीक्षण पर सलाह; अरुणाचल प्रदेश में बोपी, डोडेसेरम और ताल क्षेत्रों की खनन योजना के पुनरीक्षण पर सलाह।

इनके अलावा इंटरनेट ऑफ थिंग्स (IoT) का उपयोग करते हुए रेलवे सुरंग में चट्टान गिरने की पहचान करने के लिए निरंतर निगरानी उपकरण के विकास से संबंधित संस्थागत परियोजना पर कार्य किया गया।

रिपोर्टाधीन अवधि के दौरान खान योजना एवं इकोनोमिक्स, धँसान तथा सर्वेक्षण अनुसंधान समूह के **खान धँसान एवं सर्वेक्षण अनुभाग** द्वारा भारत के विभिन्न भागों में स्थित कोयला खदानों में भूधँसान संबंधी जांच और थ्री डायमेंशनल सबसिडेंस प्रेडिक्शन किया गया। जगन्नाथपुर-बी कोयला ब्लॉक उड़ीसा मेटालिक्स प्राइवेट लिमिटेड, रश्मी सीमेंट लिमिटेड और श्याम स्टील मैन्युफैक्चरिंग लिमिटेड के संयुक्त उद्यम पावरप्लस ट्रेडर्स प्राइवेट लिमिटेड (पीटीपीएल) को दिया गया है। इन्फ्लुएंस फ़ंक्शन पद्धति का इस्तेमाल करते हुए त्रिआयामी भूधँसान प्रेडिक्शन मॉडलिंग का उपयोग सब्सिडेंस मूवमेंट को प्रेडिक्ट करने के लिए किया गया। केविंग के साथ विस्तंभन की शुरुआत के बाद से हर पांच सालों के अंतराल पर भूधँसान, ढलान, कंप्रेसिव स्ट्रेन और टेन्साइल स्ट्रेन का प्रेडिक्शन किया गया। भूधँसान का प्रभाव किसी भी सतही संरचना को प्रभावित नहीं करेगा। विभिन्न सतही लक्षणों और संरचनाओं के सुरक्षा मूल्यांकन के लिए झरिया कोयलाक्षेत्र में टाटा स्टील के जमाडोबा 2 पिट, 6 और 7 पिट्स भुटगोरिया अमलगमेटेड कोलियरी, डिगवाडीह, सिजुआ और भेलाटांड कोलियरी में 14 से अधिक स्टोड पैनलों पर सबसिडेंस जांच की गई।

खान अग्नि, संवातन, खनिक सुरक्षा एवं स्वास्थ्य अनुसंधान समूह

वर्ष 2020-21 की अवधि के दौरान खान अग्नि, खनिक सुरक्षा एवं स्वास्थ्य अनुसंधान समूह द्वारा **"जोखिम मूल्यांकन तथा जोखिम आधारित खदान आपातकालीन निकासी और पुन: प्रवेश प्रोटोकॉल को शामिल करते हुए भारतीय कोयले की विस्फोटकता के निर्धारण के माध्यम से विस्फोट के खतरे के निवारण और प्रशमन के लिए दिशानिर्देश का**

विकास" विषय पर अनुसंधान एवं विकास परियोजना आरंभ की गई। इसका उद्देश्य कोयला धूलि की विस्फोटकता के परीक्षण के लिए राष्ट्रीय सुविधा निर्मित करने के साथ-साथ भारतीय कोयला खानों में विस्फोट के खतरे की रोकथाम और शमन के लिए दिशानिर्देश तैयार करना है।

यह अनुसंधान समूह उद्योग-प्रायोजित परियोजनाओं पर भी कार्यरत है, जिनका सार इस प्रकार है - श्यामसुंदरपुर कोलियरी और कुनुस्तोरिया कोलियरी भूमिगत खदानों में आग/ तापन की समस्या के लिए समाधान प्रदान किया गया; मेसर्स सनफ्लैग आयरन एंड स्टील कंपनी लिमिटेड के बेलगांव भूमिगत खदान के बॉटम सीम के लिए ऊष्मायन अवधि निर्धारित की गई; 10 पिट डिगवाडीह कोलियरी और चर्चा खान (आरओ) में कार्यस्थल के कठोर वातावरण की समस्या के निवारण के लिए द्रव गतिकी और संवातन जांच के बुनियादी सिद्धांतों को लागू किया गया; कंप्यूटर सिमुलेशन अध्ययन की सहायता से बीसीसीएल के अक्षत खान मुरैडीह लॉन्गवॉल खान के मुख्य फैन की क्षमता और संवातन प्रणाली का अभिन्यास निर्धारित किया गया; हिंदुस्तान ज़िंक लिमिटेड के रामपुरा अगुचा खान में खनिकों के लिए एक स्वस्थ कार्यस्थल का वातावरण बनाने और उनके लिए व्यावसायिक सुरक्षा सुनिश्चित करने के लिए खान में विद्यमान धूल का स्थैतिक एवं व्यक्तिगत प्रतिचयन, खान के धूल, डीपीएम (डीजल पार्टिकुलेट मैटर) में मौजूद सिलिका के प्रतिशत का निर्धारण तथा डीजल वाहनों से उत्सर्जित होने वाले गैसों का मॉनिटरन किया गया; इंटीग्रेटेड कोल माइनिंग लिमिटेड, दुलंगा कोल माइनिंग प्रोजेक्ट, रामनगर कोलियरी जैसे विभिन्न ओपनकास्ट कोयला खानों में स्वतः तापन/ अग्नि की समस्या का सफलता के साथ निपटान किया गया।

इनके अलावा डीजल पार्टिकुलेट मैटर के परिक्षेपण और तनूकरण व्यवहार पर संवातन प्रणाली के प्रभाव का निर्धारण करने के लिए एक संस्थागत परियोजना प्रारंभ की गई।

प्राकृतिक संसाधन एवं पर्यावरण प्रबंधन अनुसंधान समूह

प्राकृतिक संसाधन एवं पर्यावरण प्रबंधन अनुसंधान समूह द्वारा निम्नलिखित छह सहायता-अनुदान परियोजनाएँ प्रारंभ की गई हैं:

- **झारखंड के महान अभ्रक क्षेत्र में फ्लोराइड और विषाक्त धातु संदूषण: भू-रसायन और स्वास्थ्य संबंधी निहितार्थ** - यह परियोजना महिला वैज्ञानिक योजना (डब्लूओएस-ए) के तहत डीएसटी द्वारा वित्त पोषित है।
- **स्टील स्लैग के उपयोग पर जोर देने के साथ इस्पात संयंत्रों में शून्य तरल विसर्जन प्राप्त करने के लिए एकीकृत लागत प्रभावी प्रौद्योगिकी** - उक्त परियोजना इस्पात मंत्रालय, भारत सरकार द्वारा वित्त पोषित है।
- **ऊर्जा कुशल और संधारणीय औद्योगिक अपशिष्ट जल उपचार के लिए स्टैंडअलोन फॉरवर्ड ऑस्मोसिस** - यह परियोजना डीएसटी द्वारा वित्त पोषित है।
- **झारखंड के अभ्रक क्षेत्र की वायुमंडलीय धूल और वर्षा में विशैले धातुओं और फ्लोराइड और उनसे संबंधित स्वास्थ्य जोखिम का अध्ययन** - यह परियोजना सीएसआईआर-सीनियर रिसर्च एसोसिएटशिप योजना द्वारा वित्त पोषित है।
- **अम्लीय खान जल के पुनः उपयोग और सुरक्षित निपटान हेतु उपचार के लिए प्रौद्योगिकी विकास** - यह परियोजना मेघालय राज्य प्रदूषण नियंत्रण बोर्ड द्वारा वित्त पोषित है।
- **सीएसआईआर-एफटीटी परियोजनाओं के ई30डब्लू /जल थीम के तहत परियोजना** - कोयला राख का राख निपटान सरोवरों में कोयले की राख के निपटान करने के लिए पारगम्य लाइनर की जांच।

इन सहायता अनुदान परियोजनाओं के अलावा कई प्रायोजित अनुसंधान परियोजना कार्य भी आरंभ किए गए - जैसे पर्यावरण वन जलवायु परिवर्तन मंत्रालय से पर्यावरण मंजूरी प्राप्त करने के लिए गुजरात के कच्छ जिलांतर्गत लखपत तालुका स्थित माटा न मढ़

खान; चासनाला कोलियरी, जितपुर कोलियरी के ईआईए/ईएमपी का बेसलाइन डेटा जनरेशन और प्रिपरेशन। इस दौरान विभिन्न अध्ययन भी किए गए, जैसे कि - हजारीबाग, झारखंड के डुमरी कोयला खान; सेल कोलियरीज डिवीजन की जितपुर कोलियरी; एनटीपीसी लिमिटेड की दुलंगा कोयला खनन परियोजना; तलवंडी साबो पावर लिमिटेड के जेनामोर, बोकारो, झारखंड के निकट नवाडीह में पत्थर की खदान के लिए पर्यावरणीय अध्ययन, वायु और जल/भूजल की गुणवत्ता, उड़नशील राख /सरोवर राख का निपटान/ डंपिंग, कोयले और उड़नशील राख में रेडियोधर्मिता और भारी धातु की मात्रा, भूमि उपयोग पैटर्न का मॉनिटरन और पर्यावरणीय विवरण जैसे विभिन्न पर्यावरणीय मानकों का मूल्यांकन। तालाबीरा 2 और 3 ओडिशा, तालाबीरा ओडिशा माइनिंग प्राइवेट लिमिटेड में तालाबीरा 2 और 3 ओसीपी में जैवविविधता कार्य का अध्ययन किया गया। जीआईपीसीएल के वस्तान नॉर्थ और मैंग्रोल लिग्नाइट खदानों से अम्लीय खान जल को हटाने के लिए अध्ययन और लागत प्रभावी समाधान किया गया। एनटीपीसी की पकरी-बरवाडीह कोयला खनन परियोजना में जीआईएस की मदद से अतिभारित क्षेत्रों से मृदा अपरदन/मृदा के प्रवाह पर एक अध्ययन आरंभ किया गया। पंजाब और गाजीपुर में विभिन्न स्थानों पर वेधित किए जाने वाले अन्वेषणात्मक कूपों के लिए जल गुणवत्ता का डेटाबेस जेनरेशन, व्याख्या और विश्लेषण शुरू किया गया।

गैर पारंपरिक अनुसंधान समूह

उक्त अनुसंधान समूह द्वारा मिथेन उत्सर्जन से भूमिगत खानों में सुरक्षा, कोयला संस्तर मिथेन/शेल गैस संसाधन संभाव्य का मूल्यांकन, भूवैज्ञानिक शैल समूह और सीबीएम कूपों में CO2 सिक्वेस्ट्रेशन, कोयला खनन और संचालन गतिविधियों से मिथेन उत्सर्जन का आकलन, तेल और प्राकृतिक गैस एवं भूमिगत कोयला गैसीकरण से संबंधित विभिन्न अनुसंधान एवं विकास कार्य किए जाते हैं। इस दौरान निम्नलिखित एस एंड टी परियोजनाओं पर कार्य किए गए:

- परित्यक्त खानों सहित भारत में कोयला खनन और संचालन गतिविधियों के लिए बेहतर फ्यूजीटिव मिथेन उत्सर्जन कारक।
- भारत के दामोदर बेसिन का शेल गैस संभाव्य मूल्यांकन।
- भारतीय कोयला खनन कार्यों से फ्यूजीटिव कार्बन डाइऑक्साइड उत्सर्जन का आकलन।

इनके अलावा उद्योग-प्रायोजित परियोजनाएं, यथा - मुरैडीह कोलियरी, बीसीसीएल के संस्तर-III की गैसीनेस की डिग्री के वर्गीकरण के लिए मिथेन उत्सर्जन पर अन्वेषण और संबंधित आपदाओं पर सलाह; पश्चिम बंगाल और झारखंड की रानीगंज, झरिया और दामोदर-कोयल घाटी से प्राप्त कोयला कोर नमूनों के भू-रासायनिक और विशिष्ट गुणों का मूल्यांकन; रानीगंज कोलफील्ड के पलासडीहा क्षेत्र के कार्बनयुक्त शेल/कोयला नमूनों का डिज़ॉर्पशन व ऐडसॉर्पशन अध्ययन, भू-रासायनिक और अन्य गुणधर्मों का मूल्यांकन, शेल गैस और कोयला संस्तर मिथेन रिज़रवॉयर का अध्ययन; मध्य प्रदेश के शहडोल जिलांतर्गत सोहागपुर पूर्व और पश्चिम ब्लॉक सीबीएम संभाव्यता मूल्यांकन के लिए कोयला संस्तरों की तापीय परिपक्वता, सूक्ष्म-पेट्रोग्राफी और भू-यांत्रिक अभिलक्षणों पर सलाह; आर-वीआईआईसी, नाकराकोंडा कुमारडीही बी कोलियरी, बांकोला एरिया, ईसीएल के गैसनेस की डिग्री के वर्गीकरण के लिए स्वस्थाने गैस की मात्रा का निर्धारण और मिथेन उत्सर्जन पर वैज्ञानिक अन्वेषण; ओएनजीसी के बोकारो पैच #ए और #बी में मौजूद कोयला कोरों के स्वस्थाने गैस मात्रा, सॉर्पशन अभिलक्षण, पेट्रोग्राफिक और रासायनिक मेकअप और गैस गुणवत्ता की जांच; जमाडोबा, टाटा स्टील में यूसीजी के भावी अनुप्रयोग के लिए शैल यांत्रिकी के दृष्टिकोण से पूर्व-व्यवहार्यता और संबंधित भू-तकनीकी मुद्दों पर सलाह; पांडवपारा भूमिगत खदान, बैकुंठपुर क्षेत्र, एसईसीएल के कोयला संस्तर-I के गैसीनेस की डिग्री के वर्गीकरण के लिए स्वस्थाने गैस की मात्रा का निर्धारण और मिथेन उत्सर्जन पर वैज्ञानिक जांच तथा संबंधित गैस खतरों पर परामर्श भी संपन्न की गई।

ज्वाला-सह उपस्कर सुरक्षा अनुसंधान समूह

रिपोर्टाधीन अवधि के दौरान ज्वाला-सह उपस्कर सुरक्षा अनुसंधान समूह द्वारा भेल, ओएनजीसी, आईओसीएल, दिनेश प्राइवेट लिमिटेड, ईसीआईएल, ईआईसीएल जैसे विभिन्न सरकारी संगठनों और निजी कंपनियों के लिए विभिन्न प्रायोजित, परामर्शी और उद्योग के लिए सेवाएँ परियोजनाओं पर कार्य किए गए।

इस अनुसंधान समूह ने जोखिम से भरे स्थानों में इंसानों और सामग्रियों की सुरक्षा बढ़ाने के लिए अपने नॉलेजबेस का व्यापक उपयोग किया है। मेसर्स भेल, भोपाल में आईएस/आईईसी: 60079-7:2015 के अनुसार 3930KW, 6.6KV, 4पोल फ्रेम साइज 1SJ7808; 1200KW, 11KV, 4पोल फ्रेम साइज 1SJ7632-4; 2750KW, 11KV, 2पोल फ्रेम साइज 1SJ1713; 370KW, 3.3KV, 2 पोल फ्रेम साइज 1MA7564-4 में रेटेड चार इंक्रीज़्ड सेफ्टी Ex 'eb'/'ec' मोटरों के विद्युत सुरक्षा मानकों पर सलाह दी गई। आईएस/आईईसी: 60079-2:2014 के अनुसार मेसर्स भेल, भोपाल में गैस समूह IIA / IIB / IIC खतरनाक क्षेत्रों के लिए जोन-1 और जोन-2 में उपयोग किए जाने हेतु फ्रेम आकार 1TH4943 में 10580KW/4पोल/6.6KV तथा फ्रेम आकार 1SB7634-4 में 1430KW/4पोल /6.6KV पर रेटेड दो प्रेशराइज्ड (Ex 'p') मोटरों के सुरक्षा पैरामीटर से संबंधित परियोजना कार्य को सफलतापूर्वक पूरा किया गया। परीक्षण परिणामों और डिजाइन मूल्यांकन के आधार पर पर्ज्ड कंट्रोल पैनल और इंक्रीज़्ड सेफ्टी मोटर प्रासंगिक मानकों के अनुरूप पाए गए तथा और गैस समूह IIA, IIB, IIC खतरनाक क्षेत्र के जोन 1 और 2 में उपयोग किए जाने हेतु उपयुक्त भी पाए गए। मेसर्स एफईपीएल इंजीनियरिंग प्राइवेट लिमिटेड, बेलापुर द्वारा प्रायोजित परियोजना 'खतरनाक क्षेत्रों में उपयुक्तता का पता लगाने हेतु ऑयल मिस्ट कंसोल्ड जनरेटर के विद्युत सुरक्षा मानकों पर सलाह' एवं मेसर्स बॉयलर कंट्रोल्स प्राइवेट लिमिटेड द्वारा प्रायोजित परियोजना 'खतरनाक क्षेत्रों में उपयोग हेतु विस्फोटक वातावरण में इग्निशन सिस्टम के अधिष्ठापन के लिए मूल्यांकन पर सलाह' संपन्न हो गई हैं।

तार रज्जू एवं विद्युत अभियांत्रिकी अनुसंधान समूह

अप्रैल 2020 से मार्च 2021 तक की अवधि के दौरान, तार रज्जू एवं विद्युत अभियांत्रिकी अनुसंधान समूह द्वारा इस्पात हवाई रज्जुओं (ट्रैक एवं हॉलेज) और माइन वाइन्डर रज्जुओं (केज एवं स्किप) की स्थिति पर स्वस्थाने अध्ययन और सलाह प्रदान करने से संबंधित विभिन्न कार्य किए गए। लाभान्वित ग्राहकों में मेसर्स दामोदर रोपवे एंड इंफ्रा लिमिटेड, राजस्थान; मेसर्स टिम्बर ट्रेल, एशिया रिसॉर्ट्स लिमिटेड, परवाणू (हिमाचल प्रदेश); मेसर्स गुवाहाटी मेट्रोपॉलिटन डेवलपमेंट अथॉरिटी, असम; मेसर्स डीआरवी पैसेंजर रोपवे, दार्जिलिंग, पश्चिम बंगाल; मेसर्स मां चामुंडा देवी पैसेंजर रोपवे, देवास, मध्य प्रदेश आदि शामिल हैं। इनके अलावा, विभिन्न खदानों में उपयोग की जाने वाली हॉलेज रज्जुओं और वाइन्डर रज्जुओं की स्थिति के बारे में भी परामर्श दिया जाता है।

इस अनुसंधान समूह का विद्युत अनुरक्षण अनुभाग सिम्फर परिसर में नियमित विद्युत अनुरक्षण संबंधी कार्यों के अलावा कार्यालय और आवासीय क्षेत्र के वैज्ञानिक कार्यकलापों के लिए निर्बाध और गुणवत्तापूर्ण बिजली आपूर्ति हेतु सेवा प्रदान की जाती है। इस अनुभाग द्वारा अनुरक्षित 340 kWp रूफटॉप सोलर पैनल नवीकरणीय ऊर्जा प्रणाली ने 95.01 टन कार्बन डाइऑक्साइड को वातावरण में प्रवेश करने से बचाया है।

शैल एवं पदार्थ अभिलक्षणन अनुसंधान समूह

शैल एवं पदार्थ अभिलक्षणन अनुसंधान समूह के **पदार्थ अभिलक्षणन अनुभाग** द्वारा विभिन्न प्रकार के रज्जुओं, मैन वाइंर, रूफ बोल्ट, चेयर लिफ्ट मैन राइडिंग सिस्टम, सी. एस. गियर यूनिट इत्यादि वाइटल कॉम्पोनेंटों का निष्पादन मूल्यांकन, विनाशकारी

एवं गैर-विनाशकारी परीक्षणों के माध्यम से गुणवत्ता मूल्यांकन, भौतिक-यांत्रिक, रासायनिक, वेदरिबिलिटी, गुणधर्मों, यांत्रिक इंटेग्रिटी, स्थिति आदि पर वैज्ञानिक अध्ययन किए गए एवं तदनुसार सलाह दी गई।

लाभान्वित ग्राहकों की सूची में हिंदुस्तान कॉपर लिमिटेड, घाटशिला, पूर्वी सिंहभूम, झारखंड; टाटा स्टील लिमिटेड; झांजरा क्षेत्र, ईसीएल; सिदुली कोलियरी, ईसीएल; केंदुआडीह कोलियरी; नंदीरा कोलियरी, एमसीएल; महागिरी माइन्स, आईएमएफए; चर्चा खान (आरओ); चासनाला कोलियरी व जितपुर कोलियरी, सेल; नीमचा कोलियरी, ईसीएल शामिल हैं।

शैल एवं पदार्थ अभिलक्षणन अनुसंधान समूह के **शैल यांत्रिकी अनुभाग** का मुख्य उद्देश्य सुरक्षा हेतु डिजाइन को ऑप्टिमाइज़ करने के लिए खनन और सिविल अभियांत्रिकी परियोजनाओं के लिए शैलों के विभिन्न भौतिक-यांत्रिक गुणों का निर्धारण करना है। इस अनुभाग को सामर्थ्य (यूनिएक्सियल, टेनसाइल और ट्राईएक्सियल), विकृति (इलास्टिक मॉड्यूलस और पॉयज़न अनुपात), स्लेक ड्यूरेबिलिटी सूचकांक, सेर्चर ऐब्रेसिविटी सूचकांक, अल्ट्रासोनिक वेग माप, पोरोसिटी, घनत्व के मापन सहित मानक (आईएस, आईएसआरएम और एएसटीएम) शैल परीक्षण में विशेषज्ञता प्राप्त है।

1 अप्रैल 2020 से 31 मार्च 2021 तक, इस अनुभाग ने सीएमपीडीआईएल, एमईसीएल, उड़ीसा माइनिंग कॉर्पोरेशन, टाटा स्टील लिमिटेड, एमएपीएल, आदि जैसे विभिन्न संगठनों द्वारा भेजे गए शैलों और कोयला के नमूनों के भौतिक-यांत्रिक विश्लेषण हेतु वैज्ञानिक अध्ययन किए और 10,000 मीटर से अधिक बोरहोल कोर का विश्लेषण किया है।

इस अनुभाग के पास अपने उन्नत शैल यांत्रिकी प्रयोगशाला में स्थापित एक अत्याधुनिक एमटीएस 815 शैल परीक्षण प्रणाली मौजूद है। यह प्रणाली उच्च परिशुद्धता और सटीकता के साथ विशेष रूप से शैल यांत्रिकी परीक्षणों (क्रीप टेस्ट, पोस्ट-फेल्यर ऐनालिसिस, साइक्लिक टेस्ट, फ्रैक्चर टफनेस टेस्ट, डायरेक्ट टेन्साइल टेस्ट आदि) को करने में सक्षम है। एमटीएस प्रणाली का उपयोग करते हुए बलुआ पत्थर शैल के सामर्थ्य और इलास्टिक गुणधर्मों पर ताप के प्रभाव का मूल्यांकन करने के लिए आंतरिक अनुसंधान एवं विकास प्रयास भी किए गए हैं।

वर्तमान में अनुभाग में एक ज़ाइस मर्लिन वीपी कॉम्पैक्ट फील्ड एमिशन-स्कैनिंग इलेक्ट्रॉन माइक्रोस्कोपी (एफई-एसईएम) उपकरण उपलब्ध है एवं इसका उपयोग शैल नमूनों, उत्प्रेरक, जैवसंहति, फ्लाई ऐश, बॉटम ऐश, मृदा और फिलामेंटों के स्कैनिंग इलेक्ट्रॉन माइक्रोस्कोप (एसईएम) और एनर्जी-डिस्पर्सिव एक्स-रे स्पेक्ट्रोस्कोपी (ईडीएक्स) विश्लेषण के लिए किया जाता है। उपयुक्त प्रक्रियाओं का उपयोग करते हुए किए गए कई कार्यों से उच्च रेज़ोल्यूशनों पर पदार्थों की संरचना का मूल्यांकन करने और समझने में मदद मिली है।

हाल ही में, अनुभाग में रॉक-इवल 6 सुविधा स्थापित की गई है। रॉक-इवल पायरोलिसिस तकनीक पारंपरिक और अपरंपरागत हाइड्रोकार्बन रिज़रवॉयरों के स्रोत-शैल भूरासायनिक प्रोफाइलिंग के लिए पेट्रोलियम भू-रासायनिकों द्वारा व्यापक रूप से उपयोग किया जाने वाला एक बेहतरीन उपकरण है।

ईंधन अनुसंधान

दहन अनुसंधान समूह

दहन अनुसंधान समूह का **दहन विज्ञान एवं प्रौद्योगिकी अनुभाग** कोयला दहन, स्वच्छ कोयला प्रौद्योगिकियों पर मूलभूत और अनुप्रयुक्त अनुसंधान कार्य करने के साथ-साथ कोयला आधारित विद्युत उत्पादन उद्योगों को उनकी समस्याओं का समाधान करने में सहायता प्रदान करता है। इस समूह द्वारा जीएचजी उत्सर्जन से संबंधित सूची तैयार करने, कोयला से प्राप्त रसायनों का रूपांतरण एवं कोयला उद्योग और अन्य ऊर्जा क्षेत्रों के लिए स्वच्छ ईंधन समाधान और जैव-प्रक्रियाएं प्रदान की जाती हैं।

इस समूह में प्रयोगशाला स्तर पर थर्मोग्रैविमेट्रिक एनालाइज़र (TGA), बेंच स्केल ड्रॉप ट्यूब फर्नेस (DTF) और पायलट स्केल फ्यूल इवैल्यूएशन टेस्ट फैसिलिटी (FETF) जैसी तीन सुविधाएँ उपलब्ध हैं। इन तीनों सुविधाओं का उपयोग कोयलों, कोयला मिश्रणों, कोयला-बायोमास मिश्रणों की दहन विशेषताओं का अध्ययन करने के लिए किया जाता है और इनके माध्यम से एनटीपीसी, रिलायंस एनर्जी, टाटा स्टील, गोंडोवाना जियोटेक प्राइवेट लिमिटेड, नाल्को जैसे विभिन्न उद्योगों को भी सेवाएँ प्रदान की गई हैं।

यह अनुसंधान समूह विभिन्न क्षेत्रों के लिए कोयले की मानक आवश्यकता के मॉडेलिटीज को स्थापित कर रहा है, जो भारत में विभिन्न क्षेत्रों/ उद्योगों में कोयले की मानक आवश्यकता का अनुमान लगाने के लिए कोल इंडिया लिमिटेड को वैज्ञानिक आधार प्रदान करता है। इससे कोयला मंत्रालय द्वारा कोयलों का समुचित ढंग से आवंटन किए जाने के संबंध में नीतिगत निर्णय लेने और भारत में वर्तमान में खनन किए जा रहे विभिन्न ग्रेड के कीमती कोयले के दुरुपयोग को रोकने में मदद मिलेगी।

ऊर्जा क्षेत्र की सूची [द्विवार्षिक अद्यतन रिपोर्ट और तीसरा राष्ट्रीय संचार (टीएनसी) – भारत सरकार द्वारा जलवायु परिवर्तन के संबंध में संयुक्त राष्ट्र फ्रेमवर्क कन्वेंशन को सूचित किया जाना है। (यूएनएफसीसीसी)]: इस राष्ट्रीय स्तर के महत्वपूर्ण परियोजना में शामिल हैं (क) विभिन्न वर्षों के लिए ऊर्जा और विनिर्माण उद्योगों के लिए राष्ट्रीय जीएचजी सूची तैयार करना (ख) भारतीय कोयले के लिए देश विशिष्ट और क्षेत्र विशिष्ट एनसीवी और सीईएफ का अनुमान (ग) थर्मल पावर प्लांट में कोयले के दहन के लिए ऑक्सीकरण कारक का आकलन। भारत सरकार द्वारा यूएनएफसीसीसी को राष्ट्रीय ऊर्जा क्षेत्र के संबंध में जानकारी देने की दिशा में इस समूह ने जीएचजी उत्सर्जन की राष्ट्रीय ऊर्जा क्षेत्र सूची तैयार करने में महत्वपूर्ण योगदान दिया है।

दहन अनुसंधान समूह के **कोयला से रसायन अनुभाग** द्वारा कार्बनिक संश्लेषण, उत्प्रेरक विकास और सायनो-पाइरीडीन, पिकोलिन जैसे कोल टार व्युत्पन्न से निकोटिनमाइड जैसे मूल्य वर्धित उत्पादों के संश्लेषण के क्षेत्र में कार्य किए जा रहे हैं।

इस समूह के **नवीकरणीय ऊर्जा और जैव प्रौद्योगिकी अनुभाग** द्वारा विभिन्न अनुसंधान एवं विकास परियोजनाओं जैसे मिशन मोड और इन-हाउज वित्त पोषित परियोजनाओं के क्षेत्र में माइक्रोबियल मार्ग के माध्यम से CO_2 कैप्चर करने, औद्योगिक अपशिष्टों की स्थायी उपयोगिता, नवीकरणीय ऊर्जा आदि क्षेत्रों में कार्य आरंभ किए गए हैं।

इस अनुभाग ने नया क्रो और फ्यूल बॉल मॉडल बायो-मिथेन रिएक्टर विकसित कर गांवों में प्रदर्शन किया। बायो-मिथेन रिएक्टर पहिया के साथ गतिशील है और किसानों द्वारा ट्रैक्टर के माध्यम से आसानी से स्थानांतरित किया जा सकता है। इस समूह ने प्रयोगशाला स्तर पर फ्लैट पैनल और बेलनाकार फोटो बायोरिएक्टर में सूक्ष्म शैवाल का उपयोग करके CO_2 को कैप्चर करने की प्रक्रिया पर अध्ययन किया है। आइसोलेशन, सूक्ष्म शैवाल के कुशल स्ट्रेनों की पहचान करने के लिए अध्ययन किया गया और औद्योगिक अनुप्रयोग के लिए शैवाल बैंक बनाया गया।

उक्त समूह कुछ और उल्लेखनीय परियोजनाओं पर भी कार्य कर रहा है जैसे कि – कुपोषण से निपटने के लिए हाइब्रिड फोटो-बायोरिएक्टर में खाद्य-उर्वरक के लिए वाणिज्यिक शैवाल उत्पादन हेतु कोयला खान जल के उपयोग का पायलट पैमाने पर निष्पादन; कृषि/ स्टोर अनाजों में कीट नियंत्रण के लिए जैव-कीटनाशक के रूप में कोयला राख/बायोमास राख/बायोजेनिक सिलिका समृद्ध संसाधनों से सिलिका मिश्रित “Si-Bps- HAs” (सिलिका-वानस्पतिक कीटनाशक-ह्यूमिक एसिड) का पायलट पैमाने पर प्रदर्शन; उत्थित CO_2 में एकल कोशिका और तंतुमय सूक्ष्मजीवी के बीच CO_2 सिग्नलिंग का अध्ययन तथा वाणिज्यिक अनुप्रयोग के लिए उच्च मूल्य वाले उत्पादों की जाँच; कोयला मिल और कोयला वॉशरी रिजेक्ट जैव-मिथेनेशन; जलीय पौधों और फोटोट्रोफों का उपयोग करते हुए कोयला औद्योगिक बहिःस्राव और कोल फाइन रिकवरी का जैव-प्रसंस्करण, कोयले से कला एवं शिल्प - ग्रामीण महिलाओं के लिए कौशल विकास; वाणिज्यिक प्रयोजन हेतु CO_2 प्रग्रहण शैवाल जैव संहति से नवीकरणीय एवं बायोडिग्रेडेबल अभिनव फैब्रिक और पिगमेंट आदि।

कोयला कार्बनीकरण, पर्यावरण उत्सर्जन एवं सीआरएम अनुसंधान समूह

उक्त अनुसंधान समूह के **कोयला कार्बनीकरण अनुभाग** द्वारा हाल ही में एक बेंच स्केल 'हॉट स्टैम्पिंग सिस्टम ऑफ कोल' विकसित और स्थापित किया गया, जो नॉन रिकवरी या बाय प्रोडक्ट कोक ओवन संयंत्रों में चार्जिंग के लिए हॉट कोक का कोल केक बनाता है। इस विकसित प्रौद्योगिकी के कई तकनीकी लाभ हैं और यह ब्लास्ट फर्नेस ग्रेड कोक के उत्पादन के लिए निम्न स्तरीय कार्बनयुक्त पदार्थों को समायोजित करने में सक्षम है। बेंच स्तरीय विकास को 250 किलोग्राम प्रति बैच कोक मेकिंग पायलट प्लांट तक बढ़ाने की दिशा में आगे का कार्यक्रम शुरू किया गया है। इस तकनीक की सफलता से कोक बनाने में बहुत बड़ी सफलता प्राप्त होगी और भारत सरकार के आत्मानिर्भर भारत अभियान के उद्देश्यों को पूरा करने और साथ ही राष्ट्रीय इस्पात नीति 2017 में अनुमानित इस्पात उत्पादन में वृद्धि के लिए आवश्यक ईंधन संसाधनों को स्वदेशी रूप से बढ़ाने में भी मदद मिलेगी। सॉफ्ट कोक बनाने की बेहतर तकनीक विकसित की गई और पेटेंट कराई गई; और इस प्रौद्योगिकी को वर्ष 2020-21 में पांच एमएसएमई को हस्तांतरित किया गया है।

वर्ष 2020-21 की अवधि के दौरान, **पर्यावरण, उत्सर्जन एवं सीआरएम अनुभाग** द्वारा डीएसटी, सीएसआईआर, ओएनजीसी, ईआईडी पैरी, चेन्नई द्वारा प्रायोजित विभिन्न अनुसंधान एवं विकास परियोजनाओं और कुछ संस्थागत वित्त-पोषित परियोजनाओं पर कार्य किए गए।

बायोमास और स्पेंट वॉश के दहन के बाद उत्पन्न राख का सतत उपयोग किया जाना एक बड़ी चुनौती है। इस अनुभाग द्वारा दहन अपशिष्ट से पोटेशियम को निष्कर्षित करने के लिए एक बुनियादी प्रक्रिया विकसित की गई है। इस प्रक्रिया को अब ईआईडी पैरी, चेन्नई के सहयोग से औद्योगिक स्थल पर उन्नत किया गया है।

लिथियम के वैकल्पिक स्रोत के रूप में भारतीय कोयले और बायोमास में लिथियम सामग्री का पता लगाने के उद्देश्य से एक मिशन मोड परियोजना आरंभ की गई। भारतीय कोयले में पारा/भारी धातुओं की उपस्थिति के तरीके का आकलन करने के लिए विस्तृत अध्ययन किया जा रहा है। ओएनजीसी बोकारो में कोयला संस्तर मिथेन गैस में पारा सामग्री का अध्ययन में किया गया।

यह अनुभाग ठोस जैव ईंधन के लिए भारतीय मानक तैयार करने में सक्रिय रूप से शामिल है। कुछ आईएसओ मानकों (प्रतिचयन, नमूना तैयार करना, नमी का निर्धारण, राख की मात्रा, जीसीवी) की समीक्षा की गई और उन्हें बीआईएस में अपनाए जाने के लिए अनुशंसा की गई। इनके अतिरिक्त ऐश, वीएम, जीसीवी, सल्फर, पारा जैसे प्रमाणित पैरामीटरों के साथ कोयले के लिए एक प्रमाणित संदर्भ सामग्री के विकास पर भी कार्य किया जा रहा है।

माइन स्पॉएल में सुधार के लिए बायोचार आधारित मिश्रित उर्वरक विकसित किया जा रहा है। विभिन्न जैविक कचरों से तैयार बायोचार को उनके उर्वरक और ईंधन गुणों के लिए उन्नत बनाया जा रहा है। नाइट्राइड आधारित उर्वरकों के विकास के लिए कोयला राख, कोयला वाशरी रिजेक्ट और अन्य कच्चे मालों का उपयोग किया जाता है।

कोयला एवं खनिज प्रसंस्करण अनुसंधान समूह

अप्रैल 2020 से मार्च 2021 के दौरान, कोयला एवं खनिज प्रसंस्करण अनुसंधान समूह द्वारा वॉशेबिलिटी, स्वदेशी और आयातित कोयलों के प्रतिचयन, फ्लोटेशन, आदि पर विभिन्न परियोजनाएं शुरू की गईं। लाभान्वित ग्राहकों में सेल, कोलकाता; सिंगरेनी कोलियरीज कंपनी लिमिटेड, हैदराबाद; भारत कोकिंग कोल लिमिटेड; टाटा स्टील; अभिनव ग्रुप, वेस्टर्न कोलफील्ड लिमिटेड, जेएसडब्लू स्टील लिमिटेड; एनटीपीएल तूतीकोरिन, तमिलनाडु; सेल कोलियरीज डिवीजन, चासनाला शामिल हैं।

कोयले की गुणवत्ता का मूल्यांकन करने के लिए एनटीपीएल, तूतीकोरिन को वैज्ञानिक एवं तकनीकी सेवा प्रदान की गई। रिपोर्टाधीन अवधि के दौरान लगभग 2627156 टन स्वदेशी कोयले का मूल्यांकन किया गया। इस अनुसंधान समूह द्वारा विभिन्न वाशरियों (भोजुडीह, सुदामडीह, पाथेरडीह, मधुबन आदि) में कोयला वाशरी स्लरी/रिजेक्ट का प्रतिचयन और विश्लेषण किया गया। स्टील अथॉरिटी ऑफ इंडिया लिमिटेड के लिए पोर्ट एंडों, विशेष रूप से हल्दिया, पारादीप, दामरा और वाइज़ैग बंदरगाहों पर अनलोड किए गए आयातित कोयलों का प्रतिचयन और विश्लेषण भी किया गया। वर्ष 2020-21 में अनलोडिंग पोर्टों पर तीन (3) जहाजों के लिए प्रतिचयन कार्य किया गया और विश्लेषणात्मक रिपोर्ट प्रस्तुत की गई। मेसर्स टाटा स्टील लिमिटेड द्वारा विकसित फ्लोटेशन रिएजेंटों की प्रभावकारिता का पता लगाने के लिए उनका मूल्यांकन किया गया। अरुणाचल प्रदेश के ऊपरी सुबनसिरी स्थित लमदक और बोपी जिलों से प्राप्त 150 ग्रेफाइट नमूनों का अभिलक्षणन किया गया। इन ग्रेफाइट नमूनों की गुणवत्ता खराब है और इनके उपयोग को सुनिश्चित करने के लिए इनका बेनिफिसियेशन आवश्यक है। इनके अलावा इस अनुसंधान समूह द्वारा कुजू खान, सीसीएल के टोपा, पुंडी और आरा ओसी के कोकिंग कोल सीम की वाशेबिलिटी का भी अध्ययन किया।

गैसीकरण एवं उत्प्रेरण अनुसंधान समूह

संस्थान के गैसीकरण एवं उत्प्रेरण अनुसंधान समूह द्वारा ऑक्सी-ब्लोन प्रेशराइज्ड फ्लुइडाइज्ड बेड गैसीफायर विकसित करने एवं सिनगैस से मिथेनॉल तैयार करने के लिए गैसीकरण के क्षेत्रों में विभिन्न अनुसंधान एवं विकास कार्य प्रारंभ किए गए।

"मेथनॉल इकोनॉमी प्रोग्राम" के एक भाग के रूप में 1.5 टीपीडी कोल फीड रेट वाले "ऑक्सी-ब्लोन प्रेशराइज्ड फ्लुइडाइज्ड बेड गैसीफिकेशन पायलट संयंत्र सुविधा" को स्थापित किया गया। यह भारत सरकार के "आत्मनिर्भर भारत अभियान" की दिशा में एक महत्वपूर्ण कदम है। माननीय विज्ञान एवं प्रौद्योगिकी मंत्री, डॉ हर्षवर्धन द्वारा यह सुविधा राष्ट्र को दिनांक 17 नवंबर, 2020 को समर्पित की गई। पीएफबीजी सुविधा का उपयोग उच्च राख युक्त भारतीय कोयले के साथ संचालन को सफलतापूर्वक स्थापित करने के साथ-साथ डिजाइन, ऑपरेटिंग मापदंडों को अनुकूलित और बायोमास फीड स्टॉक के साथ मिश्रित करते हुए परफॉर्मेंस को अधिकतम करने के लिए किया जाएगा।

सीएसआईआर मिशन डायरेक्टरेट के तहत "कोयला सिनगैस से मिथेनॉल (CoSynol) कार्यक्रम" शुरू किया गया। इस कार्यक्रम के अंतर्गत "100 टीपीडी कोल टू मेथनॉल डेमो प्लांट" के लिए बेसिक इंजीनियरिंग पैकेज (बीईपी) के साथ-साथ क्लास से मिथेनॉल बनाने के लिए पायलट स्तरीय एकीकृत प्रौद्योगिकी विकसित की जाएगी।

ऑक्सी-ब्लोन प्रेशराइज्ड फ्लुइडाइज्ड बेड गैसीफायर में उच्च राख युक्त भारतीय कोयले के प्रदर्शन का अध्ययन किया। सिनगैस से मिथेनॉल के संश्लेषण के लिए उत्प्रेरक का विकास प्रगति पर है। विभिन्न प्रकार के गैसीफायरों में परिचालन पहलुओं के संबंध में राख की विशेषताओं का अध्ययन किया गया तथा फ्लूइडाइजेशन कोल्ड/हॉट सेट-अप प्रायोगिक सुविधा की स्थापना की गई।

कोयला से तरल अनुसंधान समूह

वित्तीय वर्ष के दौरान कोयला से तरल अनुसंधान समूह द्वारा इंडक्टिवली कपल्ड प्लाज्मा-अटॉमिक एमिशन स्पेक्ट्रोमेट्री (आईसीपी- एआईएस) और एक्स-रे डिफ्रैक्शन (एक्सआरडी) तकनीकों का उपयोग करते हुए रेयर अर्थ एलिमेंट्स (आरईई) के मूल्यांकन और खनिजों में वेरियेशन के लिए विभिन्न भारतीय तापीय विद्युत केंद्रों से प्राप्त कोयला एवं उड़न राख का मूल्यांकन किया गया। इन उड़न राखों में सेरियम (Ce), लैंथेनम (La) एवं नियोडाईमियम (Nd) सबसे प्रमुख लाइट आरईई (REE) की रूप में मिले, जिनकी सांद्रता क्रमशः 286.2, 162.6 और 113.7 ppm तक है। आरईई का आउटलुक गुणांक कोयले एवं उड़न राख के लिए क्रमशः 0.3 - 4.5 और 0.1-1.2 की सीमा में है। भारी आरईई की तुलना में हल्की आरईई की उपस्थिति अधिक

प्रॉमिनेंट है। यह शोध कार्य दिखाता है कि संवर्धन तकनीकों के माध्यम से उड़न राख से कुछ आरईई का निष्कर्षण किए जाने के लिए इनके परिणाम आशाजनक हैं।

क्षेत्रीय अनुसंधान केंद्र

सीएसआईआर-सिम्फर, नागपुर अनुसंधान केंद्र

सीएसआईआर-सिम्फर, नागपुर अनुसंधान केंद्र में दो समूह हैं - 'खनन प्रौद्योगिकी' और 'ईंधन विज्ञान'। वर्ष 2020-21 की अवधि के दौरान नागपुर अनुसंधान केंद्र ने सीआईएल, इसकी सहायक कंपनियों और सिंगरेनी कोलियरीज कंपनी लिमिटेड (एससीसीएल) की कोयला कंपनियों की थर्ड पार्टी सैंपलिंग (टीपीएस) परियोजना के अलावा भारत में कई खानों को सेवा प्रदान करने में महत्वपूर्ण भूमिका निभाई। यह अनुसंधान केंद्र सॉफ्टवेयर उन्नयन और विकास कार्यों से भी जुड़ा हुआ है।

इस केंद्र द्वारा कुछ महत्वपूर्ण परियोजनाओं पर कार्य किया गया, जैसे कि रैपिड टनलिंग के लिए विभिन्न भूवैज्ञानिक स्थितियों में रोड हेडर और टनल बोरिंग मशीन की चयन पद्धति का विकास; पनवेल-कर्जत डबल लाइन उपनगरीय कॉरिडोर में तीन सुरंगों की खुदाई और खुली खुदाई के दौरान उत्खनन, समर्थन प्रणाली के लिए सिफारिशें, डिजाइन प्रूफ की जांच और निगरानी के लिए कार्यप्रणाली का विकास; एलडब्ल्यूपी1- और एलडब्ल्यूपी2- के संयुक्त प्रभाव को ध्यान में रखते हुए एलडब्ल्यूपी3- पर सबसिडेंस की भविष्यवाणी और अड्रियाला में सुरक्षात्मक कार्यों का सुझाव; राजपुरा दरीबा खान, एचजेडएल के पूर्वी लोड में एमआरएल से ऊपर और 140 उत्तरी लोड में 100 एमआरएल से ऊपर स्टोप डिजाइन के लिए त्रि-आयामी संख्यात्मक मॉडलिंग का अध्ययन; ओमान साम्राज्य में पत्थर के खदान में परीक्षण विस्फोटों का संचालन करते हुए एक नई शैल विस्फोटन प्रणाली (कार्बन क्रेक्स) की प्रभावकारिता के परीक्षण पर वैज्ञानिक अध्ययन तथा कनवेंशनल न्यूरल नेटवर्क और हाइपरस्पेक्ट्रल इमेजिंग पर आधारित कोयला गुणवत्ता अन्वेषण तकनीक का विकास।

कोविड संबंधित कार्यों के तहत टच स्क्रीन, फिंगर स्कैनर और बायोमेट्रिक पहचान उपकरणों और अन्य उपकरणों या प्रणालियों के कीपैड के लिए संपर्क रहित ऑटो यूवी कीटाणुरहित इकाई या चेंबर का विकास तथा वायरस और बैक्टीरिया से संक्रमण के सेल्फ-ट्रांसमिशन को रोकने के लिए चेहरे, मुंह, आंखों और नाक को हाथ (हाथों) से छूने से बचने के लिए एक नवीन उपकरण का विकास जैसे उल्लेखनीय कार्य भी किए गए।

इनके अलावा मेगा कोयला नमूना परियोजना (तृतीय-पक्ष नमूनाकरण) के तहत कोयला गुणवत्ता विश्लेषण का वैज्ञानिक अध्ययन किया गया। इस मेगा परियोजना का मुख्य उद्देश्य ताप विद्युत संयंत्रों में कुशल उपयोग के लिए विभिन्न साइडिंग/ विद्युत संयंत्रों से लोड किए गए कोयलों की गुणवत्ता का अध्ययन करना था।

सीएसआईआर-सिम्फर, बिलासपुर अनुसंधान केंद्र

इस अवधि के दौरान संस्थान के बिलासपुर अनुसंधान केंद्र ने ईंधन विज्ञान में कोयला गुणवत्ता मॉनिटरन और वेधनछिद्र कोयला कोर विश्लेषण से संबंधित विभिन्न प्रायोजित परियोजनाएं शुरू की हैं। केंद्र द्वारा तृतीय पक्ष कोयला प्रतिचयन परियोजना के तहत 30,541 कोयले के नमूने एकत्रित और विश्लेषित किए गए। सीएमपीडीआईएल तथा जीएसआई द्वारा प्रायोजित परियोजनाओं के तहत 6512.59 मीटर कोयला कोर नमूनों का अभिलक्षणन किया गया। खनन अभियांत्रिकी के क्षेत्र में इस केंद्र द्वारा कई सिविल इंफ्रास्ट्रक्चर परियोजनाएं, रेलवे और राजमार्ग सुरंग परियोजनाएं, जल विद्युत परियोजनाएं और मेट्रो परियोजनाएं आरंभ की गईं। इस वित्तीय वर्ष के दौरान इन प्रायोजित परियोजनाओं से केंद्र ने 194 करोड़ रुपए का ईसीएफ उत्पन्न किया है।

सीएसआईआर-सिम्फर, रांची अनुसंधान केंद्र

वित्तीय वर्ष 2020-21 के दौरान, सीएसआईआर-सिम्फर, रांची अनुसंधान केंद्र द्वारा महानदी कोलफील्ड्स लिमिटेड, सेंट्रल कोलफील्ड्स लिमिटेड जैसे कई विद्युत संयंत्रों और कोयला खनन कंपनियों सहित देश भर में मौजूद कई सरकारी और निजी विद्युत कंपनियों द्वारा प्रायोजित विभिन्न कोयला गुणवत्ता मॉनिटरन परियोजनाएँ शुरू की गई। यह केंद्र कोयला के नमूनों के विश्लेषण द्वारा सरकारी और निजी संगठनों को तकनीकी सेवाएँ भी प्रदान करता है।

रांची अनुसंधान केंद्र झारखंड, ओडिशा, छत्तीसगढ़, पश्चिम बंगाल, महाराष्ट्र, मध्य प्रदेश और कई कोयला क्षेत्रों के विभिन्न भागों में अवस्थित माइनिंग एसोसिएट प्राइवेट लिमिटेड, एपीसी ड्रिलिंग ऐंड कंस्ट्रक्शन प्राइवेट लिमिटेड, त्रिवेणी अर्थमूवर्स प्राइवेट लिमिटेड, साउथ वेस्ट पिनेकल तथा सेंट्रल माइन प्लैनिंग डिजाइन इंस्टिट्यूट जैसी विभिन्न ड्रिलिंग एजेंसियों से प्राप्त बोरहोल कोयला कोर के गुणवत्ता मूल्यांकन के लिए पूरी तरह से समर्पित है। इस वित्तीय वर्ष में कुल 10520.68 मीटर कोयला कोर प्राप्त हुए और कोयला कोर लॉगिंग किया गया तथा सलाह के अनुसार बैंड बाई बैंड विश्लेषण के लिए 13533 नमूने जेनरेट हुए हैं। सीएसआईआर-सिम्फर विश्लेषणात्मक आंकड़ों के आधार पर कोयला संसाधनों और रिजर्व अनुमान की गणना की गई और संबंधित खनन कंपनियों द्वारा अयस्क बॉडी मॉडलिंग की जाएगी।

रांची अनुसंधान केंद्र कोयले के परीक्षण और विश्लेषण और विभिन्न उद्योगों को सेवाएँ प्रदान करने के लिए पर्याप्त आधुनिक उपकरणों से सुसज्जित है। उपलब्ध अत्याधुनिक सुविधाओं में संतुलित आधार पर प्रॉक्सिमेट विश्लेषण एयर ड्राईड एवं 60% आरएच, नमी और राख का निर्धारण एडी और इक्विलिब्रेटेड, एएफटी (ऐश फ्यूजन टेम्परेचर रेंज), सीएचएनएस और सीएचएनएसओ, सल्फर का प्रत्यक्ष निर्धारण, फॉस्फोरस के प्रतिशत का निर्धारण पारंपरिक विधि द्वारा), राख विश्लेषण, सूजन सूचकांक एसआई, एलटीजीके टाईप, सल्फर का वितरण आदि शामिल हैं।

विविध उपलब्धियाँ

- वर्ष 2020-21 में संस्थान द्वारा समाज-कल्याण व खनन-ईंधन उद्योग के विकास के लिए डस्ट सप्रेशन केमिकल, इमल्शन एक्सप्लोज़िव, इमलकोल 100 इमलकोल 300, ड्राई फॉग डस्ट सप्रेशन सिस्टम फॉर क्रशिंग, स्क्रीनिंग, बायोमेट्रिक बेस्ड एक्सप्लोडर, इम्प्रूव्ड सॉफ्ट कोक मेकिंग टेकनोलॉजी, कॉनटैक्टलेस ऑटो यूवी डिज़िन्फेक्ट यूनिट ऑर चेम्बर फॉर टच स्क्रीन्स, थम्ब ऑर फिंगर स्कैनर्स ऐंड कीपैड्स ऑफ बायोमेट्रिक आइडेंटिफिकेशन डिवाइसेस ऐंड अदर डिवाइसेस ऑर सिस्टेम्स जैसी 17 अत्याधुनिक एवं उन्नत प्रकार की प्रौद्योगिकियाँ विकसित कर उद्यमियों /उद्योगों को हस्तांतरित की गई। प्रौद्योगिकी हस्तांतरण से संस्थान को प्रीमिया /रॉयल्टी के रूप में 1,10,57,978.00 रुपए प्राप्त हुए।
- तकनीकी जानकारी के हस्तांतरण के लिए 77 द्विपक्षीय/ त्रिपक्षीय करार/ समझौता ज्ञापन हस्ताक्षरित किए गए।
- भारत में 03 पेटेन्टों को स्वीकृति मिली औऱ 11 पेटेन्ट फाइल किए गए जबकि 16 कॉपीराइट फाइल/ पंजीकृत किए गए।
- संस्थान में राष्ट्रीय विज्ञान दिवस, राष्ट्रीय प्रौद्योगिकी दिवस, विश्व पर्यावरण दिवस, विश्व महिला दिवस सीएसआईआर का 79वां स्थापना दिवस, सीएसआईआर-केन्द्रीय खनन एवं ईंधन अनुसंधान संस्थान का प्लैटिनम जयंती स्थापना दिवस, हिंदी पखवाड़ा मनाए गए। इनके अलावा वेब-संगोष्ठी, कार्यशालाएँ, कार्यकारी विकास कार्यक्रम, कौशल विकास कार्यक्रम, इन-हाउज़ प्रशिक्षण कार्यक्रम आयोजित किए गए और कॉलेजों, विश्वविद्यालयो के छात्र-छात्राओं के लिए भी शैक्षणिक प्रशिक्षण कार्यक्रम आयोजित किए गए।

- वर्ष 2020-2021 में राष्ट्रीय एवं अन्तर्राष्ट्रीय पत्रिकाओं में क्रमशः 27 एवं 83 शोध लेख प्रकाशित हुए जबकि देश में आयोजित संगोष्ठियों एवं सम्मेलनों में 04 शोध लेख प्रस्तुत किए गए। इसके अलावा 07 पुस्तक/ पुस्तक अध्याय भी प्रकाशित हुए।
- संस्थान के 03 वैज्ञानिकों ने उच्च शैक्षणिक योग्यता अर्जित कर अपना ज्ञानवर्धन किया।
- संस्थान के 03 वैज्ञानिकों को भिन्न-भिन्न पुरस्कारों से सम्मानित किया गया।
- संस्थान के 09 वैज्ञानिकों ने राष्ट्रीय एवं अंतरराष्ट्रीय प्लैटफॉर्मों पर मुख्य वक्ता, की-नोट वक्ता, व्याख्यान प्रस्तुतकर्ता के रूप मे विभिन्न राष्ट्रीय एवं अंतरराष्ट्रीय सम्मेलनों/ संगोष्ठियों/ कार्यशालाओं में प्रतिभागिता की या किसी पत्रिका में सम्पादकीय बोर्ड में सदस्य या समीक्षक, किसी संगोष्ठी में सलाहकार समिति के सदस्य, निर्णायक पैनेल में सदस्य के रूप में चयनित किए गए।
- दिनांक 31-03-2021 के अनुसार सीएसआईआर-सिम्फर सदस्यों की संख्या निम्नवत थी -

समूह/ श्रेणी	कुल
निदेशक	01
ग्रुप IV ग्रुप	122
ग्रुप III	139
ग्रुप II	45
ग्रुप I	72
प्रशासन	136
कुल	515

- दिनांक 31-03-2021 के अनुसार संस्थान द्वारा किया गया व्यय -

शीर्ष राशि		(लाख में) ₹
पूँजी	=	739.670
राजस्व	=	7203.500
स्टाफ आवास	=	48.260

कुल	=	7991.430

A. MINING AND OTHER ALLIED SECTORS

A. MINING AND OTHER ALLIED SECTORS

1. INTELLIGENT MINING SYSTEMS SECTION OF MMTD GROUP

I. S & T Projects:

(1) Development of Digital Mine using Internet of Things

- Sponsored by: Ministry of Electronics and Information Technology, Govt. of India
- Project Status: On-going
- Project Brief:

CSIR-Central Institute of Mining and Fuel Research (CSIR-CIMFR), Dhanbad and IIT Kharagpur have been implementing a S&T project entitled "Development of Digital Mine using IoT", which has been sponsored by Ministry of Electronic and Information Technology (MeitY), Government of India. A digital mine system has been developed for monitoring and prediction of mine hazards to improve safety and productivity in underground mines. The integrated system includes different modules covering hardware and software for: (i) Environment and gas monitoring, (ii) Strata monitoring, (iii) Fire and explosivity status monitoring, (iv) Miners tracking and voice communication, (v) Water level monitoring and stowing practices, (vi) On-line production and dispatch monitoring, (vii) Store inventory management, (viii) Personnel management, (ix) On-line form submissions and e-governance, (x) Training module, etc. The system uses Internet of Things (IoT)-enabled sensors and control units, flameproof and ingress protected devices, and data acquisition and prediction software. Major features of the system are as follows:

- Transforming physical mine into 3D virtual mine;
- On-line mine monitoring and prediction of hazards using IoT-based sensors and artificial intelligence (AI);
- Graphical representation of real-time sensor data, miners and asset tracking;
- Providing audio-visual warning and controlling of situation using IoT-enabled devices;
- Integrated data, voice and video communication;
- On-line production monitoring and resource management; etc.

Audio-visual warning device

Sensor modules


Miner's tracking device


Wireless communication device

Digital mine system

The developed technology has been transferred to the following 3 firms: (i) M/s Knowledge Lens Pvt. Ltd., Bengaluru; (ii) M/s Coresonant Systems Pvt. Ltd., Secunderabad; and (iii) M/s Optimized Solutions Limited, Ahmedabad.

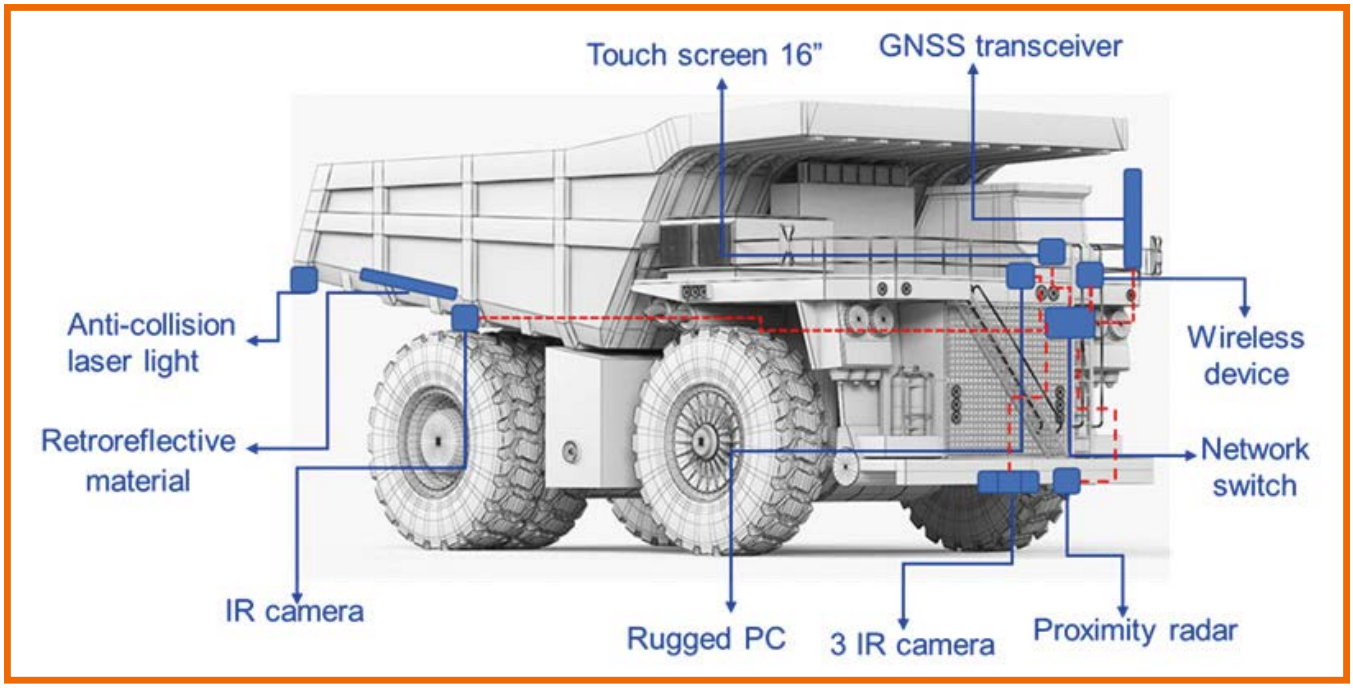
Transfer of technology in presence of the DG, CSIR at CSIR-CIMFR, Dhanbad

(2) Development of Vision Enhancement System for Foggy Weather

- Sponsored by: Ministry of Electronics and Information Technology, Govt. of India
- Project Status: On-going
- Project Brief:

CSIR-Central Institute of Mining and Fuel Research (CSIR-CIMFR), Dhanbad has developed a vision enhancement system to continue opencast mining operation during foggy weather. Vision enhancement system (VES) is an intelligent driver assistance technique for effective visualization of transportation path as well as loading/unloading areas during foggy weather with the help of thermal imaging cameras, high definition cameras, proximity radio detection and ranging (RADAR), Rover/Global navigation satellite system (GNSS), rugged graphical processing unit (GPU), wireless devices, laser light, roadside edge detection arrangements (using flasher light and self-regulating heating cable), etc.

The system provides 180° panorama field of view through real-time video stitching and image processing, rear view, object detection through proximity radar and GNSS, real time location of the vehicles by GNSS modules, audio-visual alarm to driver on object detection, processed and integrated outputs displayed on a touch screen fitted on dashboard, and display screen logically splitted into 4 quadrants. The top half displays the output of integrated algorithms applied to internet protocol (IP)-based cameras, and the lower section is further divided into 3 windows for proximity radar view, GNSS-based navigation, and the road's rear-view to provide multi-stage maneuvering and safety. The drivers can select any particular window using a touch panel to display on the full screen, while the other windows continue to run in the background and pop-up an alert when necessary. A network switch is used for the terminal connection of all Ethernet-based modules. Finally, a rugged GPU is used to process all the cameras, proximity radar, and GNSS information using advanced analytics and artificial intelligence (AI). The system uses advanced analytics, artificial intelligence and image processing techniques for real-time video processing, fleet management, object detection, proximity warning using RADAR and GNSS. The system helps in improving production, productivity and safety in opencast mines.



Schematic diagram of driving assistance system installation on dumper

(3) Setting-up of Information and Facilitation Centre for Empowering Living of Schedule Caste in Jharkhand State

- Sponsored by: Ministry of Electronics and Information Technology, Govt. of India
- Project Status: On-going
- Project Brief:

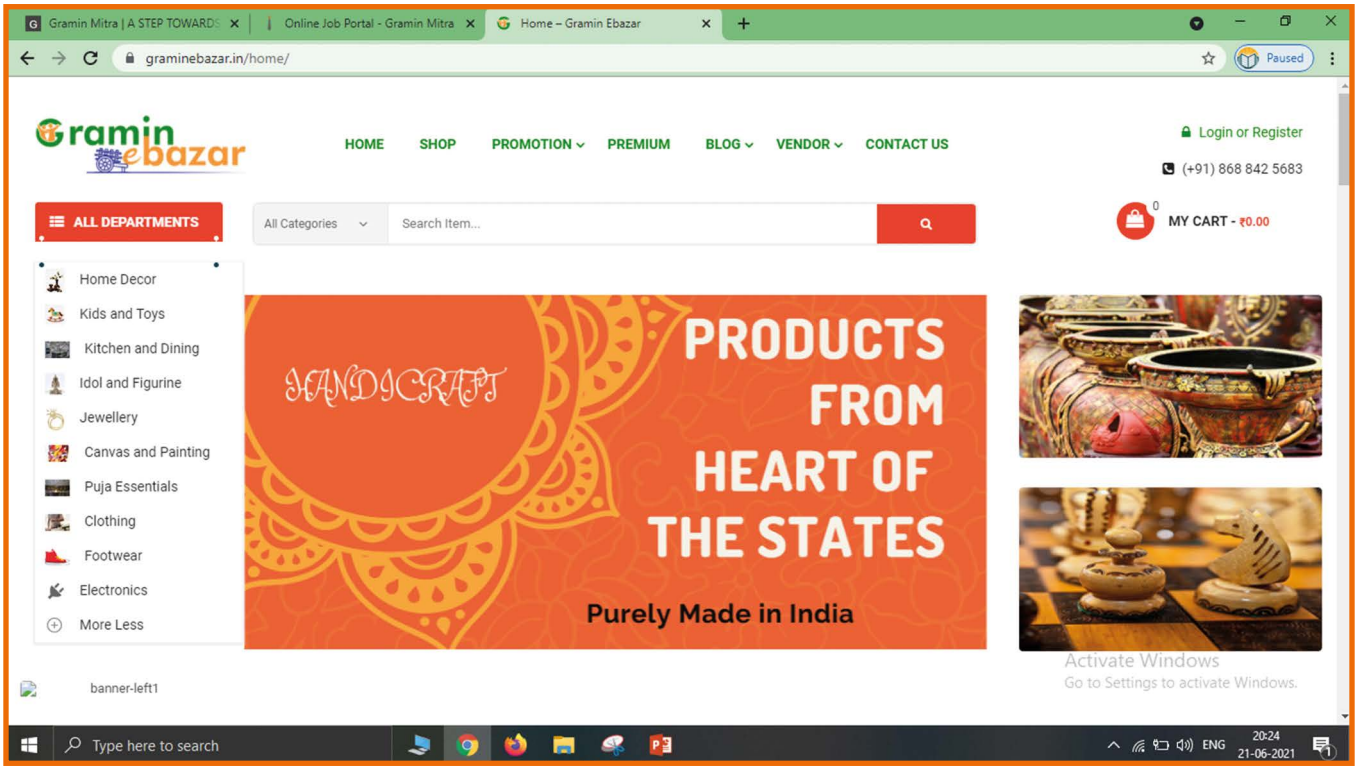
CSIR-Central Institute of Mining and Fuel Research (CSIR-CIMFR), Dhanbad has taken up a R&D project for "Setting-up of Information and Facilitation Centre for Empowering Living of SC in Jharkhand State", which has been sponsored by Ministry of Electronics and Information Technology (MeitY), Government of India. Following facilities are provided to the Rural Facilitation Centre:

(A) Facilitation Centre

- Provide information about government schemes and facilitate to avail the schemes benefits
- Computer and skill development training
- Job portal for technicians and other job seekers
- Promotion of local culture and livelihood
- Awareness programme for social upliftment
- IT and IoT based product development training

(B) Gramin E-Bazar

Selling of village products (agricultural products, handicraft items, herbal products/medicine, etc.) through e-commerce portal to establish link between farmers and sellers. A website (https://graminebazar.in)and mobile App has been developed for selling of "Make in India" and rural products. The developed knowhow has been transferred to M/s Edgeforce Solutions Pvt. Ltd., Hyderabad.



Schematic diagram of driving assistance system installation on dumper

Signing of technology licensing agreement in presence of the DG, CSIR

(C) Soil Analysis

- Soil testing and issuing soil health card
- Advice on suitable doze of fertilizer

(D) IT and IoT-based Product Development and Entrepreneurship Establishment

- Improvement of village products using new technology
- Making of economically feasible products by transferring new technology to villagers
- Creation of bridges between researchers and rural people for transferring knowhow of product development

A view of the Rural Facilitation Centre

(4) Setting-up Safety Testing Laboratory for Electronics and Information Technology Products

- Sponsored by: Ministry of Electronics and Information Technology, Govt. of India
- Project Status: Completed
- Project Brief:

As per the guideline of "Electronics and Information Technology Goods (Compulsory Registration) Order, 2012" and its amendments issued by Ministry of Electronics & IT (MeitY), GoI, it has become mandatory that all electronics and information technology products shall be registered with Bureau of Indian Standards (BIS) before selling in the market. It is mandatory that these products need to be tested and certified by the BIS recognized laboratoryfor getting BIS registration. Under this scheme, an Electronics and Information Technology Products Safety Testing Laboratory (EISTL) has been established at CSIR-CIMFR, Dhanbad, Jharkhand. The testing as per the IS/IEC standards are being carried out at EISTL for different electronics and IT products for the benefit of various stakeholders. The laboratory of CSIR-CIMFR has been accredited by NABL as well as registered by BIS, India for testing and certification with an objective to provide quality testing services using latest test and measuring instrument by the qualified and experienced professionals.

Parameters tested and standards followed in EISTL:

(i) IS 616/IEC 60065

- Amplifier with input power 2000 W and above
- Electronic Musical System with input power 200 W and above
- Electronics Games (Video)
- Optical Disc Player with built-in amplifier of input power 200 W and above
- Plasma/LCD/LED/Television of Screen up to 40”
- Power Adapters for Audio Video & Similar Electronics Equipment

(ii) IS 13252(Part-1)/IEC 60905-1

- Automatic Data Processing Machines
- Cash Register
- Copying Machine Duplicator
- Laptop/Notebook/Tablet
- Mail Processing Machine/ Postage Machine / Franking Machine
- Mobile Phones
- Passport Reader
- Point of sale Terminal
- Power Adopters for IT equipment
- Power Bank for Portable Application
- Printer & Plotters
- Scanners
- Set Top Box
- Smart Card Readers
- Telephone Answering Machines
- Visual Display Unit, Video Monitor up to 40”
- Wireless Keyboard

(iii) IS 16242(Part-1)/IEC 62040

- UPS/Inverters of Rating ≤ 5KVA

(iv) IS 16046(Part-1, Part-2,)/IEC 62133(Part-1,Part-2)

- Alkaline Secondary Batteries and Cells

EISTL provides testing and certification facilities of different electronics and IT products as listed above, in one roof for the benefit of manufacturers, buyers and stakeholders. Application of safety standards is intended to reduce the risk of injury or damage due to electric shock, high temperature, fire, mechanical hazards, radiation and chemical hazards, etc. These safety aspects insure product design is safe to use in normal and abnormal conditions. It provides the protection of human beings against injuries or safeguard against health hazards, and also property and environment during operation of equipment, installation, and process.


Hi-POT TEST


EQUIPMENT ENVIRONMENTAL CHAMBER


DVDF

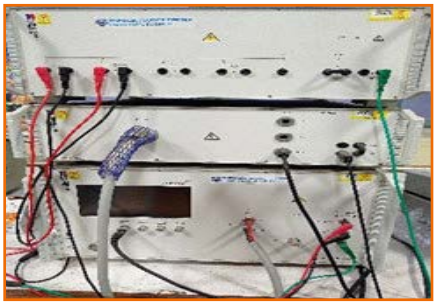

VIBRATION TEST SYSTEM


TUMBEL BARREL


BATTERY TESTER


ELECTRICAL SAFETY TESTER


NEEDLE FLAME TESTER


IMPLUSE/SURGE TESTER


THERMAL IMAGER CORD

ANCHORAGE TESTER


GLOW

2. MATERIAL CHARACTERISATION LAB.

1. **Study the performance evaluation of different size Wire Ropes used in Hindustan Copper Limited, GhatshilaSinghbhum, Jharkhand.**

   Six number of FMC Winding Ropes (Dia. 22mm 2 Nos, 26mm 2 Nos & 30mm 2 Nos) have been received for the study and thereby advice for reuse. The ropes were subjected to breaking load, tensile, torsion, reverse bend, wear and corrosion, lubrication and micro examination to study their condition. The ropes were in good condition and possess good strength. So they can be further use in mines.

2. **Quality evaluation of winding / haulage rope through destructive and non-destructive test of TATA Steel Limited.**

   Winding / haulage rope used in Tata Steel Limited has been investigated after being used in mines. Elevenropes have been studied through destructive testing i.e by breaking load, tensile, torsion, reverse bend, wear and corrosion, lubrication and micro examination to study their condition. The ropes were in good condition and possess good strength. So they were recommended further use in mines.

3. **Scientific study on physico-mechanical, chemical and weatherability properties of Roof Bolt and its accessories of Jhanjra Area, ECL.**

   The study on the physico mechanical properties of the roof bolts were found to be okay. The tensile strength also found to be of grade Fe 500 and Fe 650 with elongation and yield strength as per the standard prescribed values (IS 1786-2008). The tensile strength of the roof bolt assembly revealed that the thread portion of bolt has been broken without slippage of the nut and without visual deformation of domed washer plate and conical sheet. The chemical analysis of the sample received was found to be as per the prescribed values of DGMS Technical circular except the dome washer whose micro alloying elements is greater than the prescribed values of 0.50% maximum. In case of weatherabillity test the maximum weight loss has been found to in the bearing plate but the values are within the prescribed limit of value as per DGMS Technical Circular for DGMS/S&T/Tech. Cir. (Approval) No. 3.

4. **Study the mechanical integrity of 5 T C.S. Gear through NDT of Pit No. 2, J.K. unit, Siduli Colliery, ECL.**

   The study on the condition of vital components like C.S.Gear, Chain Sling, Safety Hook, Friction Wedge Rope Cappel, Shackle with pin, link plate etc was carried out through non-destructive testing. To detect the surface and subsurface flaws, Magnetic Particle crack detection (MPCD) was used and to detect the internal flaws, Ultrasonic technique was used. Condition of most of the vital components of Man Riding system were found satisfactory.

5. **Study the condition of vital components of Mine Winding Systems of Pit No. 6 & 8, Kenduadih Colliery.**

   The study on the condition of vital components like C.S.Gear, Chain Sling, Safety Hook, Friction Wedge Rope Cappel, Shackle with pin, link plate etc was carried out through non-destructive testing. To detect the surface and subsurface flaws, Magnetic Particle crack detection (MPCD) was used and to detect the internal flaws, Ultrasonic technique was used. Condition of most of the vital components of Man Riding system were found satisfactory.

6. **Study the present condition of vital components of Chair Lift man riding system, installed at Nandira Colliery, MCL.**

   The study on the condition of vital components of Chair Lift Man Riding System like Pulleys, Drive sheave, shafts, pins, chairs, steel structures Anchoring pins etcwas carried out through non-destructive testing. To evaluate the surface and subsurface flaws, Magnetic Particle crack detection (MPCD) was used whereas Ultrasonic technique for internal flaws Condition of most of the vital components of Man Riding system were found satisfactory.

7. **To access the residual life of C.S.Gear, Wire Rope and C Link of Kenda Area.**

   The study on the condition of vital components like C.S.Gear, Chain Sling, Safety Hook, Friction Wedge Rope Cappel, Shackle with pin, link plate etcwas carried out through non-destructive testing. To detect the surface

and subsurface flaws, Magnetic Particle crack detection (MPCD) was used, while Ultrasonic technique was used for internal flaws.

113 Nos. of C-Link is carried out through tensile test and non-destructive testing. The tensile strength of C-Link 110 Nos. was found okay and 3 nos. failed in elongation test.

Condition of most of the vital components of Man Riding system were found satisfactory.

8. **Study the physical and chemical property of four deck cage of 30 Mt capacity.**

   The study on the condition ofPlateswas carried out through non-destructive testing. To detect the surface and subsurface flaws, Magnetic Particle crack detection (MPCD) was conducted to detect the internal flaws, Ultrasonic technique was applied. Condition of most of the vital components of Man Riding system were found satisfactory.

9. **Study the condition of vital components of Winding System and Wire Rope installed at Mahagiri Mines, IMFA.**

   Two number of FLC Winding Ropes (Dia. 32mm) have been received for the study and thereby advice for reuse. The ropes were subjected to breaking load, tensile, torsion, reverse bend, wear and corrosion, lubrication and micro examination to study its condition. The ropes were found in good condition and possess good strength. So they can be further use in installation.

   The study on the condition of vital components like C.S.Gear, Chain Sling, Safety Hook, Friction Wedge Rope Cappel, Shackle with pin, link plate etc was carried out through non-destructive testing. To detect the surface and subsurface flaws, Magnetic Particle crack detection (MPCD) was used and to detect the internal flaws, Ultrasonic technique was applied.

10. **Study and advice on 35 mm diameter rope used for Man Winder at Katghori Shaft of Churcha Mine (R.O)**

    Six number of FMC Winding Ropes (Dia. 22mm 2 Nos, 26mm 2 Nos & 30mm 2 Nos) have been received for the study and thereby advice for reuse. The ropes were subjected to breaking load, tensile, torsion, reverse bend, wear and corrosion, lubrication and micro examination to study its condition. The ropes were in good condition and possess good strength. So they can be further use in installation.

11. **Study of mechanical integrity vital components of Chasnalla Colliery, SAIL.**

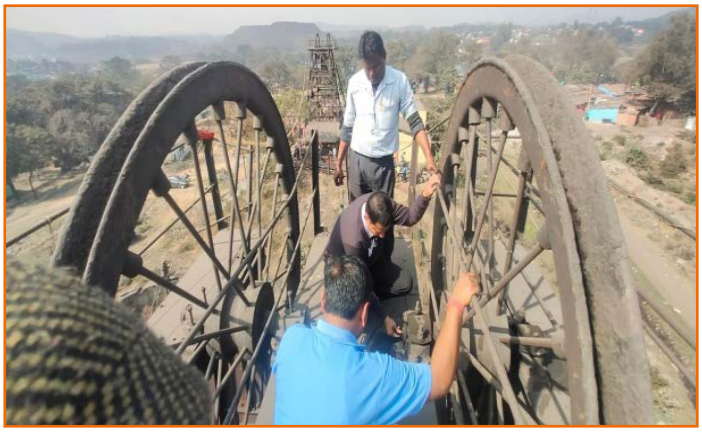
    The study on the condition of vital components like Winding Engine, Winder main shaft, Pin of tie rod assembly, Head Gear Pulley,etc was carried out through non-destructive testing. To detect the surface and subsurface flaws, Magnetic Particle crack detection (MPCD) was conducted and to detect the internal flaws, Ultrasonic technique was applied. Condition of most of the vital components of Man Riding system were found satisfactory.

12. **Assessment of the condition of 8T C.S.Gear unit of Jitpur Colliery, SAIL through NDT.**

    The study on the condition of vital components like C.S.Gear, Chain Sling, Safety Hook, Friction Wedge Rope Cappel, Shackle with pin, link plate etc was carried out through non-destructive testing. To detect the surface and subsurface flaws, Magnetic Particle crack detection (MPCD) was conducted and to detect the internal flaws, Ultrasonic technique was applied. Condition of most of the vital components of Man Riding system were found satisfactory.

13. **Study and advice on the condition of two C.S.Gear systems, installed at Nimcha Colliery, ECL through NDT.**

    The study on the condition of vital components like C.S.Gear, Chain Sling, Safety Hook, Friction Wedge Rope Cappel, Shackle with pin, link plate etc was carried out through non-destructive testing. To detect the surface and subsurface flaws, Magnetic Particle crack detection (MPCD) was used and to detect the internal flaws, Ultrasonic technique was conducted. Condition of most of the vital components of Man Riding system were found satisfactory.



Laboratory Test of Wire Rope at 500t Horizontal Tensile Testing Machine

3. MINE BACK FILLING RESEARCH GROUP

During April 2020 to March 2021, the Mine Backfilling research group has undertaken various assignments on mine backfilling for both underground and opencast mines, fly ash utilization, Blind backfilling and stability of old unapproachable workings below surface constraints.

During this period, this research group has taken up industry sponsored projects related to opencast filling using fly ash and overburden (OB) mainlyfrom, Jindal Steel & Power Limited (JSPL), Tamnar, , Gidhumuri and Paturia opencast mine using ash from CSPGCL.Fig. 1 illustrates the scheme of opencast filling using fly ash and OB.

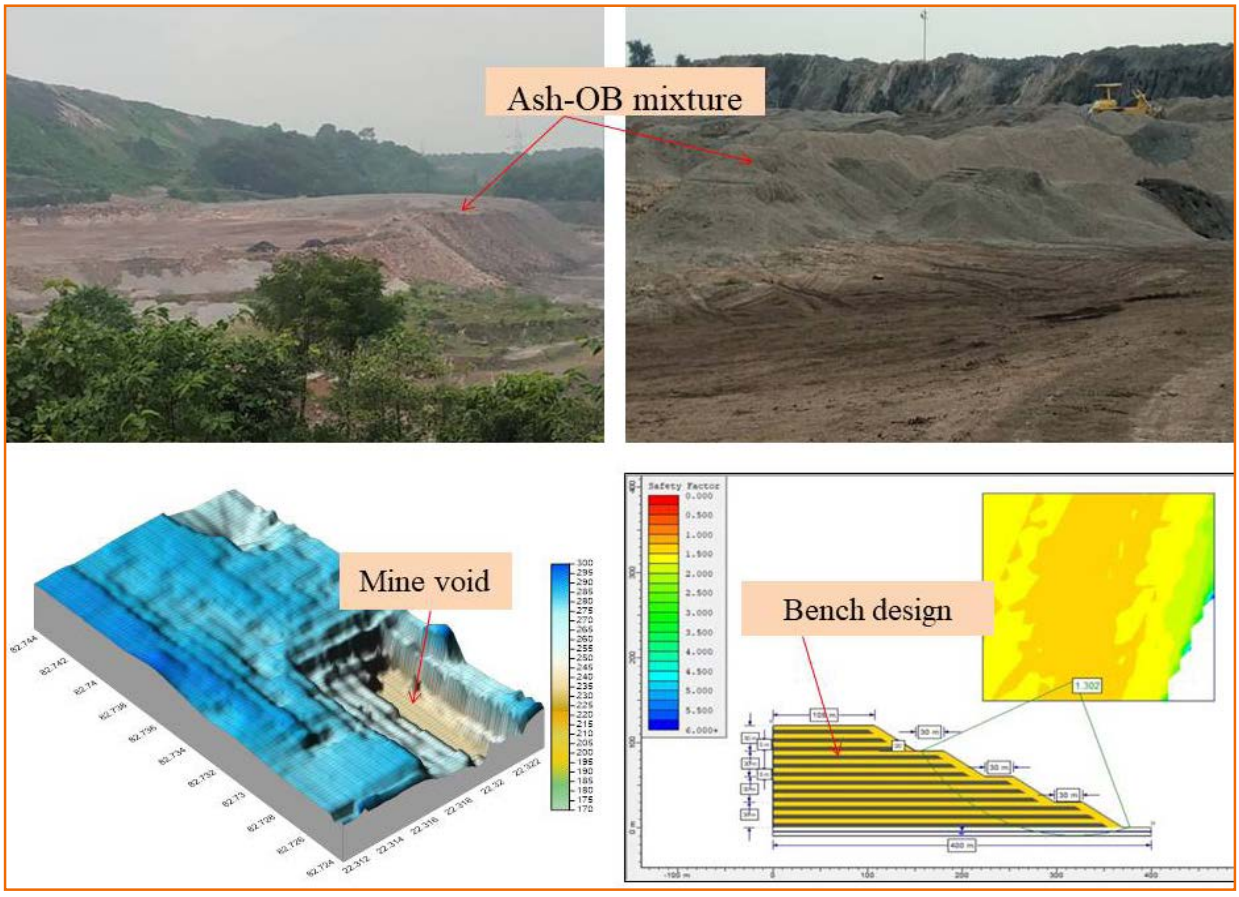


Fig.1. Ash filling in opencast mines.

Various lab and field investigations were carried out for investigating the use of coal ash in underground mine void filling. To list a few, the lab and field experimentation of bottom ash stowing at Jitpur colliery, SAIL,use of coal ash from Jharsuguda Captive Power Plant for filling in underground mines, VEDANTA Power, use of bottom ash for stowing in Chasnala colliery, SAIL. A brief of these worksare presented in Fig. 2.

continuation with the previous year work on Stability analysis of underground workings of Handidhua colliery, Deulbera colliery, Talcher colliery and Nandira colliery of Talcher area. Various blind backfill designs were proposed for stabilizing the unapproachable underground voids of Handidhua and Deulbera colliery of Talcher Area, MCL (Fig. 3). In addition to this one more important work on stability analysis of construction site for DAV school at Lingaraj Area, MCL has also been carried out.

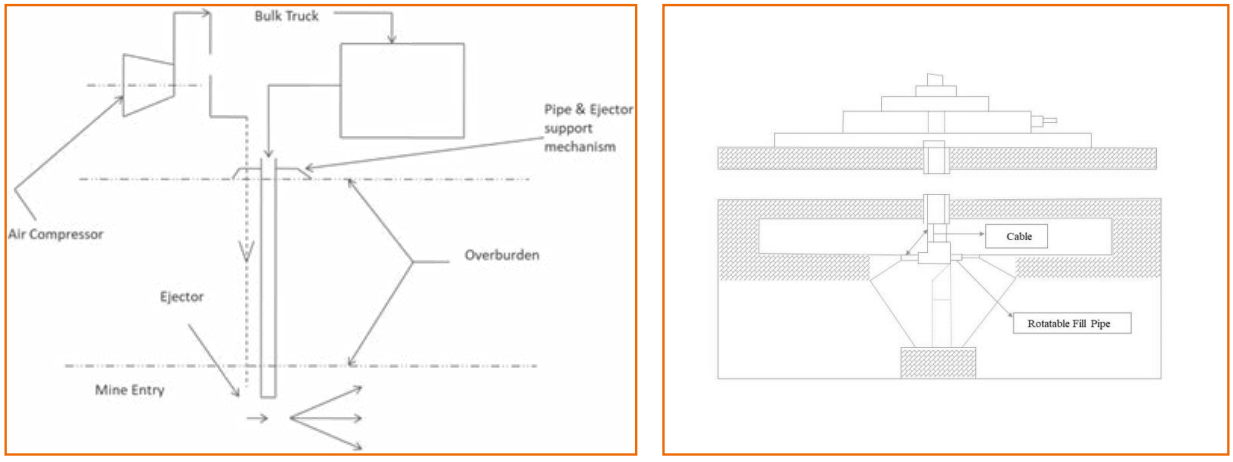


Fig. 3.Schematic of hydro pneumatic stowing with rotatable fill pipe.

The cemented hydraulic filling at Mahagiri mines, IMFA has been upgraded and higher filling rate has been achieved. The proper backfilling of underground stopes of Mahagiri mines, IMFA has resulted in free standing backfill wall after extraction of adjacent secondary stope (Fig. 4). Also field instrumentations were carried out to monitor the backfill pressure acting on the barricades (Fig. 4).

Fig. 4. Backfilling at Mahagiri mines, IMFAwith free standing backfill wall and backfill instrumentation.

The extensive work carried out in the field of paste backfilling is remarkable. The backfill bulkhead design with fiber reinforced shotcrete (FRC) barricade for Zawarmala, Mochia and RajpuraDariba underground mine of Hindustan Zinc Limited (HZL) are unique in nature.The proper bulkhead design has ensured increase in pouring rate and at the same reduced the mining cycle time. Further, Scientific backfill instrumentation at the Zawarmala, Mochia and RajpuraDariba underground mine of HZL has ensured safety of the backfill barricades. A glimpse of these works are shown in Fig.5

Fig. 5. Paste backfilling in underground metal mines of HZL.

The GAP project granted by CIL R & D board aims at developing a suitable Paste Fill material from Fly Ash (Power Plant Reject) and its transportation system to underground coal mines for stabilisation of working as an alternative of sand stowing for increasing the percentage of extraction of coal and to ascertain its cost effectiveness with due regard to safety and environment in Sarni UG Mine, Pathakhera Area, WCL. Field experimentation is in progress at the Sarniunderground (u/g) Mine, Pathakhera Area, WCL.

Fig. 5.Field investigations for paste fill in underground coal mines at Sarni u/g Mine, Pathakhera Area, WCL.

4. MINE FIRE, VENTILATION, MINERS' SAFETY AND HEALTH

One R&D project on Coal Dust Explosibility study sponsored by CIL R&D Board, Kolkata is being implemented in the department. Various industry sponsored projects related with the problems of oppressive climatic condition at workplaces in underground mines, prevention and control of fire in coal mines, determination of main fan capacity and layout of ventilation system of virgin mine are also undertaken by the department.One In-house project is undertaken to determine the effect of ventilation system on dispersion and dilution behavior of diesel particulate matter.It has also undertaken various assignments, viz.mine air sample analysis, air borne respirable dust study & free silica determination, performance evaluation of self-rescuers and breathing apparatus, calibration of various instruments used in mines, and testing & certification of PPEs aiming to create a healthier workplace environment and ensure occupational safety for the miners through research activities and providing consultancy services to industry to achieve the same.Calibration of Mechanical Anemometer, Digital Anemometer and Magnehelic Pressure Gauge have also been carried out as a routine job. Details of the work undertaken during the year 2020-21 are as follows:

(A) R& D project

1. The project entitled "Development of Guideline for Prevention & Mitigation of Explosion Hazard by Risk Assessment and Determination of Explosibility of Indian Coal incorporating Risk based Mine Emergency Evacuation and Re-entry Protocol" has been undertaken with an aim to create a national facility for testing of explosibility of coal dust and framing of guidelines for prevention and mitigation of explosion hazard in Indian coal mines. Under this project state-of-the-art facility for fire and explosion study has been developed. The facility includes 20l explosion chamber and Minimum Ignition energy apparatus, Particle Size Distribution

Analyser, Thermogravimetric Analyser & Differential Scanning Calorimeter (TGA-DSC), Critical Oxidation Setup, Bomb calorimeter and CFD software. Coal characteristics of 39 coal seams collected from fiery and degree III gassy mines covering as many as six subsidiaries of CIL have been determined by various experimental methods, viz. Proximate and Ultimate analyses, Gross Calorific Values, Differential Scanning Calorimetric study. Further, first phase of installation of 20 litre explosion chamber and MIE apparatus has been completed.Analysis of coal samples through Particle Size Distribution Analyser and TGA-DSC have been completed. CFD simulation for dispersion and combustion of coal dust in 20 litre spherical chamber has been carried out. The project is in implementation stage.

Fig. 1 20L explosion chamber

Fig. 2 Mininmum ignition energy apparatus

Fig. 3 TGA-DSCSet up

Fig. 4 Critrical oxidation Set Up

Fig. 5 Particle Size Distribution Analyser

(B) Industry Sponsored Project

1. The fire / heating problem in two underground mines, viz. Shyamsundarpur colliery, Bankola Area ECL and Kunustoria colliery, Kunustoria Area, ECL have been addressed. The fire of SARPI unit in Shyamsundarpur colliery was a localised fire in their old pits No. 1, 2 and 3and Kunustoria fire was a pillar fire problem where there was a formation of explosive mixture. However, these fires were brought under control by proper sealing maintaining starvation of oxygen and sometimes in addition with infusion of nitrogen foam. Monitoring of fire with the basis of fire ratios and Explosibility were also carried out. Both these scientific studies are in progress.
2. Incubation period was determined for bottom seam of Belgaon underground mine of M/S Sunflag Iron and Steel Co. Ltd. This mine is located in Chandrapura Districts of Maharashtra State.
3. The problem of oppressive workplace environment in two mines, viz.10 pits Digwadih Colliery of M/s Tata Steel Ltd and Churcha mines (RO) of Baikunthpur Area, SECL have been taken up by way of applying basic principles of fluid dynamics and carrying ventilation investigation. In both the cases based on ventilation investigation and after detail discussion with the mine management interim report have been submitted.The remaining job is to identify the responsible parameters for deterioration in climatic condition and prediction of results after rectification/modifications of ventilation network of the mine by computer simulation studies.The work of both the projects is in progress.
4. Main fan capacity and layout of ventilation system of Muraidih longwall mine, a virgin mine of BCCL was determined with the help of computer simulation studies utilizing basic mine dimension data and ventilation standard as stipulated in CMR 2017. The assignment was funded by M/s Minop Innovative Technologies Pvt Ltd, Dhanbad.
5. To create a healthier workplace environment and to ensure occupational safety for the miners an industry sponsored project was undertaken from Rampura Agucha Mine, HZL. The objective covers static and personal sampling of mine dusts, the percentage of silica determination in mine dusts, DPM (Diesel Particulate Matter) and monitoring of gases emitted from diesel vehicles.The study can help in adopting suitable control technologies and developing specific monitoring techniques in order to reduce silica as well as DPM exposure. Direct-on-Filter method using Fourier Transform Infra-red (FTIR) Spectroscopy determines free silica content in respirable dust. The project is in progress.
6. The problem of spontaneous heating/ fire in different opencast coal mines (coal and overburden benches, OB dump), viz. Integrated Coal Mining Limited, Sarisatolli, Dulanga coal mining project of NTPC Ltd., Sundergarh, Ramnagore Colliery, Kulti, ISP, SAILwas dealt with success. Scientific advice was also given in dealing with OB dump of Eastern quarry of Pakri-Barwadih coal mine project, NTPC, Hazaribag. Incubation period of coal seam was also determined with the help of laboratory and field investigations. These projects are in completion stage.

In-house Project

One In-house project was undertaken to determine the effect of ventilation system on dispersion and dilution behavior of diesel particulate matter. CSIR-CIMFR Mine fire model gallery will be utilized for the study purpose. Laboratory study will be followed by CFD modeling. The project is in progress.

(C) Testing

A glimpse of the major testing services offered to industry are mentioned below:

Performance Evaluation of Various Safety & Rescue Equipment Used in Mines:

Self-Contained Self Rescuer (SCSR) and Breathing Apparatus are the major life support equipment during disaster in coal mines. To ensure their performance during emergency, their periodical evaluation as per Indian Standard is required. A total of 258 SCSR samples and 1 number of Breathing Apparatus of different make and model from various manufacturing industries and coal mines have been evaluated using artificial breathing simulator machine and other associated setups in laboratory condition as per IS 15803:2008, DGMS (Tech.) Circular No. 08A of 2008 and IS 10245:1994 respectively.

Testing of Miner's Safety Equipments

Mining operations around the world pose a great risk to worker's health and safety. Thus it becomes inevitable that the PPEs which are going to be donned by the workers are quality tested and meet all the standards. The department has a wide range of state-of -the-art facilities to test the sound quality of the PPEs which include: Safety Helmets, Safety Boots, Safety Flame Lamp, LED Caplamp, brattice cloth, semi-rigid and flexible ventilation ducting and calibration of other major underground instruments,viz. methanometer, toximeter, multi-gas detector, anemometer, magnehelic pressure gauge etc. For the year 2020-2021, a total of 10 anemometers, 58 methanometers, 28 toximeters, 28 multi-gas detector and 9 magnehelic pressure gauge from different user industry were calibrated. For the testing of safety equipment, two batches of flame safety lamp, two batches of safety helmets were tested for impact test and two batches of LED Cap lamp was tested at our laboratory.

Respirable Dust Analysis

Occupational exposures to silica are associated with the development of silicosis, lung cancer, pulmonary tuberculosis, and respiratory diseases. Mining is one of the sectors more impacted by the exposure to silica. Hence, determination of per cent of silica in mine dusts is statutory requirement. It also helps in adopting suitable control technologies. Accordingly state of the art lab facilities have been developed to analyse of air borne respirable dust samples collected on filter paper for free silica analysis, respirable dust concentration and maximum exposure limit using Direct-on-filter method of FTIR Spectroscopy conforming to DGMS (Tech)(S&T) Circular No.1,2010. For the year 2020-21, a total of 39 dust samples were analysed for silica determination for various collieries.

Mine airsample Analysis

Mine air sample analysis and their interpretation with respect to fire ratios, viz. Graham's ratio, Oxides of carbon ratio, Young's ratio plays a pivotal role in understanding the status of fire in sealed off area of a mine. Mine air sample were analysed with respect to carbon monoxide per cent, carbon dioxide per cent, methane per cent, hydrogen per cent and oxygen per cent. A total of 395 samples were analysed in the year 2020-2021. These samples were regularly received from Jitpur Colliery, SAIL and Bhurkunda Colliery, CCL for their analysis.

During this period, our services reached out to different organizations and companies, viz. Northern Coalfields Limited (NCL), Western Coalfields Ltd. (WCL), South Eastern Coalfields Ltd. (SECL), Mahanadi Coalfields Limited (MCL),Eastern Coalfields Ltd. (ECL), Hutti Gold Mines Co. Ltd. (Karnataka), Industrial Components (Kolkata), TATA Steel Ltd.,ISP, SAIL, J.K. Dey& Sons (Kolkata), Intech Safety Pvt. Ltd.(Kolkata),Suparna Chemicals Ltd. (Mumbai), Industrial Precision Products (Kolkata), Industrial Appliances and Products (Kolkata), K.D. Chopra & Co. (Kolkata), M/s Nanda Millar Co., Kolkata etc.

5. MINE MECHANIZATION, AUTOMATION & TECHNOLOGY DEVELOPMENT GROUP

(AUTOMATION AND PRODUCT DEVELOPMENT DIVISION)

A. Assessment of Rock Bolting In –Situ by Ultrasonic Guided Waves for Human Safety in Underground Mines

This project has been undertaken, as a Mission project of (4M) Theme of CSIR, with the objective to establish and standardize ultrasound guided wave technique for testing of roof bolts in in-situ grouted condition. This will help us to assess its integrity, residual bolt strength, condition of the bolt in terms of corrosion patches, necking, bending, loss of cement/resin encapsulation etc, and develop guidelines for testing of roof bolts in in-situ grouted condition. Numerical Modelling tool will be used to know stress pattern in a bolt during depillaring operation and the effect of the bolt length.

(Visit of Moonidih colliery , BCCL Dhanbad)

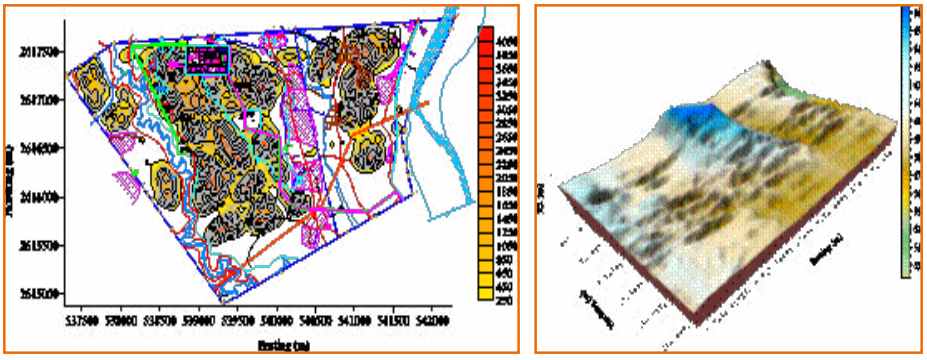
B. Studies of Physico-mechanical characteristics of prototype steel chocks. M/s Tata Steel Limited, Jamadoba, Dhanbad

Strata control in underground mines is a very big problem. The use of inadequate support in mine working leads to the development of fracture in the surrounding strata, which may break and result in accident.Steel Chocks are the commonly used in development and depillaring areas i.e. at goafedge as well as at junction of board & pillar workings. Steel chocks are of two types (Integrated & dismantle) and of various sizes. The height of the roof support can be easily adjusted by placing different sizes of chocks. Studies of Physico-mechanical characteristics of prototype steel chocks have been conducted as per DGMS circular No. DGMS (Tech)(S&T)/ Cir/No.1, 2007.

6. MINE SUBSIDENCE AND SURVEYING

Mine Subsidence and Surveying Section conducted subsidence investigation and three dimensional subsidence prediction in coal mines located in different parts of India. The outcomes of the investigations are briefed below:

The Jaganathpur-B coal block is awarded to Powerplus Traders Private Limited (PTPL) in February 2020 by Ministry of Coal (MoC). PTPL is a joint venture of Orissa Metaliks Private Limited, Rashmi Cement Limited and Shyam Steel Manufacturing Limited. This rectangular shaped coal block is located in the north-eastern part of the Raniganj coalfield, West Bengal and covers an area of 8.694 sq. km. Out of ten, there are nine workable coal seams namely R-IX, R-VIII (T), R-VIII (B), R-VII, R-VIIA&B, R-VIIC, R-V (T), R-V (B) and R-III/II in the block. The coal block has been divided into 10 sectors separated by the faults. A total of 288 panels are proposed to be extracted by Bord& Pillar method of mining with caving using continuous miner. The depth of seams lies between 45 m and 480 m. The per cent of extraction in the panel was taken as 70 for subsidence calculation. The thickness of seam varies from 1.50 to 6.5 m. Maximum height of extraction was considered as 4.5 m for III/ II seam in subsidence prediction modelling. Three dimensional subsidence prediction modelling using influence function method was used to predict the subsidence movements. Subsidence, slope, compressive strain and tensile strain were predicted at every five year interval since the commencement of depillaring with caving. All the proposed 288 panels in nine seams are to be depillared in 70 years. There are number of villages and surface structures within the coal block. Angle of draw of 22o was taken into account for design of all proposed panels to err on the side of the safety. The influence of subsidence would not affect any surface structure.The predicted maximum subsidence, slope, compressive strain and tensile strain due to extraction of coal from nine seams after seventy years are 4098 mm, 44 mm/m, 10.0 mm/m and 9.1 mm/m respectively.Suitable drainage should be made to avoid logging of water in the centre of subsidence troughs as it would affect the surface topography. The predicted maximum compressive strain and tensile strain at the surface of 10.0 mm/m and 9.1 mm/m respectively would lead to development of cracks with crevices of 60 to 100 mm at the surface. The surface cracks formed during extraction should immediately be filled-in with soil/mitti to prevent breathing of air and inflow of water to the underground workings.Embankment with an elevation above HFL is advisable on the west side of the Ajay river subject to actual ground topography. This exercise should be conducted within a span of 10 years.



Subsidence contour (in mm) and 3D surface profile after 70 year

Subsidence investigations were conducted over 14 stowed panels during October, 2018 and September, 2019 at Jamadoba 2 Pit, 6&7 Pits Bhutgoria Amalgamated colliery, Digwadih, Sijua and Bhelatand collieries of Tata Steel in Jharia Coalfield for the safety evaluation of different surface features and structures. All the panels were extracted by bord and pillar method of mining with 70-80 percent of coal extraction in conjunction with hydraulic sand stowing. Depillaring operations were carried out at depths varying from 133 m to 593 m. The width-depth ratio of the panels varied between 0.27 and 0.87, i.e., all the panels were under sub-critical width. All these panels were extracted under multi-seam mining condition with overlying old stowed and caved goaves. Panel IX/6S of Digwadih colliery and IX/6S 6&7 Pits Bhutgoria Amalgamated colliery were completed during the study period. The important surface features over most of the panels include company quarters, private roads, ponds, filter plant, tank, high tension lines and private buildings. Maximum subsidence movement was 10.77% of extraction thicknesses over the 1S panel in XIV(W) and XIII(W) seam at Bhelatand colliery. Maximum slope, compressive and tensile strains observed over measured panels was 5.0 mm/m, 1.27 mm/m and 1.22 mm/m respectively. Subsidence, slope and strains profiles were influenced by overlying old goaves, position of goaf edges, inclination of the seam, topography of the surface profiles as well as left out stooks/ribs in the overlying seams worked by bord& pillar method of mining.Subsidence movements did not cause any adverse impact on surface features and structures.

7. NATURAL RESOURCES AND ENVIRONMENT MANAGEMENT (NREM) GROUP

I. Projects

A. Grant-In-Aid Projects

1. Fluoride and Toxic metal contamination in great mica belt of Jharkhand: Geochemistry and health implications

This project is funded by DST under the Women Scientist Scheme (WOS-A) to Dr. Soma Giri. A thorough appraisal of fluoride and toxic metals in water, soil and dietary components of the mica mining areas of Jharkhand is being carried out herein to understand the comprehensive dynamics of the region with reference to geochemistry, source apportionment, water, soil and foodstuff quality and eventually extent of health risk of the exposed population. One manuscript has been published in an international journal with impact factor 5.190 and 3 manuscripts are under preparation. The human health risk assessment through the consumption of food and water in the mica mining areas would facilitate long term impact assessment for devising future management strategies.

2. Integrated Cost-effective Technology for Attaining Zero Liquid Discharge in Steel Plants with Emphasis on Steel Slag Utilization.

This project on for attaining zero liquid discharge is funded by Ministry of Steel, Government of India, as a Grant-in-aid /S&T project. The physico-chemical properties of slag have been evaluated. Identification of wastewater matrix which can be remediated by slag has been undertaken. A semi-continuous prototype has been designed for treatment of steel industry wastewater. Simultaneously, viable technique for silica hydrate formation towards waste valorization has also been developed.

3. Standalone Forward Osmosis for energy efficient and sustainable industrial wastewater treatment.

The central aim of the project is to develop a broad spectrum forward osmosis system which merges upstream and downstream processes in one-single process intensified assembly. The design and process development towards multiple uses of draw solutes and their regeneration in a single step has also been explored.

4. Study of toxic metals and fluoride in the atmospheric dust and rain of the Mica Belt of Jharkhand and the associated health risks

The study is funded by CSIR-Senior Research Associateship scheme to Dr. Mukesh Kumar Mahato for three years. The major objectives of the study are to (i) characterize the chemical composition of precipitation events with special reference to fluoride and toxic metals, (ii) source apportionment of metals and ions (iii) assessing the wet deposition rate of the chemical constituents and (iv) mineralogical investigation of the dust

samples in the mica belt of Jharkhand. A total of 75 rainwater samples of monsoon season were collected and analyzed for major anions, cations and general parameters pH, conductivity, major anions (F, Cl, NO3, SO4) and cations (Ca, Mg, Na, K, NH4). Atmospheric dust and road dust samples were also collected at eight and 21 sites during summer and winter seasons for elemental analysis, mineralogical test and textural investigation.

5. **Technology development for treatment of acid mine water for its reuse and safe disposal**

   This project funded by Meghalaya State Pollution Control Board aims to mitigate the problem of acidic mine water. For this purpose, a 250 litre/hour pilot plant will be setup in the outskirts of Shillong, Capital city of Meghalaya. Field studies and site selection has been concluded. Laboratory remediation experimentation and design optimizations have also been concluded. The design for fabrication of the plant has been created. Currently the process for installation and fabrication of the demonstration plant in Meghalaya is being undertaken.

6. **Investigation into permeable liner for disposal of coal ash in ash disposal ponds**

   This project is running under the theme E30W/Water of CSIR-FTT projects. Disposal of ash into ash ponds lends to environmental issues like ground water and surface water pollution. As such fly ash is not a hazardous solid waste but its leachate water may contain few harmful elements that may have adverse effect on water bodies. All new ash ponds will have plastic liner to prevent ground water pollution. The disadvantage of plastic liner is that the drainage becomes very difficult and as results the deposited pond ash could not get dried up to the same extent as compared to the pond without plastic liner. In the present study zeo-synthetic permeable liner made up of fly ash zeolite/ natural zeolite has been used in the laboratory to know their effective utilization in ash ponds. Successful utilisation of zeolites as permeable liner for disposal of fly ash into ash disposal ponds of thermal power plants, for protection of groundwater, the use of plastic HDPE/ LDPE plastic liner can be replaced by less costly zeolite permeable liner. It will have beneficial effect in preventing groundwater contamination beneath the fly ash disposal pond.

B. Sponsored Research Projects

1. **Baseline data generation and preparation of EIA/EMP of Mata no Madh Lignite Mine, Taluka-Lakhpat, Dist.-Kutch, Gujarat**

   This project is funded by Gujarat Mineral Development Corporation Limited (GMDCL) for detailed study of Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP). The scope of the study includes detailed characterization of exiting status of environment in the study area with respect to various environmental components, viz. air, noise, water, land, biological and socio-economic components and other parameters of human interest. Form-I of the above said mine has been prepared and submitted to GMDCL for authority onward submission of MoEF&CC, New Delhi for further compliance and ToR presentation. This study is mandatory requirement for environmental clearance at MoEF&CC, New Delhi.

2. **Biodiversity action study of Talabira 2 &3 OCP in Talabira Odisha Mining Pvt. Ltd., Talabira 2&3 Odisha**

   This project is funded by Talabira Mining Pvt Ltd for assessment of Biodiversity of flora-fauna and mitigative measures by using bioengineering and biological measures. The scope of the study also included the study of community structure environmental gradients A detailed plan for terrestrial and aquatic habitats restoration/ conservation by using native species and report for management for invasive species have prepared. The study provided a detailed action plan and process flow chart for biodiversity action plan (BAP) based on secondary data and quick field observation.

3. **EIA study and preparation of EMP of Chasnalla colliery for grant of Environmental Clearance from MoEF&CC.**

   This project is funded by Steel Authority of India Limited (SAIL) for point by point study of Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) of Chasnalla colliery. The scope of the study incorporates in-depth characterization of the existing status of the environment in the study region with

respect to different environmental components, viz. air, noise, water, land, biological and socio-economic components and other parameters of human interest. Form-I of the above-said mine has been prepared and submitted to SAIL authority for onward submission of MoEF&CC, New Delhi additional compliance. This study is an obligatory necessity for environmental clearance at MoEF&CC, New Delhi.

4. **EIA study and Preparation of EMP of Jitpur colliery for grant of Environmental Clearance from MoEF&CC**

   This project is funded by Steel Authority of India Limited (SAIL) for detailed study of Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP). The scope of the study includes detailed characterization of exiting status of environment in the study area with respect to various environmental components, viz. air, noise, water, land, biological and socio-economic components and other parameters of human interest. Form-I of the above said mine has been prepared and submitted to SAIL authority for onward submission of MoEF&CC, New Delhi for further compliance and ToR presentation. This study is mandatory requirement for environmental clearance at MoEF&CC, New Delhi.

5. **Environmental studies and advice on Pilot Project on OB and fly-ash mix for external OB dumping at Dulanga Coal Mining Project of NTPC Limited**

   NTPC, Dulanga has assigned a new project on Environmental studies and advice on pilot projects on OB and fly ash mix for external OB dumping on Dulanga coal mining project, Sundergarh. The major objective of the project are environmental studies on air and water quality and leaching of fly ash during initial, dumping and after dump construction stages and its effect on quality of nearby water resources. Health survey of the local population in and around proposed dump site will also be carried out to assess the health status of the people residing in the nearby areas.

6. **Environmental studies related to air quality and water samples at different points of Jitpur Colliery of SAIL Collieries Division**

   This project is funded by Steel Authority of India Limited (SAIL to know the current environmental status of air and water quality of different sites of Jitpur Colliery. Sampling and analysis of PM2.5, PM10, SO2 and NO2 have been carried out on seasonal basis for the monitoring year. Total three sampling stations have been selected for air quality monitoring on the basis of wind direction and other meteorological parameters. To assess the impact of mining on water quality, four water samples have been collected from different locations. This comprises of two supply water of MADA, one mine effluent and one surface water sample. Based on analytical evaluation of data preventive measures were suggested like Spraying of water on the roads for controlling the dust to its minimum level, regular maintenance of the vehicles. It is also suggested that mine water must be collected in settling tank before its discharge and reuse.

7. **Environmental study, monitoring of land use pattern and preparation of Environmental statement for Dumri Coal Mine, Hazaribag, Jharkhand**

   This project is funded by M/s Hindalco Industries Ltd., for environmental study of upcoming Dumri Coal Mine, a captive mine situated at Hazaribag district of Jharkhand. The detailed study with respect to air, water, noise and soil has been carried out in the year 2020-21. To know the air quality of the green field area, different air quality-monitoring stations have been fixed in the core and buffer zones. Sampling and analysis of PM2.5, PM10, SO2 and NO2 have been carried out on seasonal basis for the monitoring year. Total four sampling stations have been selected for air quality monitoring on the basis of wind direction and other meteorological parameters. Based on analytical evaluation of data preventive measures were suggested like use of sprinkling system on haul and transport road, regular maintenance of the heavy earth moving machines and wetting of active OB dumps to avoid wind erosion during the mining operartion. Reclamation and revegetation of overburden dumps should be done to control soil erosion, denudation of agricultural land and nearby riverine system, wetlands and to improves the aesthetics of the area.

8. **Evaluation of environmental parameters for disposal of pond ash in abandoned stone quarry at Nawadih near Jenamore, Bokaro, Jharkhand**

   Sampling and analysis of ambient air quality test of PM10, PM 2.5, NOx, SOx on quarterly basis for one year. The major objectives of study are sampling and analysis of groundwater in the periphery of the ash dumping area (25 water quality parameters) on quarterly basis for one year, leaching studies of pond ash and hydro-geological studies (before and during ash dumping) Bioaccumulation and Bio-magnification test on surrounding flora.

9. **Investigation and evaluation of soil infiltration and assessment of groundwater quality in Fatehpur district of Uttar Pradesh and advice on water resource management**

   Water quality assessment of surface and sub-surface water resources of the Fatehpur district were carried out under the WAPCOS sponsored project on "Groundwater quality assessment and soil infiltration test in Fatehpur district of Uttar Pradesh". Groundwater samples were collected from both shallow and deep aquifers of the Fatehpur district during pre- and post-monsoon seasons and analysed for major cations (Ca^{2}+, Mg^{2}+, Na+, K+), anions (F-, Cl-, HCO_3-, NO_3- SO_4^{2}-), heavy metals (Fe, Mn, Cu, Pb, Zn, Ni, Cr, Se, and As) and other general parameters (EC, pH, TDS, Alkalinity, Total hardness). The major objective of the study was to evaluate the physicochemical characteristics of the surface and groundwater resources of the Fatehpur district and assess the geochemical processes controlling the water composition of the area and suitability of water for drinking and irrigation uses. Fatehpur is a part of Ganga-Yamuna doab in Central Ganga plain and known for its agricultural productivity. Soil infiltration test was also conducted at 20 locations for assessing soil infiltration rate at different locations in Fatehpur district.

10. **Long term study on radioactivity and heavy metals content in coal and fly ash of Talwandi Sabo Power Limited**

    CSIR-Central Institute of Mining and Fuel Research, Dhanbad (CSIR-CIMFR) has undertaken a scientific study on radio activity and heavy metals content in coal and fly ash of Talwandi Sabo Power Limited on request of TSPL. The major objective of this study was to quantify the heavy metals content and natural radioactivity levels of raw coal and coal residue (dry fly ash, bottom ash and pond ash) generated at Talwandi Thermal Power Plant. This study will help in evaluation of contamination possibilities of the natural resources and assessing associated human health risk and radiation hazard indices from the activity concentrations of 226Ra, 238U and 40K and in predicting any radiological hazard to final users, and the general public from its exploitation and uses.

11. **Study and cost effective solutions for the removal of acidic mine water from Vastan North and Mangrol lignite mines of GIPCL**

    Collection of acid mine water from two mine pits namely Vastan North Pit and Mangrol Pit. Characterisation of mine water with respect to acidity, ions and metals will be carried out at CSIR-CIMFR laboratory. After characterization a cost effective treatment will be carried at laboratory scale to make the mine water suitable for discharge into environment.

12. **Study on soil erosion/soil flow from the overburden areas with the help of GIS at Pakri - Barwadih coal mining project, NTPC**

    Opencast mine releases huge amount of mining wastes material as a form of overburden dump materials that are prone to soil erosion and create problems of sedimentation and water quality and affecting agriculture activity also. Rain causes severe erosion of fine size particles from the barren mine overburden dumps. Such erosion processes may bring instability to the dumps resulting dump failure. Hence, assessment and quantification of soil loss is the pre-requisite for planning of any management plan and implementing protective measures to minimize soil erosion loss of any area. The present study attempted to quantify the soil erosion/soil flow from Pakri Barwadih mining areas by applying combined approach of GIS and RUSLE model. The study is assigned to CSIR-CIMFR by M/s Thriveni Sainik Mining Private Limited, a Mine Developer cum Operator (MDO) of Pakri - Barwadih Coal Mining Project of NTPC Ltd.

13. **Water quality data base generation, interpretation, and analysis for exploratory wells to be drilled at various locations in Punjab and Ghazipur**

About eleven hundred groundwater samples were collected from different aquifer depths (100, 200 and 300 m) at variation locations in Ghazipur district of Uttar Pradesh and Punjab state and analyzed for EC, pH, TDS, Alkalinity, Total hardness, major cations (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}), anions (F^{-}, Cl^{-}, HCO_3^{-}, NO_3^{-}, SO_4^{2-}), heavy metals (Fe, Mn, Cu, Pb, Zn, Ni, Cr, Se, and As). The analysed data were used for physico-chemical characterization of groundwater resources and assess controlling factors determining the water composition and spatio-temporal variation in the concentration of chemical species. The water resources were also assessed for its suitability to domestic and irrigation uses.

8. NONCONVENTIONAL GASES RESEARCH GROUP

The group is involved in R &D work on safety in underground mines from methane emission, evaluation of coalbed methane/shale gas resource potential, CO2 sequestration in geological formation and CBM wells, estimation of methane emission from coal mining and handling activities and oil and natural gas systemsand underground coal gasification.

(i) S & T Projects:

1. **Improved fugitive methane emission factors for coal mining and handling activities in India including abandoned mines.**

Field and laboratory investigationsare completed and methane emission factors for different degreeof gassiness of coal seams were developed and used for quantification of fugitive methane emission from coal mining and handling activities. The work is in progress.

2. **Shale gas potentiality evaluation of Damodar Basin of India**

The measurement of 3D/2D seismic study was carried out at Rangamati, ECL and Radhanagar, Jharia coalfield by CSIR-NGRI for identification of subsurface lithology, type of formation and occurrence of thick shale beds. The drilling and sample collection was completed at the drill point selected at Rangamati and Radhanagarfor shale reservoir characterization.Megascopic properties like colour, hardness, fracture, specific gravity, homogeneity, banding etc. have been done for shale core samples. Surface area, pore size and pore volume were measured for shale core samples to evaluate pore characteristics and pore structures.Detailed mineralogical and Petrographical-maceral studies, FTIR, XRD analysis,Rock-Eval pyrolysis,SEM-EDAX analysis was completed and final reportwas submitted to CMPDIL, Ranchi for approval by the concerned government departments. The work is completed

3. **Estimation of Fugitive Carbon Dioxide Emissions from Indian Coal Mining Activities.**

Methane, Carbon dioxide, Nitrogen and other gases are generated during coalification process. These gases are found in coal pores, fissures and cleat system as free and adsorbed on the internal surface of coal pores. Among these gases methane and carbon dioxide are available in good quantity and are responsible for global warming as a result of mining operation and handling systems. The emission coefficient of carbon dioxide gas has been developed for the quantification of fugitive carbon dioxide emission during coal mining and handling activities in India. The work is in progress.

(ii) Industry Sponsor Project

1. Investigation on methane emission for classification of degree of gassiness of Seam -III of Muraidih Colliery, BCCL and advice on associated hazards.
2. Geo-chemical and specialized properties of coal core samples from Raniganj, Jharia and Damodar-Koel Valley of West Bengal and Jharkhand.
3. Shale gas and coalbed methane reservoir studies: desorption and adsorption isotherm studies, geochemical and other properties of carbonaceous shale/coal samples of Palasdiha area, Raniganj coalfield.

4. Advice on thermal maturity, micro-petrography and geomechanical characteristics of coal seams at Sohagpur East & West blocks, Dist. Shahdol, MP for CBM potentiality assessment.
5. Scientific investigation on methane emission and determination of in-situ gas content for categorization of degree of gassiness of R-VIIC, Nakrakonda Kumardihi B Colliery, Bankola Area, ECL.
6. Investigation on in-situ gas content, sorption characteristics, petrographic and chemical makeup and gas quality of the coal cores in Bokaro patch #A and #B of ONGC.
7. Advice on Pre-feasibility from Rock Mechanics point of view and related geotechnical issues for future application of UCG at Jamadoba, Tata Steel.
8. Scientific investigation on methane emission and determination of in-situ gas content for categorization of degree of gassiness of Coal seam-I, Pandavpara underground mine, Baikunthpur Area, SECL and advice on associated gas hazards.

9 . ROCK EXCAVATION ENGINEERING RESEARCH GROUP

During the period of April 2020 to March 2021, the Rock Excavation Engineering (REE) Research Group has carried out a number of important projects in the field of rock blasting and explosives. The various projects carried out by the Research Group can be divided broadly into three categories as (1) Development and optimization of controlled blasting in mines (2) Hard rock excavation using controlled blasting in civil engineering construction projects and (3) Development and quality testing of commercial explosives.

The Research Group has carried out an important national project for the development of safe and efficient blasting technique for the construction of strategic roads along the Indo-China borders. The MoUs have been signed between CSIR-CIMFR and Border Roads Organisation (BRO), Ministry of Defence, Government of India wherein CSIR-CIMFR provides the technical know-how for expediting the pace of rock excavation works at the various strategically important defence road construction sites of BRO along the Indian Borders. There are several problems and difficulties in the construction of roads along the borders such as, extreme cold weather, high altitude and difficult terrain, geologically complex rock deposits, ecologically fragile rock masses causing frequent landslides and rock falls etc. The research group has already provided consultation at several critical roads being constructed near the Indo-China and Indo-Pak borders. The BRO has confirmed the increased pace of excavation at the roads post-CIMFR intervention.

The Research Group has also been involved in the flattening of Ulwe hill using controlled blasting as a part of land development work for the Greenfield project of Navi Mumbai International Airport (NMIA) since June 2016. The Research Group has been continuously working at the site during the Covid-19 pandemic also for designing, supervision and monitoring of the total drilling and blasting operations. Similarly, the land development work for construction of 2 x 660 MW Obra-C Thermal Power Plant has been carried out using drilling and blasting techniques under the supervision of the Research Group. Controlled blasting works for the foundation of various structures of the thermal power plants have been successfully completed during the annual year.

The Research Group also worked in a number of important railway projects for safe excavation of rocks using controlled blasting which include the followings.

(1) Flattening of slopes using controlled blasting at Bordave, Ukshi Yard, Agave and Shirsawane cuttings under the jurisdiction of DGM/SW/RN in Ratnagiri Region of Konkan Railway.

(2) Design and continuous supervision of foundation blasting work at Betwa river for construction of Jhansi-Bina 3rd railway line bridge considering the safety and stability of existing bridge situated at a distance of 25 m.

(3) Scientific study for controlled blasting and continuous supervision of foundation blasting work at Koel river for construction of 2nd railway line bridge between Hatia-Bondamunda section of SE Railway considering the safety and stability of nearby existing bridge.

(4) Scientific study for finalizing scheme of blasting and slope stability between Km 6.6 to 8.0 in Karaila-Anpara Section in connection with doubling of Karaila Road-Shaktinagar Project under Dhanbad Division of East Central Railway (ECR).

(5) Advice on directional controlled blasting to excavate hard rock for lying 2nd line nearby existing rail track and other structures at Sanvordem Yard (Kulem-Madgaon Section of SW Railway), RVNL, Goa.

The Research Group has successfully developed controlled blast design patterns for conducting safe and efficient blasting operations without affecting the nearby residential houses/structures at the different opencast mines in various parts of the country such as: (1) Pakri Barwadih Coal Mines Project of M/s NTPC Limited, Hazaribargh; (2) Magadh Opencast Project, CCL; (3) Dalpahar Iron and Manganese Mines of M/s D. C. Jain, Odisha; (4) Khanbandh Iron Ore Mine of M/s Sree Metaliks Limited, Odisha; (5) Aditya Limestone Mines of M/s UltraTech Cement Limited, Shambhupura, Chittorgarh; (6) Budgauna and Majhgawan Limestone Mines of M/s UltraTech Cement Ltd. (Unit: Sidhi Cement Works); (7) Argat Limestone Mine of Sidhi Cement Works; (8) Chormari and Degarhat Limestone Mines, Jaypee Rewa Plant; (9) Sonadih Limestone Mines of M/s Nuvoco Vistas Corp. Ltd. (10) Baghai Limestone Mine of M/s Prism Johnson Limited, etc.

The Research Group has also carried out study for optimization of blast design parameters to control blast induced ground vibration within stipulated limit considering the safety and stability of surface structures in and around the mine at the different underground mines of Hindustan Zinc Limited viz. Kayad, Rampuragucha, Sindesar-Khurd, Rajpura-Dariba and Zawar groups of underground mines.

The Research Group has also carried out R&D works for the development of explosives which include water resistant ANFO explosives, replacement of Fuel Oil with used oils in ANFO explosives etc. The testing and evaluation of explosives and blasting accessories being supplied by the different explosive companies have also been carried out at the opencast mines viz. Jhamarkotra Rock Phosphate Mines of M/s Rajasthan State Mines & Minerals Limited (RSMML) and the various Iron Ore Mines of M/s Tata Steel Limited. Similarly, study and evaluation of seismographs for their reliable operation and advice on technical aspects for accurate vibration recording was performed for the seismographs of several companies.

MoU signed between CSIR-CIMFR and BRO at New Delhi on November 25, 2020

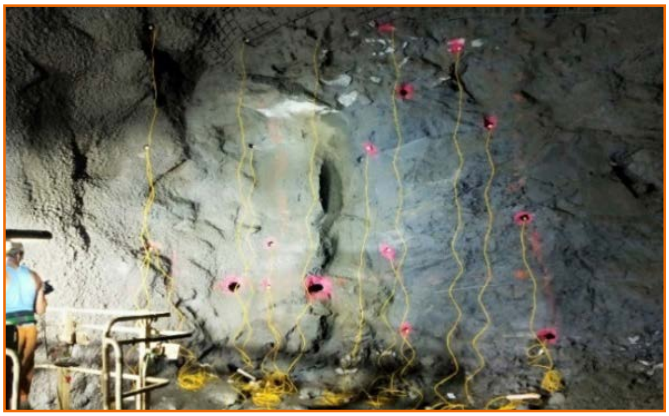
Proud moment for CSIR-CIMFR Team with Director General of CSIR after signing MoU with BRO

Directional Controlled blasting for flattening of slopes at Ukshi station of Konkan Railway

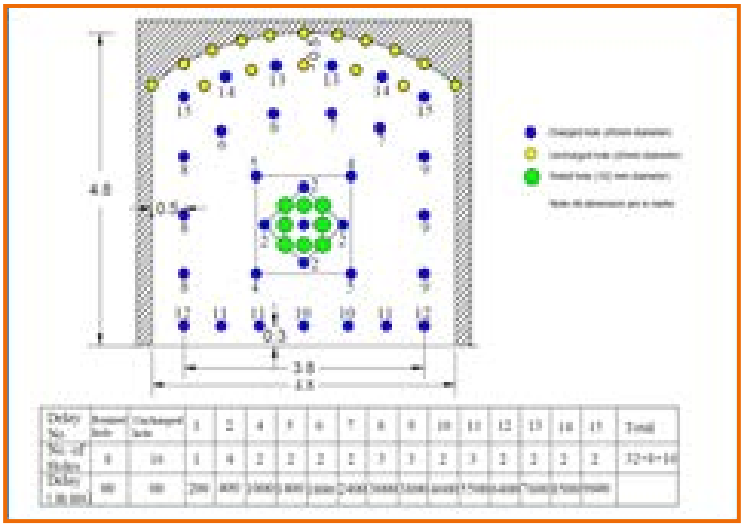
Controlled blast conducted for foundation of 2nd Railway Line bridge pier at Koel river near Bano, Jharkhand, SE Railway

Foundations excavated using controlled blasting for construction of Pier for 2nd Railway Line bridge at Koel river, SE Railway

Doubling site of railway line at Karaila-Anpara Section, ECR using controlled blasting



Ulwe Hill for construction of Navi Mumbai International Airport (No. of holes - 620 holes, Rock volume blasted - 1,58,600 m^3, Explosive used - 78 Tonne



View of the blasting face and the recommended blast design for Paste Drivage in Rampuragucha underground mine

10. ROCKMASS CHARACTERISATION AND INNOVATIVE MINING METHODS SECTION

During April 2020 to March 2021, Rockmass Characterisation and Innovative Mining MethodsSectionwas engaged in various industries sponsored and consultancy assignments related to rock mass characterization, determination of RMR (Rock Mass Rating) for support design, ground control and assessment of support system of a deep mine based on continuous monitoring of the strata movement of the mine,safe development and design of galleries, rhomboid shaped pillars and support system, ground control and assessment of support system efficacy with reduced pillars size and continuous monitoring of the strata movement against air-blast and subsidence from the time of working to the life of the mine.Theseassignments were received from companies like M/s Trident &Auro Mining LLP,M/s SMS Limited Kondapuram, M/s Eastern Coalfields Limited (ECL), M/s Western Coalfields Limited (WCL), M/s Singareni Collieries Company Limited (SCCL), M/s Bharat Coking Coal Limited, M/s Indian Metal and Ferro Alloys Limited (IMFA), Odisha, M/s Techno-Blast Private Limited, Chhattisgarh, andJitpur Colliery ofSteel Authority of India Limited (SAIL),Hindustan Salt Limited (HSL) and Indian Railways (IR).

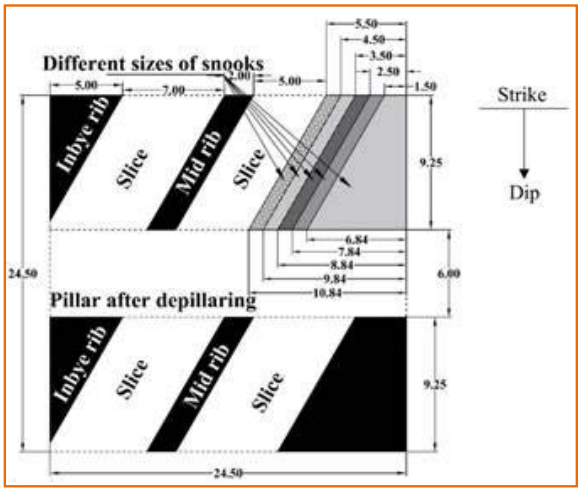
CSIR-CIMFR visited the sites located in different parts of India to conduct scientific study for safe development and extraction of pillars by installing strata control instruments and carrying out parametric study on numerical models fordifferent panels of the mentioned mines.Considering the site details of Tawa-II underground coal mine, Pathakhera Area, WCL, galleries, rhomboid shaped pillars and support system have been designed for Panel Nos. 2&3 of Lower Workable Seam using Continuous Miner technology. CSIR-CIMFR conducted the strata behaviour study in E3panel of Sarniunderground mine, WCLduring depillaringfor assessment of support system efficacy with

reduced pillars size and continuous monitoring of the strata movement against air-blast and subsidence from the time of working to the life of the mine.Detailed methodology wassuggested for the final extraction of coal pillars using sand stowingand caving techniques in different panels of mines at Satgram Area and Amritnagar Colliery inECL, including roof bolts as support system at the goaf edges, strata control and management plan (SCAMP).

At Maheshpur Colliery, Govindpur Area, BCCL, 24m thick combined seam (V/VI/VII Seam) is being developed along the roof by bord and pillar method of mining (BPMM). The galleries are 4.8m wide and 3.0 m high with sandstone as immediate roof and depth variation from 65-160m. In combined seam, the bottom lift will be accessed by a 4.5m wide drift with coal as its roof. The overlying VIII seam is located at a parting of 38m from combined seam and developed about 10 years ago which isfound to be standing on pillars and partly depillared with caving. CMRI-RMR has been estimated for drift and gallery and further adjusted to 46.8 and 56.7 respectively due to solid blasting, which falls in fair roof category.

At Patmohna colliery, Sodepur Area of ECL, R-VIII seam is 3.0m thick and dipping at 1 in 6 which is being depillared by BPMM. The galleries are 4.5m wide and 2.2m in height, pillar size is30m x 30m (centre-to-centre) and average depth of cover is 162.4m. The underlying virgin R-VII seam (Lower Dhadka Seam) and overlying virgin R-IX Seam (Gopalpur Seam) are located at a parting of 136m and 70m respectively from R-VIII seam. Geotechnical studies have been conducted near Panel-18 depillaring district, where the full seam thickness is visible due to roof fall. The immediate roof of R-VIII seam (Borachak Seam) is 0.8m coal overlain by 1.2m shale. Samples have been collected from 17L/8D (Jn). Since there are two types of strata present in the 2m of immediate roof, therefore, combined RMR value is calculated to be 54.2, which is adjusted to48.78(Fair roof category)considering the effect of solid blasting.

At Jitpur mine of SAIL, 9.0 m thick XIV Seam is being extracted in three lifts with stowing after formation of panels from block- 14 to 17. The strata control studies using geotechnical instruments and formulation of compatible support system has been initiated with the help of field study and sample collection. The longwall face is supported with roof bolts, wooden/steel props and chocks whereas the gate roads have yielding arches. The depth of working is varying from 364-400 m. It has been observed that the yielding arches have become flat/distorted due to high vertical mining induced stresses and a dead load of 6.0 m coal is acting over it. The roof falls at the 3-way junctions and faces have occurred and suitable support system have been advised. The study is still ongoing and the collected samples are being tested at Rock Mechanics Laboratory of CSIR-CIMFR.

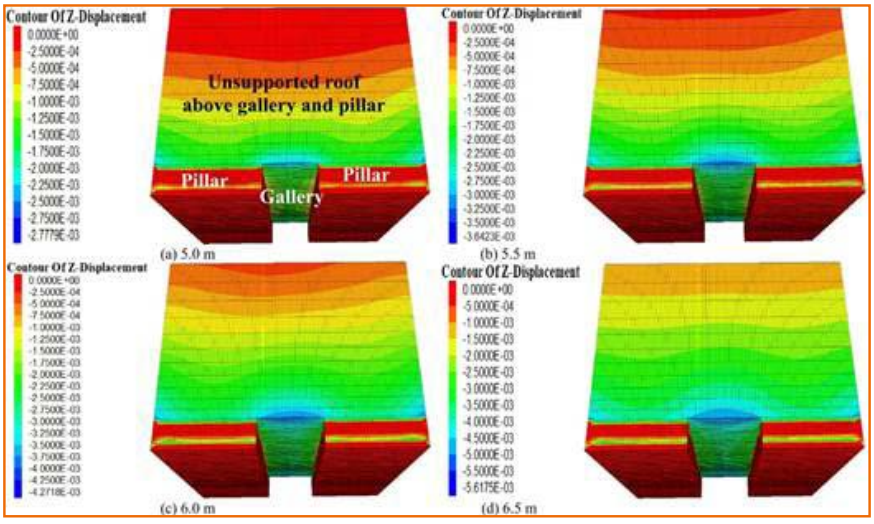


All dimensions are in meters (to-the scale)

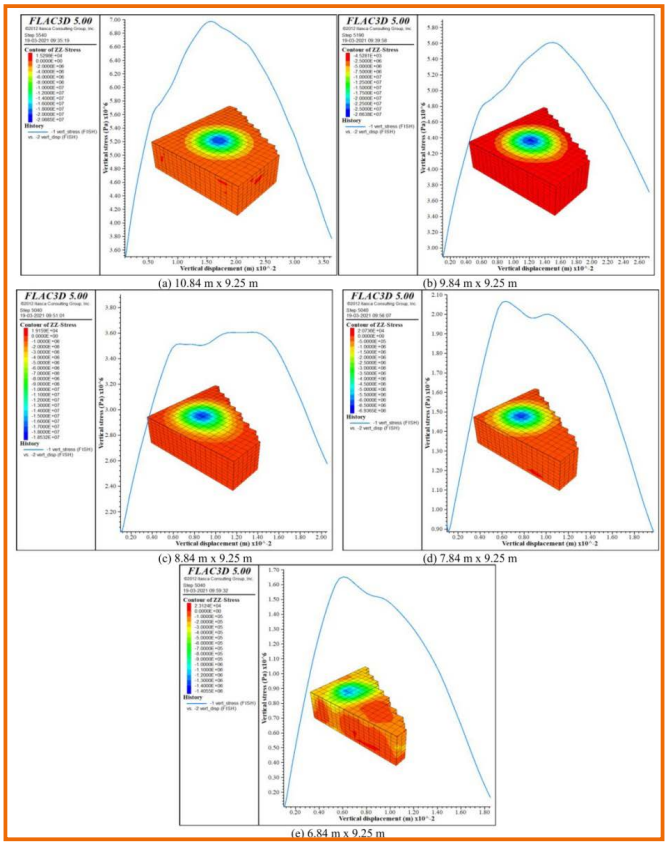
The scientific study on rock mass characterization and formulation of support system for Drang rock salt mine located at Mandi district of Himachal Pradesh has been proposed to CSIR-CIMFR after the technical snag in the form of rock salt floor dilution, pothole formation, arch support tilting etc. as observed by the mine management in a 50m long constructed incline. CSIR-CIMFR conducted the field study and found that the cap rock of rock salt bed has not been identified before the incline development which led to puncturing of the aquifer and continuous water ingress. Also, the superimposed water logged old working (not mentioned in the survey plan) is filled with ground water. Therefore, the field studies begin with the collection of data and different information from survey, geology, rock-test etc. Also, the role of abutment stress, water ingress and impervious strata (cap rock of rock salt bed) have been studied in detail to design the incline. The location (RL) and the capacity of the ISMB arch has been calculated based on the analysis of field data. Support system for the mine has been proposed based on the rock mass characterization using GSI system.

Design of support system for stabilization of hill slope beside Godda-Hansdiha Railway Line has been proposed on the basis of rockmass structure and division of hill in three zones (1) Lower cut portion of 4 m height soil strata of the hill slope from railway track level of 180 m RL, (2) Middle portion of 4–16 m height soil strata of the hill slope from lower cut and (3) Top portion of rock strata of 6–28 m above soil layer. The lower portion was supported with 4m height of RCC retaining wall and middle portion with geo-synthetic concrete mat, whereas the top one is with tennis net for the protection of commutates/visitors and gazing animal.

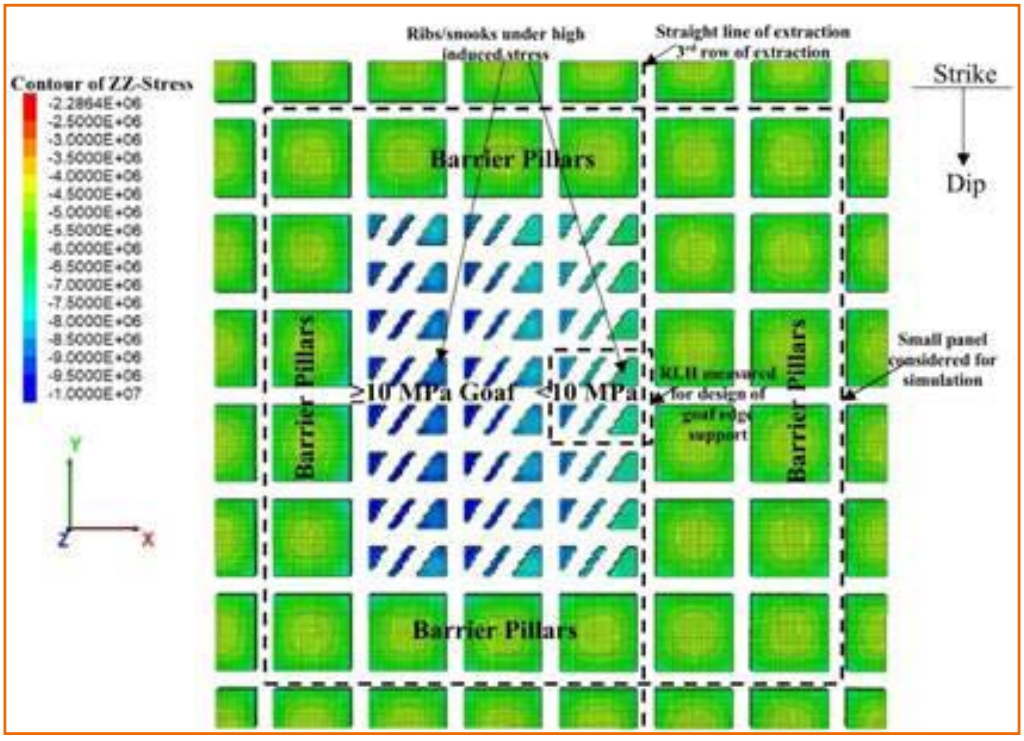
Different sizes of snook considered for split and fender method of pillar extraction in the two panels at Tawa-II mine.



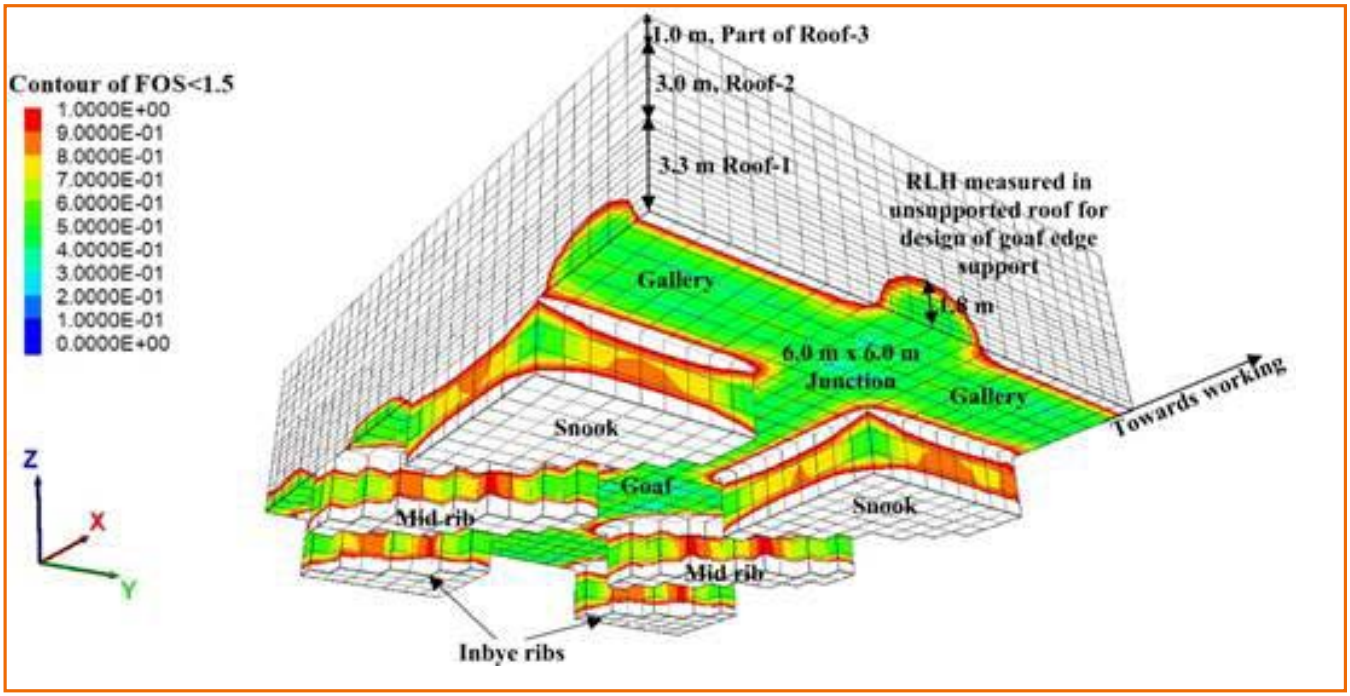
Contour of vertical displacement for fixing widthof galleryin the two panels at Tawa-II mine.



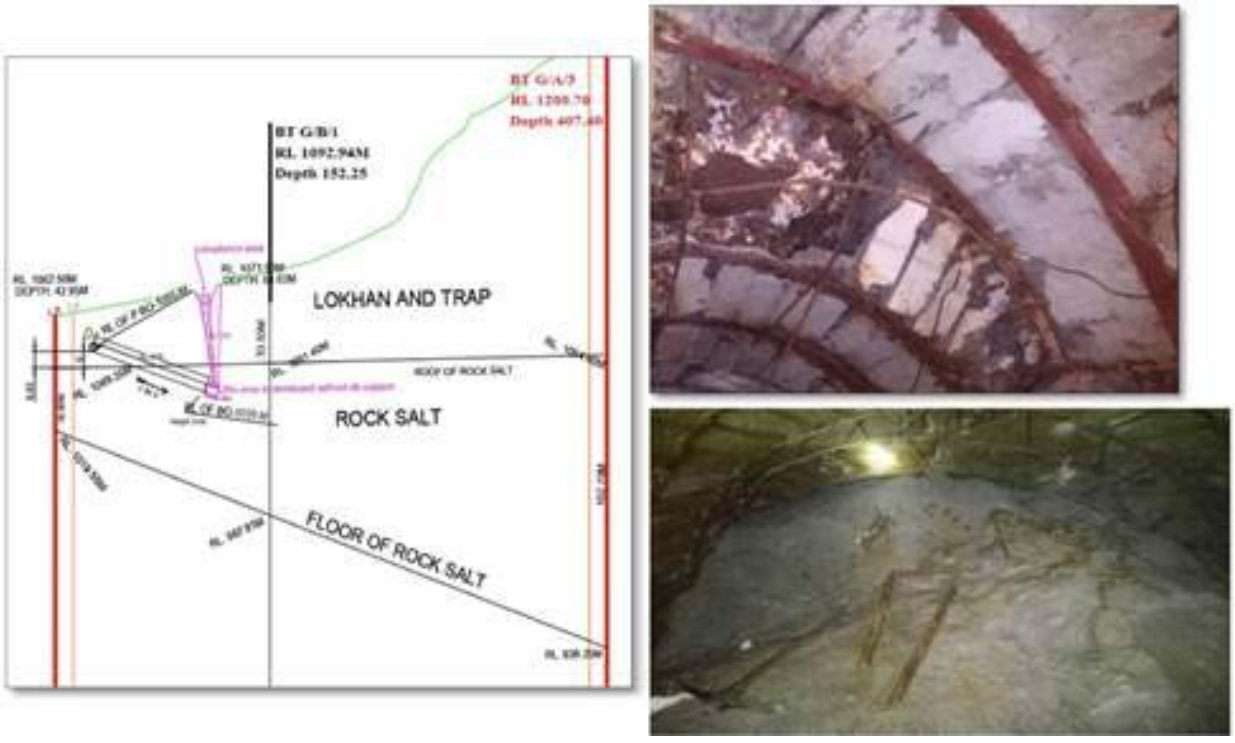
Vertical stress-displacement characteristics of different sizes of rib/snook for a pillar size of 24.5 m x 24.5 m (corner-to-corner)for the design of rib/snook during split and fender method of pillar extraction in the two panels at Tawa-II mine.



Manner of pillar extraction, their sequence and locations marked for measurement of RLH in the numerical model for the design of support system in the two panels of Tawa-II mine.

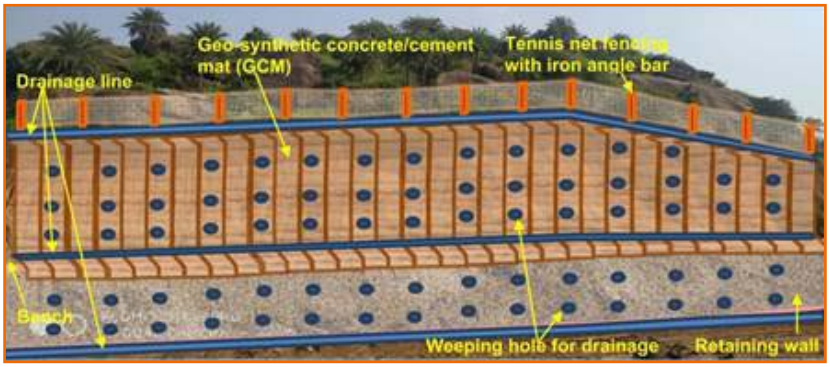


Rock load height observed in unsupported immediate roof at the goaf edge in FLAC3D for the design of support system in the two panels of Tawa-II mine.



Status of the incline in Drang rock salt mine as found during field study.

Division of hill in three zones for stabilization of hill slope beside Godda-Hansdiha Railway Line



Design of support system for stabilization of hill slope beside Godda-Hansdiha Railway Line

11. ROCK MECHANICS LABORATORY

1. Physico-Mechanical analysis of Borehole cores- to be prepared by Shri SKS Sir

The Rock Mechanics Laboratory has expertise in R&D as well as testing of the behaviour of rock specifically required for planning, design and construction of mining and civil engineering projects. The main objective of this laboratory is to determine different physico-mechanical properties of rocks for mining and civil engineering projects and for optimizing design safety. The laboratory also conducts investigation for developing better understanding of near–surface to shallow crustal earth processes. The laboratory specialises in standard (IS, ISRM and ASTM) rock testing, including measurement of strength (Uniaxial, Tensile and Triaxial), deformability (Elastic modulus and Poisson's ratio), Slake durability index, Cerchar Abrassivity Index, Ultrasonic velocity measurement, Porosity, Density etc.

In the financial year 2020-2021 (from 1st April, 2020 to 31st March, 2021), Rock Mechanics Laboratory of CSIR-CIMFR has undertaken scientific studies for Physico-mechanical analysis of rocks and coal samples, sent by various organizations such as CMPDIL, MECL, Orissa Mining Corporation, Tata Steel Ltd., MAPL, etc, and has analyzed >10, 000 meters of borehole cores sent for evaluation by different organizations.

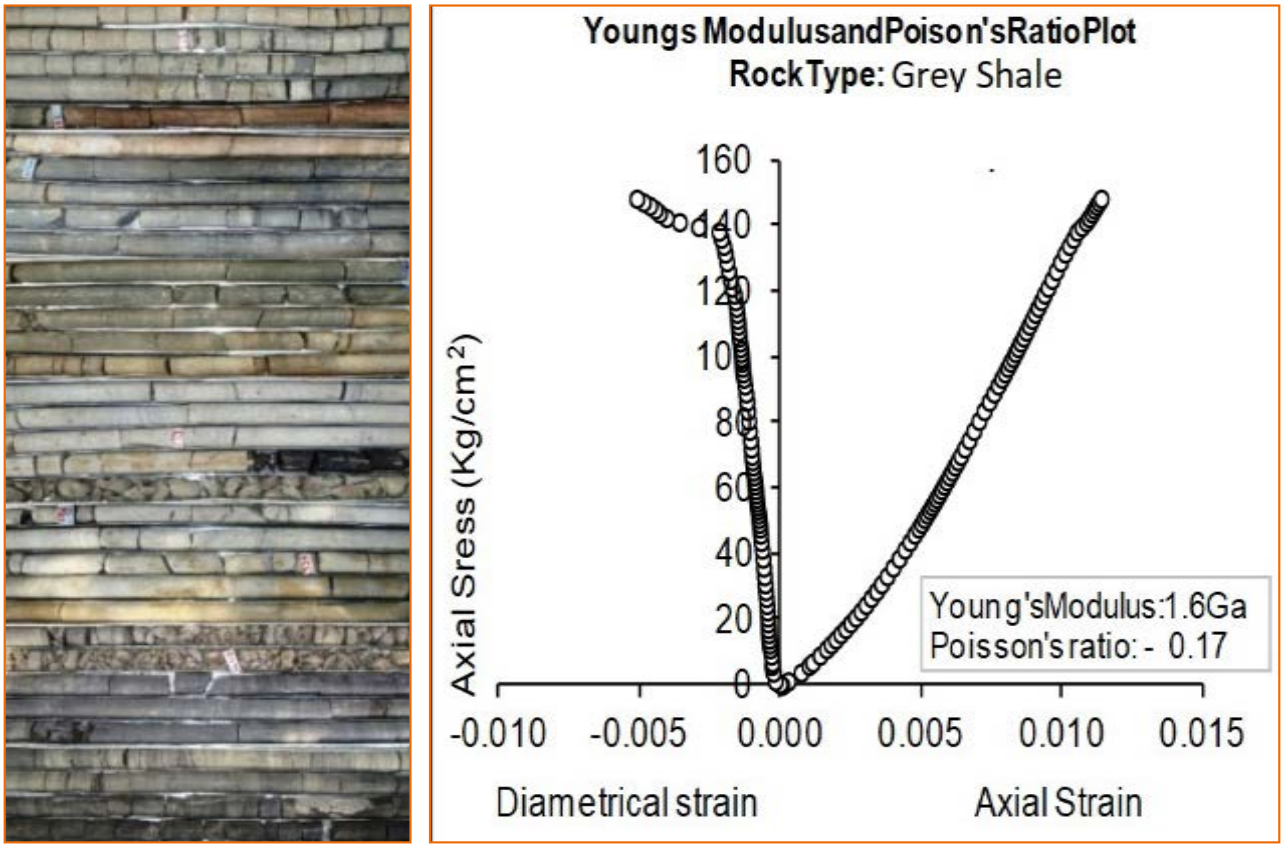


Figure 1: Borehole cores received from various organizations for determining physico-mechanical properties of rocks, and an ideal Youngs Modulus and Poisson's Ratio Plot of a grey shale sample

ADVANCED ROCK MECHANICS LABORATORY

The CSIR-CIMFR has a state-of-the-art MTS 815 Rock Testing System installed at its Advanced Rock Mechanics Laboratory. The equipment is a servo-controlled unit with maximum compression and tension rating of 2700 kN and 1350 kN, respectively. Maximum confining pressure that can be applied for triaxial testing is 80 MPa. The system is capable of exclusively performing a host of rock mechanic tests (creep test, post failure analysis, cyclic test, fracture toughness test, direct tensile test etc.) with high precision and accuracy.

Figure 2: MTS 815 Rock Testing System (Load frame height is 2337 mm)

The MTS 815 Rock Testing System is engaged in R&D service support to mining as well as civil engineering industries. Recently, Orissa Mining Corporation (OMC) has sent peridotitie rock samples for evaluation of rock mechanical properties. MTS system was used to undertake the UCS tests. A representative force vs displacement curve obtained from the compression test of a peridotite rock sample is given in figure 3.

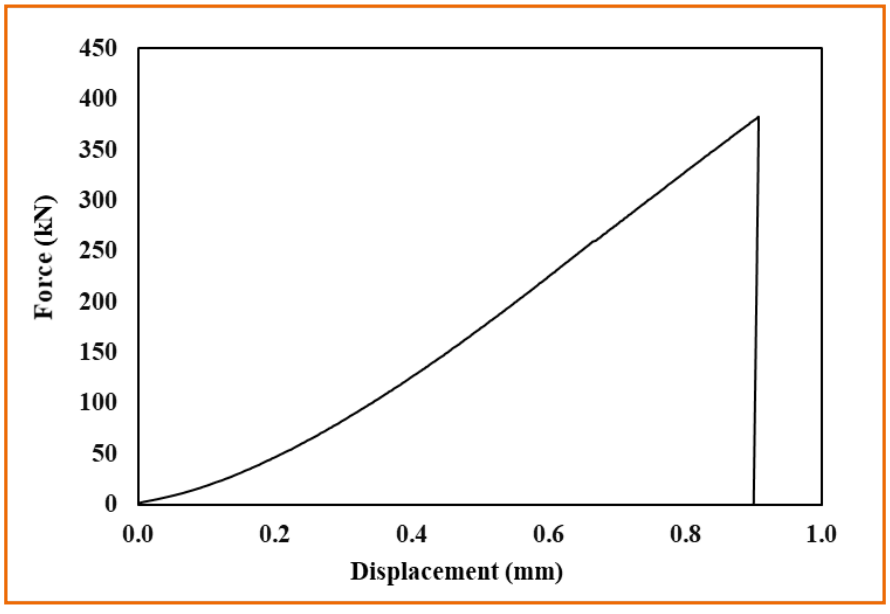


Figure 3: Force vs Displacement curve of UCS test on peridotite sample

In-house R&D attempts have been made to evaluate the impact of heat on the strength and elastic properties of sandstone rock using the MTS system. It has been observed from the study that the strength of sandstone rock decreases with increasing temperature, and with increasing temperature a brittle to ductile transition was observed. Figure 4 represents the stress vs. strain curves of uniaxially loaded sandstone at different test temperatures.

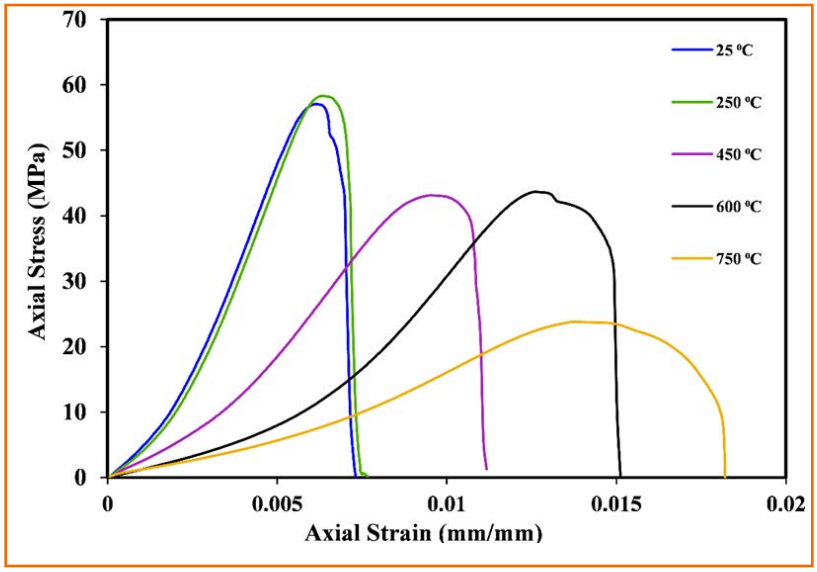


Figure 4: Axial stress vs. axial strain curves at each temperature investigated

3. Field Emission-Scanning Electron Microscopy (FE-SEM)

A Zeiss Merlin VP compact FE-SEM equipment is currently available at the CSIR-CIMFR and is used for conducting the scanning electron microscope (SEM) and energy-dispersive X-ray

Spectroscopy (EDX) analysis of rocks samples, catalysts, biomass, fly ash, bottom ash, soils and filaments. Several works have been conducted using appropriate procedures that have helped in evaluating and understanding the structure of materials at high resolutions. Ideally, samples are coated with gold to make them conductive and facilitate the analysis.

Figure 5: Diatom identified in coal from Raniganj basin, India

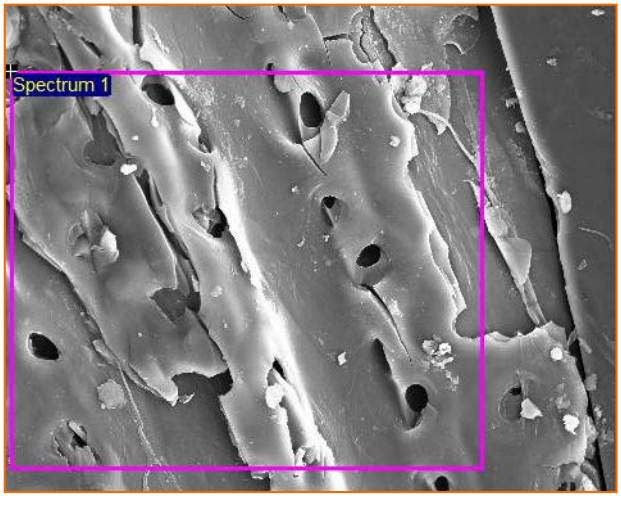


Figure 6: Fossilized charcoal identified in coal, showing macroporous structure

3. Rock-Eval 6 facility

Very recently, the Rock-Eval 6 facility has been installed at the CSIR-CIMFR Dhanbad. The Rock-Eval pyrolysis technique is a widely used and highly regarded tool used by petroleum geochemists for source-rock geochemical profiling of conventional and unconventional hydrocarbon reservoirs. In its most common configuration, it is an open-system programmed-pyrolysis mechanism, whereby between predefined temperature thresholds ramped heating patterns are applied to carefully prepared samples. Different important parameters such as free hydrocarbons, heavier hydrocarbons, total organic carbon (TOC), thermal maturity, hydrogen index, kerogen type etc. can be derived and calculated using the Rock-Eval 6 device.

Using this technique, very recently, the researchers of the department could identify the differential signals shown by 'coking coals' and 'non-coking coals' which could be successfully used for identification of suitability of coal samples for steel industries. Similarly, using the oxidation-stage of the device, the researchers have been able to propose a new thermal maturity index, which is especially useful for maturity estimation of low-organic and thermally altered rocks. Some other important research works which fundamentally discusses oil/gas generation potential of shales from India and the kinetics of hydrocarbon generation as a function of organic matter type and thermal maturity levels, has been executed and published by the members of the department.

This facility has also been used recently to characterize marine sediments given by the CSIR-NIO Goa. The Geological Survey of India (GSI) had also sent few shale samples for analysis using Rock-Eval 6 device at the CSIR-CIMFR Dhanbad very recently.

Figure 7: Rock-Eval 6 device installed at the CSIR-CIMFR Dhanbad

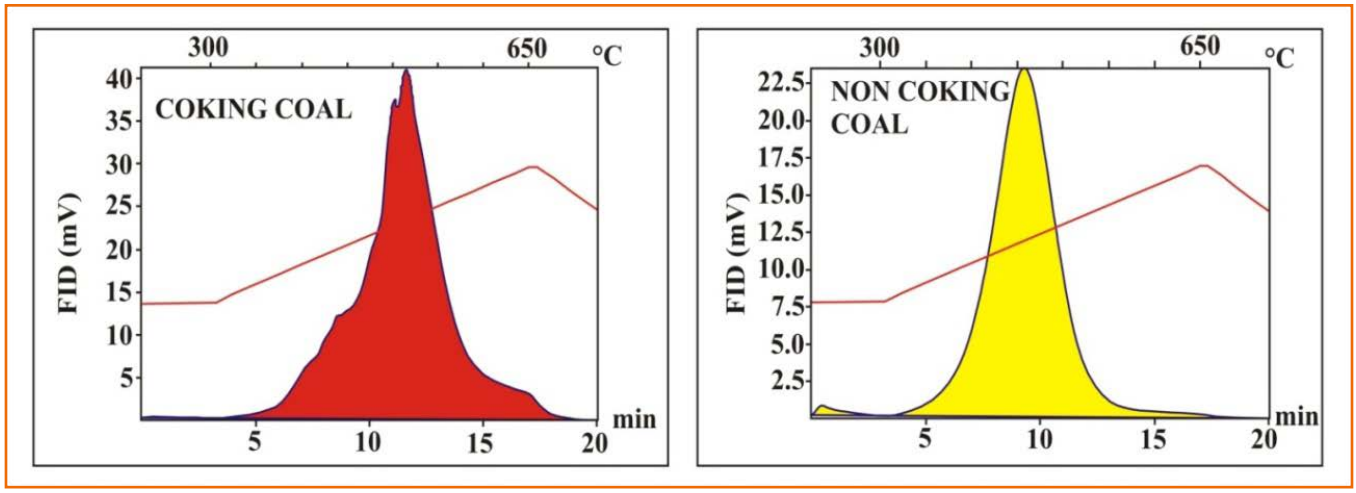


Figure 8: Different signals and responses observed for coking coal and non-coking coal when analyzed using Rock-Rval

12. WIRE ROPE & ELECTRICAL ENGINEERING

During April, 2020 to March, 2021, Wire Rope and Electrical Engineering Research Group has undertaken various assignments on in-situ study and advice on the condition of steel aerial ropes (track and haulage) and mine winder ropes (cage and skip).

The topics of the study and the clients of this research group included:

1. Evaluation and advice on the present condition of haulage rope of detachable grip mono-cable passenger ropeway at Trikutpahar, Deoghar, Jharkhand
2. In situ evaluation and advice on the present condition of haulage rope of Pushkar site of M/s Damodar Ropeways & Infra Ltd., Rajasthan
3. Evaluation and advice on the present condition of double drum winder ropes of Mahagiiri Mines (Chromite), Jazpur, Odisha
4. Evaluation and advice on the present condition of haulage rope of detachable grip monocable passenger ropeway at Maihar, M.P.
5. In-situ investigation and advice on the present condition of four nos of track ropes (single visit) and two nos of haulage ropes(two visits) of passenger cable car aerial ropeway installation of M/s Timber Trail, Asia Resorts Limited, Parwanoo (HP) –(1st Interim Report)
6. In situ evaluation and advice on the present condition of of track and haulge ropes of passenger ropeway across river Brahmaputra at Guwahati for M/s Guwahati Metropolitan Development Authority, Assam
7. Evaluation and advice on the present condition of haulage rope of DRV passenger ropeway at Darjeeling, West Bengal
8. In situ evaluation and advice on the present condition of track and haulage ropes of passenger ropeway from Bhawan to BhaironGhati, Katra, Jammu & Kashmir (1st Interim Report).
9. Evaluation and advice on the present condition of haulage rope of MaaChamunda Devi Passenger Ropeway, Dewas, M.P.

ELECTRICAL MAINTENANCE ACTIVITIES

Wire Rope and Electrical Engineering being only research group with a service division, Electrical Maintenance Section is engaged in support service for uninterrupted and quality power supply for scientific activities of the office and residential area, in addition to regular electrical maintenance activities at CIMFR estate. The department hosts a complete 11 KV distribution system within the campus combined with 600 KVA, 400 KVA & 380 KVA capacities Diesel Generator backup with 400 KVA being the latest addition especially for operation of high end research facilitates with uninterrupted supply. Essential modifications are made from time to time as & when required to upgrade the existing facilities to accommodate new research and scientific facilities.

As a CSIR-MNRE project, a 340 kWp rooftop solar panel Renewable Energy system was also installed and commissioned in November 2019 and integrated with existing system in August 2020 at CSIR-CIMFR, Barwa Road Campus. In all, 1064 Solar panel modules are installed each with 325 Wp 36V, 72 cell SPV module, dimension 190 mm x 990mm x 42 mm on five different buildings within the campus to harness the solar energy, with efficiency of 16.75%. Till date, 118.76 MWh unit energy has been generated and fed to the internal distribution system of the office. The energy generation from solar roof top plant has saved 95.01 tons of CO_2 from entering the atmosphere.

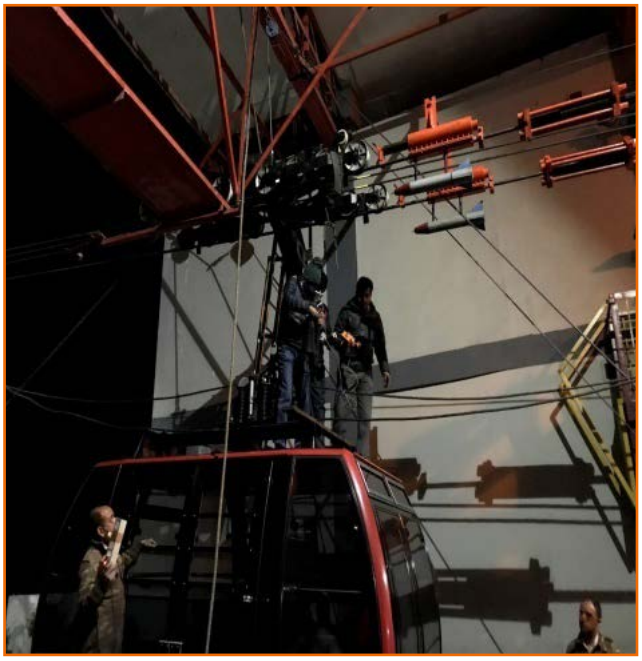
Scanning of Mine winder rope in progress at IMFA, Ltd, Jajpur, Odisha, with all safety precautions
As a part of Non-destructive study – Visual inspection in progress to observe any defect(s) on surface of steel wire rope at Dewas, M.P.

Haulage rope scanning of Shri Mata Vaishno Devi, Katra, J&K

A view of ropeway terminal during visual inspection over the hill at Darjeeling, WB

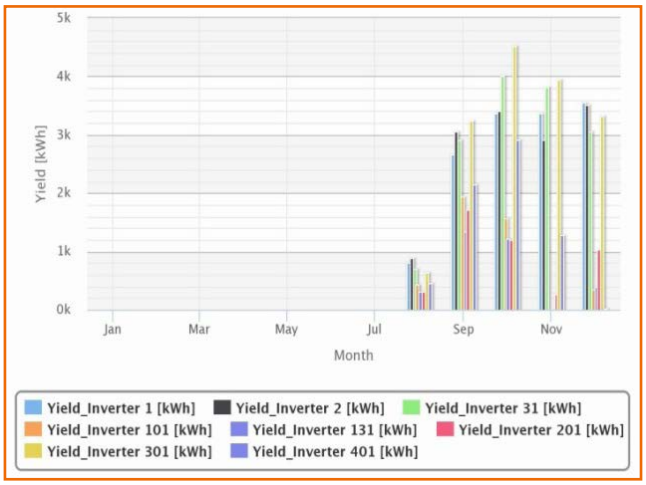
Installed Wire Rope Tester on track ropes of Cable car ropeway at Guwahati, Assam

Experienced Technical staff while installing Wire Rope Tester on various sites (Left: Maihar, M.P.; Right: Darjeeling, W.B.) and holding instrument steady while scanning

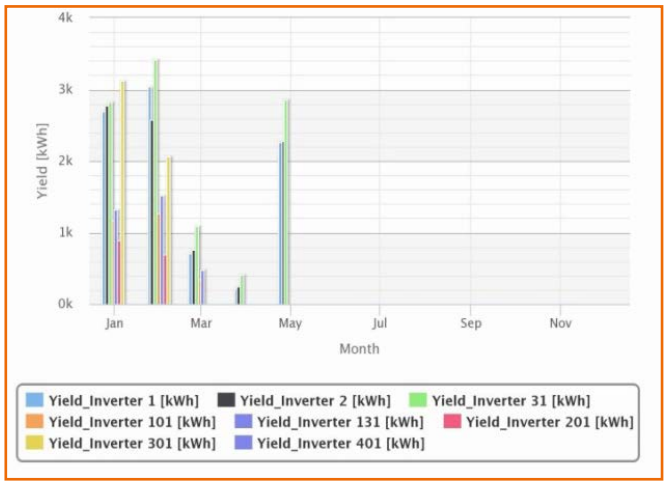


Onsite Non-destructive study of haulage rope at M/s Timber Trail Pvt. Ltd, Parwanoo, H.P. – Carried out after working hours to avoid shutdown and economical loss to business

Rooftop Solar panel array of KWp installed at Main Building, CSIR-CIMFR, Barwa Road, Dhanbad



Yield of Solar roof top PV plant in KWh during August 2020 to December 2020



Yield of Solar roof top PV plant in KWh during January 2021 to May 2021

B - INFRASTRUCTURE AND TECHNICAL SERVICES

13. A. PROJECT PLANNING & INDUSTRY INTERFACE DIVISION

The following events were organized by PP&II Division during 2020-21:

1. **National Technology Day** was celebrated at CSIR-Central Institute of Mining and Fuel Research, Dhanbad on 11.05.2020 and Ms. Pallabi Das, Scientist, CSIR-CIMFR delivered a lecture on "Sustainable Water Treatment Technology: Innovation to Mitigate the Challenges". It was attended by all Scientists of CSIR-CIMFR, Dhanbad through MS Team during COVID 19.
2. **World Environment Day function** was celebrated at CSIR-Central Institute of Mining and Fuel Research, Dhanbad on 05.06.2020 and plantation work was carried out in Newly constructed CIMFR Health Centre campus in CSIR-CIMFR Colony.
3. **Padma Bhushan Dr. V. K. Saraswat, Member, Niti Aayog, Govt of India** was Chief Guest of 79th CSIR Foundation Day celebration held in CSIR-CIMFR Dhanbad virtually. He delivered foundation Day lecture on "A low carbon energy transition strategy for making India Atmanirbhar" through VC on 30.09.2020.
4. **CSIR-CIMFR Platinum Jubilee Foundation day Celebration function** held on 17.11.2020 in **CSIR-CIMFR Dhanbad. Dr. Harshvardhan, Hon'ble Minister of Science & Technology, Earth Sciences and Health & Family Welfare and Vice President CSIR** was the Chief Guest. **Padma Bhushan Dr. V. K. Saraswat, Hon'ble Member, NITI Aayog, New Delhi** was the Guest of Honour in the function and **Dr. Shekhar C. Mande, Director General CSIR and Secretary DSIR, New Delhi** was presided over the function through VC. Dr. V. K. Saraswat delivered Guest of Honour lecture on "Technology transformation for sustainability, where we are —– Where we are heading through Video Conferencing.
5. **National Science Day** was celebrated on 28.02.2021 at CSIR-Central Institute of Mining and Fuel Research, Dhanbad and **Prof. Anil Kumar Gupta, Professor & Head, Centre for Oceans, Rivers, Atmosphere and Land Sciences, Indian Institute of Technology, Kharagpur delivered lecture as Chief Guest on** "Evolution of the Indian Monsoon since its Neogene".

13.B. HRD, SKILL DEVELOPMENT & JIGYASA

1. During the said period following Executive Development Programmes / Skill Development Programme were conducted by HRD, CSIR-CIMFR, Dhanbad for knowledge dissemination

Sl. No.	Name of Course	Duration	Participating Organisation
1.	Skill Development Programme on "Analytical Chemistry and its Application in soil and water Analysis"	23.03.2021 to 27.03.2021	Students from different Universities i.e BBMKU, SSLNT Mahila College, A.N College etc.
2.	Online Executive Development Programme on "FLP Equipment"	22.03.2021 to 26.03.2021	Middle Level Management Executives of ONGC
3.	Workshop on "Concepts of coal Sampling Techniques	16.03.2021 to 17.03.2021	Delegates from various organization i.e NTPC, MPL, BRBCL etc
4.	Workshop on "Basic Concepts in coal Petrology"	18.01.2021 to 20.01.2021	Delegates from various organization i.e NTPC, CIL,IIT BHU etc.
5.	Training Programme on "Mushroom Cultivation and Consumption"	17.01.2021 to 22.01.2021	Farmers from local village area, Dhanbad
6.	" Training Programme on "Mushroom Cultivation and Consumption	28.10.2020 to 03.11.2020	Farmers from local village area, Dhanbad

2. IN-House Training arranged.

Sl. No.	Name of Course	Duration	Medium	No. of Participants
1.	Two days Awareness programme on ISO17025:2017	07th and 8th December, 2020	Through Ms-Team (Online)	
2.	Four days internal auditor training programme on ISO 17025:2017	14th and 17th December, 2020 (On-site)		
3.	Training programme on AutoCAD 2D & 3D (On-Going)	23rd Feb to 3rd March, 2021	CSIR-CIMFR	18
4.	French language learning classes	01.09.2020 to 24.12.2020	Through Ms-Team (Online)	29

3. Organised One day Workshop on "Understanding Purchase Procedure as per CSIR Manual on Procurement of Goods – 2019", dated 08.06.2020- 22 participants.

4. Organised One day Workshop on "Self-Reliant India: Science and Technology" on 29th Jnauary, 2021 was organized at CSIR-CIMFR, Dhanbad.

5. Vocational/Project Training for PG & UG Engineering and science students were arranged according to their academic session. **36** PG Science/Engineering and **111** UG Science / Engineering a total of **147** students of different streams like Computer Science, EEE, Mechanical Engineering, Applied Chemistry, etc. were benefited from the vocational / project training during the said period. Students from different colleges / universities namely IIT (ISM) Dhanbad, BIT Sindri, BHU, IIT, NIT, UPES (Dehradun) V.B.U. Hazaribag, RGPV Bhopal, etc. come to get their project training / internship as their academic requirement.

6. Organised SRTP (CSIR-Summer Research Training Programme) – No of participants **(12).**

7. Organised JIGYASA – ATL-Jigyasa Webinar series (Determination of Strength & elastic Properties of Rock Sample) under . JIGYASA Programme (31.08.2020)

8. Facilitated **182** S&T CSIR-CIMFR personnel to attend Seminar, Symposium at national and international platform as a part of knowledge sharing and knowledge management including seminar/symposium.

National Workshop on “Basic Concepts in Coal Petrology”

National Workshop on “Concepts of coal Sampling Techniques”

Online Executive Development Programme on “FLP Equipment”

Training Programme on “Mushroom Cultivation and Consumption”

Online French Class

Up- Skilling Training Programme on AutoCAD

13.C. KNOWLEDGE DISSEMINATION CENTRE

13. C.1. SCIENCE COMMUNICATION & PUBLICATION

Annual Report: Reports on all the R&D activities and supporting services as also other technical as well as financial information of the institute for the year 2019- 20 were collected, compiled, edited and published in the form of CSIR-CIMFR Annual Report for distribution to the policy makers of the country, higher ranks of the mining and fuel sectors and academic as well as research institutes of India and abroad.

Technical Notes and Write-ups: Technical notes and write-ups on various R&D work and other important activities were prepared and issued to different organizations and individuals when asked for.

CSIR Annual Report: A report covering the summary of the major accomplishments of CSIR-CIMFR in R&D work during 2019- 20 was prepared and sent to CSIR for inclusion in CSIR annual report.

Display Advertisements: A good number of display advertisements were prepared and released during the year to keep up good images of the institute.

Distribution of Publications: Regular as well as special publications were distributed among the people and organizations connected with mining, fuel and allied industries of India and abroad.

Mailing List: The mailing list covering the addresses of different organizations as well as distinguished persons connected with mining, fuel and allied industries in India and abroad was updated regularly for distribution of publications and selection of experts as well as referees.

CSIR-CIMFR Project & Work Record Book: CSIR-CIMFR Project &work record book for the year 2021 was published and distributed amongst scientists, officers and other staff members of the institute.

13.C. 2. KNOWLEDGE DISSEMINATION CENTRE

CIMFR KDC is actively engages in acquision technical processing and updating the collection and providing a platform for E- access of information sources to expand the horizon of information base to the scientific community.

KDC (library) is also playing a coordinating role between users and the literature, providing personal information service through current Awareness (CAS) and Selective Dissemination of Information (SDI) using modern information technology.

Besides the day-to-day circulation, reference and reprographic service, KDC is also rendering the following service Documentation, List of latest addition, Bibliographic service, OPAC search, CD-ROM search, In-house database, Internet Facility and Access to E-Journals.

As per the instructions of the official language implementation, KDC has been developing a variety of collection in Hindi language.

Institutional Repository (IR) has been established using open source software with an aim to provide online access to CSIR-CIMFR research articles. Users have also been guided to maximize utilization of E-Resources.

KOHA library management software has been successfully installed and Union catalogue of CSIR (KNOWGATE) was implemented. The total collection of KDC was bar-coded and EM security system was also implemented at KDC

Books Reports, Standards, Specification and Bound volumes 34071

13.D. PROJECT PLANNING, MONITORING & E-SERVICES

Project Planning & Monitoring cell acts as a bridge between the Project Leaders and the Sponsoring Agencies on one hand and facilitator between Scientists, Director, and different wings of administration including accounts on the other hand.

The Main Activities:

- Acts as Repository of the project related documents such as Project Proposals, Fund receipts and Project Completion Reports.
- Coordination of all externally funded projects.
- Help in review meeting to Project Leaders and Project Coordinators of CSIR-CIMFR Plan projects.
- Maintenance of project related database.
- Convening review meeting of In-house projects.
- Preparation of annual budget in consultation with the scientists.
- Coordination of IT facilities to the staff members of CSIR-CIMFR.

External Cash Flow (ECF)

CSIR-CIMFR, Dhanbad received external cash flow of Rs.883.91Crore in the financial year 2020-21, of which Public Sector Rs. 741.57Crore, Private Sector Rs. 137.45 Crore, Government fund is Rs.4.67 Crore and Foreign agencies 0.22 Crore as depicted in Fig.1.

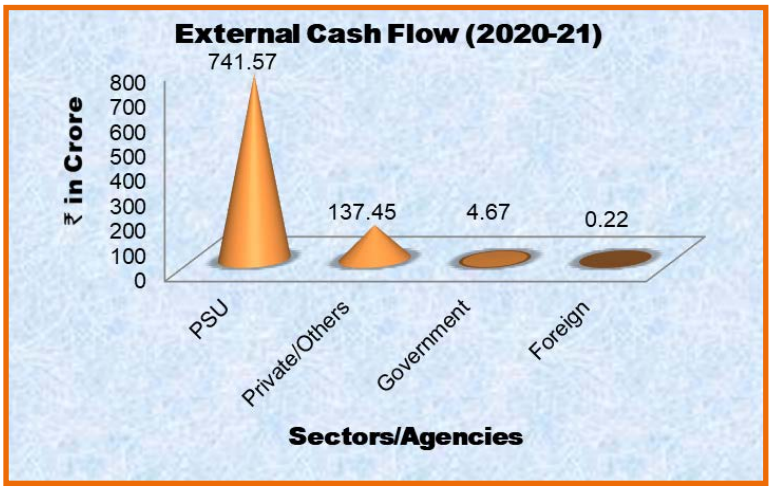


Fig. 1: External Cash Flow for 2020-21

Performance of the institute in terms of external cash flow generated in the last six financial years is compared with that of last four years as shown in Fig.2.

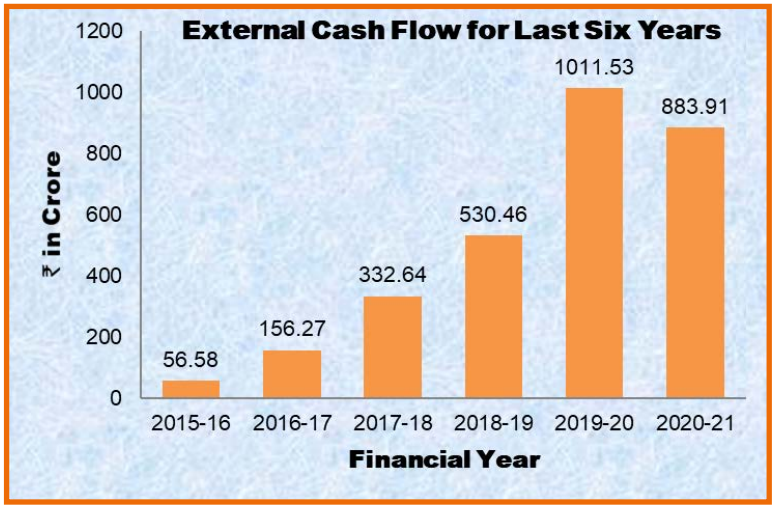


Fig. 2: External Cash Flow for last Six years

13.E. STANDARDS, TECHNOLOGY MANAGEMENT & INTERNATIONAL S&T AFFAIRS DIVISION

A ON ISO 9001:2015 Certification Program:

External Audit successfully completed as per ISO 9001:2015 during 8-10 February' 2021 at CSIR-CIMFR Barwa Road Campus, Digwadih campus, Ranchi unit, Bilaspur Unit and Nagpur unit by TUV NORD Germany/ India. The certification is valid upto 29.12.2021. One round of Internal Audit were also conducted. For the close monitoring & review of Quality Management System, Management Review meeting were held. Revision of Departmental Quality Manuals and Apex Quality Manual were completed. Calibrations done for the testing & measuring equipments/ instruments.

B. On ISO 17025:2017 NABL Accreditation Program:

For the Scientists & Technical Officers of three departments viz. Natural Resources & Environment Management, Material Characterisation and Rock Mechanics Laboratory two types of training programs were organized.

(i) Two Days Awareness Training Program on ISO 17025:2017 Standard held during 7–8 Dec' 2020 at CIMFR, Dhanbad.

(ii) Four Days Training Program on ISO 17025:2017 Standard Cum Internal Auditing held during 11- 14th January' 2021 at CIMFR, Dhanbad.

C. International S&T Affairs: Due to COVID-19 Pandemic prevailing in India and abroad no foreign visit of Scientists & Officers took place during 2020-21.

D. Technology Transferred during 2020-21:

Sl. No.	Title	Client	Amount (₹)	Type
1.	Dust Suppression Chemical	Syntron Industries Pvt. Ltd., Ahmedabad, Gujarat	₹ 5,00,000=00	Royalty
2.	Emulsion explosive Emulcoal-100, Emulcoal-300	M/s. IDL Explosives Limited, Kukatpally, Post Bag No. 1, Santhnagar (IE), P.O: Hyderabad	₹ 3,83,478=00	Royalty
3.	Biometric Based Exploder	M/s. Pranay Enterprises, Plot No. 105, Behind Bharat Electronics Limited, IDA Mallapur, Hyderabad	₹ 6,19,500=00	Lumpsum Premium
4.	Dust Suppression Chemical	Syntron Industries Pvt. Ltd., Ahmedabad, Gujarat	₹ 2,00,000=00	Royalty
5.	Dust Suppression Chemical	Syntron Industries Pvt. Ltd., Ahmedabad, Gujarat	₹ 50,000=00	Royalty
6.	Dry Fog Dust Suppression System for Crushing, Screening and Loading Plants & Mining Areas	M/s. Control System & Solutions, 28/2F, Nakuleswar Bhattacharjee Lane, Kolkata – 700 026	₹ 50,000=00 (1st Part Payment due to COVID-19)	First Royalty (Part payment)
7.	Improved Soft Coke Making Technology	Shardapunj Fuel Coke Pvt. Ltd., 1st Floor, Rishi Complex, Mughalsarai, Chandauli – 232 101, U.P	₹ 9,44,000=00 Including GST	Lumpsum Premium
8.	Improved Soft Coke Making Technology	M/s. Kahkasha Enterprises, Near Union Bank of India, Pilawal Road, Millat Colony, Hazaribag - 825301	₹ 9,44,000=00 Including GST	Lumpsum Premium
9.	Contactless Auto UV Disinfect Unit or Chamber for Touch Screens, Thumb or Finger Scanners and Keypads of Biometric Identification Devices and Other Devices or Systems	M/s Ashta Tech Automation Pvt. Ltd., Vimal Paints, Plot no. C-18/4, MIDC Hingna Industrial Estate, Wadi, Nagpur	₹ 1,47,500=00 Including GST (50% Payment - 1st Installment)	Lumpsum Premium
10.	Dry Fog Dust Suppression System for Crushing, Screening and Loading Plants & Mining Areas	M/s. Control System & Solutions, 28/2F, Nakuleswar Bhattacharjee Lane, Kolkata – 700 026	₹ 1,10,000=00 (2nd Part Payment due to COVID-19)	First Royalty (Part payment)
11.	Improved Soft Coke Making Technology	M/s. Ganpati Enterprises, P.O: Bhagwanpur, Kaimur, Bhabua, Pin- 821 102, Bihar	₹ 9,44,000=00 Including GST	Lumpsum Premium
		Sub Total (A):	₹ 48,92,478=00	

Technology Transferred during 2020-21 (Continued):

Sl. No.	Title	Client	Amount ()	Type
1.	Digital Mine Using Internet of Things	M/s Knowledge Lens Pvt. Ltd., Bengaluru	₹17,70,000=00 Including GST	Lumpsum Premium
2.	Digital Mine Using Internet of Things	M/s Coresonant Systems Private Limited, Secunderabad	₹17,70,000=00 Including GST	Lumpsum Premium
3.	Fragalyst 6.0 Software	MineExcellence Pty Ltd., 34 Gleeson Drive, Bundoora, Victoria, Australia - 3083	₹1,18,000=00 Including GST	Lumpsum Premium
4.	Digital Mine Using Internet of Things	M/s. Optimized Solutions Limited, B- 505, The First, B/h. Keshav Baug Party Plot, Vastrapur, Ahmedabad – 380 015	₹17,70,000=00 Including GST	Lumpsum Premium
5.	Gramin E- Bazar Software	M/s. Edgeforce Solutions Pvt. Ltd., Desk B-08, Vindhya C-5, CIE, IIIT Hyderabad Campus, Survey No. 25, Gachibowli, Hyderabad	₹5,90,000=00 Including GST	Lumpsum Premium
6.	Contactless Auto UV Disinfect Unit or Chamber for Touch Screens, Thumb or Finger Scanners and Keypads of Biometric Identification Devices and Other Devices or Systems	M/s Ashta Tech Automation Pvt. Ltd., Vimal Paints, Plot no. C-18/4, MIDC Hingna Industrial Estate, Wadi, Nagpur	₹1,47,500=00 Including GST (Full & Final Payment – 2nd Installment)	Lumpsum Premium
Sub Total (B):			₹61,65,500=00	
Grand Total (A+B):			₹1,10,57,978=00	

Total External Cash Flow (ECF) generated during the year 2020-21 in the form of Premia and Royalty was 1,10,57,978=00 (Rupees One Crore Ten Lakhs Fifty Seven Thousand Nine Hundred and Seventy Eight Only).

E. Agreements/ MoU's signed:

Sl. No	Title of the Agreement	Party Name and Address	Date
1	Contract Agreement for Hiring of Service Provider for Loading and Unloading of Coal samples	COTECNA Inspection India Private Limited, Mumbai	22/05/2020
2	Tripartite Agreement between Northern Coalfields Limited; Nabha Power Limited and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Northern Coalfields Limited (NCL), At + PO – Singrauli, M. P. – 486 889 and M/s Nabha Power Limited, P.O Box No.-28, Near Village Nalash, Rajpura, Dist.: Patiala, Punjab	22.06.2020
3	Collaborative Agreement for Industrial Collaboration to Up-scale the process for extraction of Potassium from Ash	M/s. EID Parry (India) Limited, 3rd Floor, No. 234 Dare House, N.S.C Bose Road, Chennai	23/06/2020
4	Licensing of Knowhow of Biometric Based Exploder	M/s. Pranay Enterprises, Plot No. 105, Behind Bharat Electronics Limited, IDA Mallapur, Hyderabad	22/06/2020
5	Tripartite Agreement between Northern Coalfields Limited; NTPC Limited and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Northern Coalfields Limited (NCL), At + PO – Singrauli, M. P. – 486 889 and NTPC Limited, NTPC Bhawan, Scope Complex, 7, Institutional Area, Lodi Road, New Delhi	03.07.2020

Sl. No	Title of the Agreement	Party Name and Address	Date
6	Tripartite Agreement between Bharat Coking Coal Limited; Koyla Bhawan Nagar, P.O: Dhanbad – 826 005; M/s. Talwandi Sabo Power Limited, Mansa, Panjab and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Bharat Coking Coal Limited; Koyla Bhawan Nagar, P.O: Dhanbad – 826 005 and M/s. Talwandi Sabo Power Limited, Banawala, Mansa- Talwandi Sabo Road, Dist.: Mansa, Punjab – 151 302	09.07.2020
7	Tripartite Agreement between Eastern Coalfields Limited; Nabha Power Limited and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Eastern Coalfields Limited, Sanctoria, P.O: Dishergarh, Burdwan, West Bengal and M/s Nabha Power Limited, P.O Box No.-28, Near Village Nalash, Rajpura, Dist.: Patiala, Punjab	10.07.2020
8	Confidentiality Agreement bet' CSIR-CIMFR, Dhanbad and Tata Steel Limited, Jamshedpur	Tata Steel Limited, Jamshedpur, Dist.:Singhbhum(East), harkhand	13.07.2020
9	Tripartite Agreement between Bharat Coking Coal Limited; Nabha Power Limited and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Bharat Coking Coal Limited Koyla Bhawan, Koyla Nagar, Dhanbad – 826 005 and M/s Nabha Power Limited, P.O Box No.-28, Nalash, Rajpura, Dist.: Patiala, Punjab	14.07.2020
10	Tripartite Agreement between Central Coalfields Limited; Nabha Power Limited and CSIR-CIMFR, Dhanbad for Coal Sampling Work	CSIR-CIMFR, Dhanbad and Central Coalfields Limited, Darbhanga House, Ranchi-834 029 and M/s Nabha Power Limited, Near Village Nalash, Rajpura, Dist.: Patiala, Punjab – 140 401	15.07.2020
11	Agreement for Know How Transfer of Improved Soft Coke Making a CSIR-CIMFR Technology	Shardapunj Fuel Coke Pvt. Ltd., 1st Floor, Rishi Complex, Mughalsarai, Chandauli-232 101, U.P	15.07.2020
12	Tripartite Agreement between Eastern Coalfields Limited; NTPC Limited and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Eastern Coalfields Limited, Sanctoria, P.O: Dishergarh, Paschim Burdwan, West Bengal –713 333 and NTPC Limited, NTPC Bhawan, Scope Complex, 7, Institutional Area, Lodi Road, New Delhi	17.07.2020
13	Agreement for Know How Transfer of Improved Soft Coke Making CSIR-CIMFR Technology	Kahkasha Enterprises, Near Union Bank of India, Pilawal Road, Millat Colony, Hazaribag - 825301	27.07.2020
14	Contactless Auto UV Disinfect Unit or Chamber for Touch Screens, Thumb or Finger Scanners and Keypads of Biometric Identification Devices and Other Devices or Systems	M/s Ashta Tech Automation Pvt. Ltd., Vimal Paints, Plot no. C-18/4, MIDC Hingna Industrial Estate, Wadi, Nagpur	29.07.2020
15	Tripartite Agreement between Eastern Coalfields Limited; Maithon Power Limited and CSIR-CIMFR, Dhanbad for Coal Sampling Work	CSIR-CIMFR, Dhanbad and Eastern Coalfields Limited, Sanctoria, P.O: Dishergarh, Paschim Burdwan, West Benga l– 713 333 and Maithon Power Limited, Sant Tukaram Road, Camac Bunder, Mumbai-400 009	13.08.2020
16	Tripartite Agreement between Northern Coalfields Limited; M/s. Talwandi Sabo Power Limited and CSIR-CIMFR, Dhanbad for Coal Sampling Work	CSIR-CIMFR, Dhanbad and Northern Coalfields Limited (NCL), At + PO – Singrauli, M. P. and M/s. Talwandi Sabo Power Limited, Village Banawala, Mansa-Talwandi Sabo Road, Mansa, Punjab	17.08.2020

Sl. No	Title of the Agreement	Party Name and Address	Date
17	Tripartite Agreement between Central Coalfields Limited; Nabha Power Limited and CSIR-CIMFR, Dhanbad for Coal Sampling Work	CSIR-CIMFR, Dhanbad & Central Coalfields Limited, Darbhanga House, Ranchi- 834 029 and M/s Nabha Power Limited, Near Village Nalash, Rajpura, Dist.: Patiala, Punjab – 140 401	21.08.2020
18	Tripartite Agreement between Eastern Coalfields Limited; Andhra Pradesh Power Development Company Ltd., and CSIR-CIMFR, Dhanbad for Coal Sampling Work	CSIR-CIMFR, Dhanbad and Eastern Coalfields Limited, Sanctoria, P.O: Dishergarh, Paschim Burdwan, West Bengal – 713333 and Andhra Pradesh Power Development Company Ltd., Andhra Loyola College Road, Vijayawada – 520 008	25.08.2020
19	Tripartite Agreement between Western Coalfields Limited; GMR, Warora Energy Limited and CSIR-CIMFR, Dhanbad for Coal Sampling Work	CSIR-CIMFR, Dhanbad and Western Coalfields Limited, Civil Lines, Nagpur 400001 and GMR, Warora Energy Limited, Naman Centre, Bandra Kurla Complex, Bandra (East), Mumbai	27.08.2020
20	Supplementary Agreement bet' Western Coalfields Limited (WCL); NTPC Limited and CSIR-CIMFR, Dhanbad	Western Coalfields Limited, Coal Estate, Civil Lines, Nagpur-440001; NTPC Bhawan, Core-7, SCOPE Complex, 7, Institutional Area, Lodhi Road, New Delhi and CSIR-CIMFR, Dhanbad	27.08.2020
21	Supplementary Agreement bet' South Eastern Coalfields Limited (SECL); NTPC Limited and CSIR-CIMFR, Dhanbad	South Eastern Coalfields Limited, Seepal Road, Bilaspur (Chhattisgarh- 495006; NTPC Bhawan, Core-7, SCOPE Complex, 7, Institutional Area, Lodhi Road, New Delhi- 110003 and CSIR-CIMFR	19.10.2020
22	Supplementary Agreement bet' North Eastern Coalfields (NEC), Coal India Limited; NTPC Limited and CSIR-CIMFR, Dhanbad	North Eastern Coalfields, Margherita- 786181, Assam; NTPC Bhawan, Core-7, SCOPE Complex, 7, Institutional Area, Lodhi Road, New Delhi- 110003 and CSIR-CIMFR, Dhanbad	27.08.2020
23	Supplementary Agreement bet' Northern Coalfields Limited(NCL); NTPC Limited and CSIR-CIMFR, Dhanbad	Northern Coalfields Limited, Singrauli, MP-486889; NTPC Bhawan, Core-7, SCOPE Complex, 7, Institutional Area, Lodhi Road, New Delhi- 110003 and CSIR-CIMFR, Dhanbad	27.08.2020
24	Supplementary Agreement bet' Mahanadi Coalfields Limited(MCL); NTPC Limited and CSIR-CIMFR, Dhanbad	Mahanadi Coalfields Limited, Sambalpur-768020,Orissa; NTPC Bhawan, Core-7, SCOPE Complex, 7, Institutional Area, Lodhi Road, New Delhi- 110003 and CSIR-CIMFR, Dhanbad	19.10.2020
25	Supplementary Agreement bet' Eastern Coalfields Limited(ECL); NTPC Limited and CSIR-CIMFR, Dhanbad	Eastern Coalfields Limited, Sanctoria, PO. Dishergarh, Burdwan; NTPC Bhawan, Core-7, SCOPE Complex, 7, Institutional Area, Lodhi Road, New Delhi- 110003 and CSIR-CIMFR, Dhanbad	27.08.2020
26	Supplementary Agreement bet' Central Coalfields Limited(CCL); NTPC Limited and CSIR-CIMFR, Dhanbad	Central Coalfields Limited, Darbhanga House, Kutchery Road, Ranchi- 834029, Jharkhand; NTPC Bhawan, Core-7, SCOPE Complex, 7, Institutional Area, Lodhi Road, New Delhi- 110003 and CSIR-CIMFR, Dhanbad	27.08.2020
27	Supplementary Agreement bet' Bharat Coking Coal Limited(BCCL); NTPC Limited and CSIR-CIMFR, Dhanbad	Bharat Coking Coal Limited, Koyla Bhawan, Koyla Nagar, Dhanbad- 826005; NTPC Bhawan, Core-7, SCOPE Complex, 7, Institutional Area, Lodhi Road, New Delhi- 110003 and CSIR-CIMFR	05.09.2020

Sl. No	Title of the Agreement	Party Name and Address	Date
28	Tripartite Agreement between Eastern Coalfields Limited (ECL); M/s. Talwandi Sabo Power Limited, Mansa, Panjab and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Eastern Coalfields Limited, Sanctoria, PO. Dishergarh, Burdwan 713333 West Bengal and M/s. Talwandi Sabo Power Limited, Banawala, Mansa-Talwandi Sabo Road, Dist.: Mansa, Punjab – 151 302	14.09.2020
29	Tripartite Agreement between Central Coalfields Limited; Nabha Power Limited and CSIR-CIMFR, Dhanbad for Coal Sampling Work	CSIR-CIMFR, Dhanbad and Central Coalfields Limited, Darbhanga House, Ranchi-834 029 and M/s Nabha Power Limited, Near Village Nalash, Rajpura, Dist.: Patiala, Punjab – 140 401	17.09.2020
30	Tripartite Agreement between Northern Coalfields Limited; Nabha Power Limited and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Northern Coalfields Limited (NCL), At + PO – Singrauli, M. P. – 486 889 and M/s Nabha Power Limited, P.O Box No.-28, Near Village Nalash, Rajpura, Dist.: Patiala, Punjab	18.09.2020
31	MoU between CSIR-CIMFR, Dhanbad and BBMKU, Dhanbad	Binod Bihari Mahto Koyalanchal University, Dhanbad	24.09.2020
32	Tripartite Agreement between Central Coalfields Limited; NTPC Limited and CSIR-CIMFR, Dhanbad for Coal Sampling Work	CSIR-CIMFR, Dhanbad and Central Coalfields Limited, Darbhanga House, Ranchi- 834 029 and M/s NTPC Bhawan, Core-7, SCOPE Complex, 7, Institutional Area, Lodhi Road, New Delhi- 110003	28.09.2020
33	Agreement for Know How Transfer of Improved Soft Coke Making CSIR-CIMFR Technology	M/s. Ganpati Enterprises, P.O/ P.S: Bhagwanpur, Kaimur (Bhabua), Pin: 821 102, Bihar	07.10.2020
34	Agreement bet' The Odisha Mining Corporation Limited, Bhubaneswar and CSIR-CIMFR, Dhanbad	The Odisha Mining Corporation Limited, OMC House, Bhubaneswar - 751001	22.10.2020
35	Tripartite Agreement between Eastern Coalfields Limited (ECL); M/s. Andhra Pradesh Power Development Com. Ltd., Vijayawada and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Eastern Coalfields Limited, Sanctoria, PO. Dishergarh, Burdwan 713333 West Bengal and M/s. Andhra Pradesh Power Development Com. Ltd., Vijayawada	23.10.2020
36	Tripartite Agreement between Eastern Coalfields Limited (ECL); M/s. Talwandi Sabo Power Limited, Mansa, Panjab and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Eastern Coalfields Limited, Sanctoria, PO. Dishergarh, Burdwan and M/s. Talwandi Sabo Power Limited, Banawala, Mansa- Talwandi Sabo Road, Dist.: Mansa, Punjab	27.10.2020
37	Tripartite Agreement between Northern Coalfields Limited; Nabha Power Limited and CSIR-CIMFR, Dhanbad for Coal Sampling Work	CSIR-CIMFR, Dhanbad and Northern Coalfields Limited (NCL), At + PO – Singrauli, M. P. and M/s Nabha Power Limited, Near Village Nalash, Rajpura, Dist.: Patiala, Punjab – 140 401	27.10.2020
38	Tripartite Agreement between Eastern Coalfields Limited; Nabha Power Limited and CSIR-CIMFR, Dhanbad for Coal Sampling Work	CSIR-CIMFR, Dhanbad and Eastern Coalfields Limited, Sanctoria, PO. Dishergarh, Burdwan 713333 West Bengal and M/s Nabha Power Limited, Rajpura, Dist.: Patiala, Punjab – 140 401	03.11.2020
39	Bilateral Agreement between CSIR-CIMFR, Dhanbad and Maithon Power Limited	Maithon Power Limited, Corporate Centre, B, 34, Sant Tukaram Road, Camac Bunder, Mumbai – 400 009	17.11.2020

Sl. No	Title of the Agreement	Party Name and Address	Date
40	Amendment in the original Tripartite Agreement between Western Coalfields Limited, Nagpur; NTPC Limited, New Delhi and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Western Coalfields Limited, Civil Lines, Nagpur 400001 and NTPC Bhawan, Core-7, SCOPE Complex, 7, Institutional Area, Lodhi Road, New Delhi- 110003 and CSIR-CIMFR, Dhanbad	17.11.2020
41	Digital Mine Using Internet of Things	CSIR-CIMFR, Dhanbad and M/s Knowledge Lens Pvt. Ltd., H115 Concorde Silicon Valley, Next to Wipro Gate 16, Bengaluru – 560 100, Karnataka	17.11.2020
42	Digital Mine Using Internet of Things	CSIR-CIMFR, Dhanbad and M/s Coresonant Systems Private Limited, H. No.. 1-1-130 to 144/303, 3rd Floor, Navaketan Complex, 62, S.D. Road, Opp: Clock Tower, Secunderabad	17.11.2020
43	Development of latest techniques for application of Geo-Synthetic Concrete Cement Mat (GCCM) for Indian geo-mining conditions and other areas	CSIR-CIMFR, Dhanbad and M/s Sanbros Spares Private Limited, Block No.101 & 102, 1st Floor, Hansraj Habitats, Resi- Phase 1, 27, Great Nag Road, Nagpur – 440 009, Maharashtra, India	17.11.2020
44	Agreement for use of CIMFR facility "Electrical Resistivity Imaging Survey (**ERI**) System" for coal exploration at Bilashpur, Chattisgarh	CSIR-CIMFR, Dhanbad and M/s. AKD Geomining solutions (OPC) Private Limited, Mahananda Apartment, Lake Avenue, Kanke Road, Ranchi, Jharkhand,	17.11.2020
45	Tripartite Agreement between Central Coalfields Limited; NTPC Limited; Nabinagar Power Generating Company, Aurangabad, Bihar and CSIR-CIMFR, Dhanbad for Coal Sampling Work	CSIR-CIMFR, Dhanbad and Central Coalfields Limited, Darbhanga House, Ranchi-834 029 and M/s NTPC Bhawan, Core-7, SCOPE Complex, 7, Institutional Area, Lodhi Road, New Delhi- 110003	17.11.2020
46	Tripartite Agreement between Eastern Coalfields Limited (ECL); M/s. Talwandi Sabo Power Limited, Mansa, Panjab and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Eastern Coalfields Limited, Sanctoria, PO. Dishergarh, Burdwan 713333 West Bengal and M/s. Talwandi Sabo Power Limited, Banawala, Mansa-Talwandi Sabo Road, Dist.: Mansa, Punjab – 151 302	24.11.2020
47	Agreement for Advice on Controlled Blast Design for Excavation of Rock at BRO Road Construction Sites	CSIR-CIMFR, Dhanbad and Border Roads Organisation (BRO), Ministry of Defence, Seema Sadak Bhawan, Ring Road, Delhi Cantt. New Delhi-110 010	25.11.2020
48	Tripartite Agreement between Northern Coalfields Limited; Nabha Power Limited and CSIR-CIMFR, Dhanbad for Coal Sampling Work	CSIR-CIMFR, Dhanbad and Northern Coalfields Limited (NCL), At + PO – Singrauli, M. P. and M/s Nabha Power Limited, Near Village Nalash, Rajpura, Dist.: Patiala, Punjab – 140 401	27.11.2020
49	Tripartite Agreement between Northern Coalfields Limited (NCL); M/s. Talwandi Sabo Power Limited, Mansa, Panjab and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Northern Coalfields Limited (NCL), At + PO – Singrauli, M. P. and M/s. Talwandi Sabo Power Limited, Banawala, Mansa- Talwandi Sabo Road, Dist.: Mansa, Punjab – 151 302	30.11.2020

Sl. No	Title of the Agreement	Party Name and Address	Date
50	Tripartite Agreement between Eastern Coalfields Limited (ECL); M/s. Andhra Pradesh Power Development Com. Ltd., Vijayawada and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Eastern Coalfields Limited, Sanctoria, PO. Dishergarh, Burdwan 713333 West Bengal and M/s. Andhra Pradesh Power Development Com. Ltd., Vijayawada	04.12.2020
51	Tripartite Agreement between South Eastern Coalfields Limited (SECL); M/s. Jindal Power Limited, Raigarh and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and South Eastern Coalfields Limited (SECL), SECL Bhawan, Seepat Road, Bilaspur, Chhattisgarh and M/s. Jindal Power Limited, O.P Jindal Super Thermal Power Plant, Tamnar, Raigarh, Chhattisgarh	11.12.2020
52	Tripartite Agreement between Eastern Coalfields Limited; Nabha Power Limited and CSIR-CIMFR, Dhanbad for Coal Sampling Work	CSIR-CIMFR, Dhanbad and Eastern Coalfields Limited, Sanctoria, PO. Dishergarh, Burdwan 713333 West Bengal and M/s Nabha Power Limited, Near Village Nalash, Rajpura, Dist.: Patiala, Punjab – 140 401	17.12.2020
53	Agreement for Technology Transfer of Heat Recovery Type Non-Recovery Coke Oven	M/s. Tuaman Engineering Ltd., Fortuna Tower, 23A, 8th Floor, Room No. 16, N.S. Road, B.B.D Bag, Kolkata – 700 001	24.12.2020
54	Tripartite Agreement between Central Coalfields Limited; Nabha Power Limited and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Central Coalfields Limited, Darbhanga House, Ranchi- 834 029 and M/s Nabha Power Limited, P.O Box No.-28, Near Village Nalash, Rajpura, Dist.: Patiala, Punjab	26.12.2020
55	Tripartite Agreement between Eastern Coalfields Limited; Nabha Power Limited and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Eastern Coalfields Limited, Sanctoria, P.O: Dishergarh, Burdwan, West Bengal and M/s Nabha Power Limited, P.O Box No.-28, Near Village Nalash, Rajpura, Dist.: Patiala, Punjab	28.12.2020
56	Bilateral Agreement between CSIR-CIMFR, Dhanbad and NTPC Limited, New Delhi	CSIR-CIMFR, Dhanbad and NTPC Limited, NTPC Bhawan, Core -7, Score Complex, 7 Institutional Area, Lodi Road, New Delhi – 110 003	28.12.2020
57	Agreement for Collaborative Research for the development & upgradation of Fragalyst 6.0 Software	Wavelet Technologies Private Limited, Amchi Colony, N.D.A Road, Bawdhan, Pune	29.12.2020
58	Tripartite Agreement between South Eastern Coalfields Limited (SECL); M/s. Jindal Power Limited, Raigarh and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and South Eastern Coalfields Limited (SECL), SECL Bhawan, Seepat Road, Bilaspur, Chhattisgarh and M/s. Jindal Power Limited, O.P Jindal Super Thermal Power Plant, Tamnar, Raigarh, Chhattisgarh	04.01.2021
59	Tripartite Agreement between Eastern Coalfields Limited (ECL); M/s. Andhra Pradesh Power Development Com. Ltd., Vijayawada and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Eastern Coalfields Limited, Sanctoria, PO. Dishergarh, Burdwan 713333 West Bengal and M/s. Andhra Pradesh Power Development Com. Ltd., Vijayawada	11.01.2021
60	Digital Mine Using Internet of Things	M/s. Optimized Solutions Limited, 310, ATMA House, Opp. Old RBI, Ashram Road, Ahmedabad – 380 009, Gujarat	18.01.2021

Sl. No	Title of the Agreement	Party Name and Address	Date
61	Gramin E-Bazar Software	M/s. Edgeforce Solutions Pvt. Ltd., Desk B-08, Vindhya C-5, CIE, IIIT Hyderabad Campus, Survey No. 25, Gachibowli, Hyderabad – 500 032	18.01.2021
62	MoU between CSIR-CIMFR, Dhanbad and Ranchi University, Ranchi	University Department of Geology, Ranchi University, Ranchi – 834 008 , Jharkhand	18.01.2021
63	Tripartite Agreement between Eastern Coalfields Limited (ECL); M/s. Talwandi Sabo Power Limited, Mansa, Panjab and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Eastern Coalfields Limited (ECL), Sanctoria, PO. Dishergarh, Burdwan, West Bengal and M/s. Talwandi Sabo Power Limited, Mansa- Talwandi Sabo Road, Dist.: Mansa, Punjab	20.01.2021
64	Amendment in the original Tripartite Agreement between Singareni Collieries Company Limited, Kothagudem; Telangana State Power Generation Corporation Limited and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Singareni Collieries Company Limited, Kothagudem and M/s. Telangana State Power Generation Corporation Limited, Vidyut Soudha, Somajiguda, Hyderabad and CSIR-CIMFR, Dhanbad	27.01.2021
65	Tripartite Agreement between Central Coalfields Limited; Nabha Power Limited and CSIR-CIMFR, Dhanbad for Coal Sampling Work	CSIR-CIMFR, Dhanbad and Central Coalfields Limited, Darbhanga House, Ranchi- 834 029 and M/s Nabha Power Limited, Dist.: Patiala, Punjab – 140 401	28.01.2021
66	Tripartite Agreement between Eastern Coalfields Limited; Nabha Power Limited and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Eastern Coalfields Limited, Sanctoria, P.O: Dishergarh, Burdwan, West Bengal and M/s Nabha Power Limited, P.O Box No.-28, Near Village Nalash, Rajpura, Dist.: Patiala, Punjab	29.01.2021
67	Tripartite Agreement between South Eastern Coalfields Limited (SECL); M/s. Jindal Power Limited, Raigarh and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and South Eastern Coalfields Limited (SECL), SECL Bhawan, Seepat Road, Bilaspur, Chhattisgarh and M/s. Jindal Power Limited, O.P Jindal Super Thermal Power Plant, Tamnar, Raigarh, Chhattisgarh	09.02.2021
68	Tripartite Agreement between Northern Coalfields Limited (NCL); M/s. Gujarat State Electricity Corporation Limited, Vadodra and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Northern Coalfields Limited (NCL), At + PO – Singrauli, M. P. and M/s. Gujarat State Electricity Corporation Limited, Vidyut Bhavan, Race Course, Vadodra	10.02.2021
69	Bilateral Agreement between CSIR-CIMFR, Dhanbad and NTPC Limited, New Delhi	CSIR-CIMFR, Dhanbad and NTPC Limited, NTPC Bhawan, Core -7, Score Complex, Lodi Road, New Delhi	18.02.2021
70	Tripartite Agreement between Eastern Coalfields Limited (ECL); M/s. Talwandi Sabo Power Limited, Mansa, Panjab and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Eastern Coalfields Limited, Sanctoria, PO. Dishergarh, Burdwan 713333 West Bengal and M/s. Talwandi Sabo Power Limited, Banawala, Mansa-Talwandi Sabo Road, Dist.: Mansa, Punjab – 151 302	25.02.2021
71	Tripartite Agreement between Central Coalfields Limited; M/s. Talwandi Sabo Power Limited, Mansa, Panjab and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Central Coalfields Limited, Darbhanga House, Ranchi-834 029 and M/s. Talwandi Sabo Power Limited, Banawala, Mansa- Talwandi Sabo Road, Dist.: Mansa, Punjab – 151 302	26.02.2021

Sl. No	Title of the Agreement	Party Name and Address	Date
72	Tripartite Agreement between Central Coalfields Limited; M/s. Gujarat State Electricity Corporation Limited and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Central Coalfields Limited, Darbhanga House, Ranchi- 834 029 and M/s. Gujarat State Electricity Corporation Limited, Vidyut Bhavan, Race Course, Vadodra	08.03.2021
73	Tripartite Agreement between Eastern Coalfields Limited (ECL); M/s. Talwandi Sabo Power Limited, Mansa, Panjab and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Eastern Coalfields Limited, Sanctoria, PO. Dishergarh, Burdwan 713333 West Bengal and M/s. Talwandi Sabo Power Limited, Banawala, Mansa-Talwandi Sabo Road, Dist.: Mansa, Punjab – 151 302	12.03.2021
74	Tripartite Agreement between Central Coalfields Limited; Nabha Power Limited and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Central Coalfields Limited, Darbhanga House, Ranchi- 834 029 and M/s Nabha Power Limited, P.O Box No.-28, Near Village Nalash, Rajpura, Dist.: Patiala, Punjab	19.03.2021
75	Tripartite Agreement between Central Coalfields Limited; M/s. Talwandi Sabo Power Limited, Mansa, Panjab and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Central Coalfields Limited, Darbhanga House, Ranchi-834 029 and M/s. Talwandi Sabo Power Limited, Banawala, Mansa- Talwandi Sabo Road, Dist.: Mansa, Punjab – 151 302	22.03.2021
76	Tripartite Agreement between Eastern Coalfields Limited; Nabha Power Limited and CSIR-CIMFR, Dhanbad	CSIR-CIMFR, Dhanbad and Eastern Coalfields Limited, Sanctoria, P.O: Dishergarh, Burdwan, West Bengal and M/s Nabha Power Limited, P.O Box No.-28, Near Village Nalash, Rajpura, Dist.: Patiala, Punjab	22.03.2021
77	Tripartite Agreement between Northern Coalfields Limited; Nabha Power Limited and CSIR-CIMFR, Dhanbad for Coal Sampling Work	CSIR-CIMFR, Dhanbad and Northern Coalfields Limited (NCL), At + PO – Singrauli, M. P. and M/s Nabha Power Limited, Near Village Nalash, Rajpura, Dist.: Patiala, Punjab – 140 401	25.03.2021

12.F. TESTING CELL

Testing Cell of CSIR-CIMFR, Barwa Road Campus, Dhanbad is a single window system which provides ready assistances to the manufacturers of Mining and Allied Industries in getting their different equipment/component/materials tested, evaluated, calibrated and certified. The Cell co-ordinates and monitors the testing analysis and calibration related activities of eight laboratories at present. The relevant Information's, Estimated test charges, PI/Quotations, Challan preparation manual as well as ERP, Tax Invoices and Test Certificates / Reports releases to the concerned customers for both Indigenous and Foreign make equipment/components.

The various activities of the concerned testing laboratories are covered under ISO 9001:2015 to satisfy customers need in getting systematic, transparency and quality oriented services in respect to the testing and certification of equipment/component/materials.

Testing and evaluation reports of various samples including equipment/components were issued by the cell during the period from 1st April'2020 to 31st March'2021 = 682 (six hundred and eighty two) numbers only in Total and an amount of revenue Rs.4,24, 84,393.60 (Rupees four crores twenty four lakhs eighty four thousand three hundred ninety three and paisa sixty) only was generated through the same.

C. FUEL SCIENCES

14. COAL CARBONIZATION, ENVIRONMENT EMISSION & CRM RESEARCH GROUP

Coal Carbonization

During the period 2020-21, Coal Carbonisation Section was engaged in different R&D projects, some in-house funded projects and transfer of developed technology.

R&D activity of the research group is focused on impact of coal qualities on coke making, study on blending different coals and their effect on coke property, carbonization of coal, bio-mass and other non-conventional carbonaceous raw materials, investigation for better coke making technique, designing different type of soft coke and hard coke oven for commercial coke production as well as research activity. R&D study for value addition of coal and coke fine by briquetting and pelletization is another important thrust area of this research group. The research group has pilot plants for both low and high temperature carbonization study, stamp charging facility, pilot plants for briquetting and centrifugal pelletization of coal and coke fines, facilities for thermal curing of briquette and pellet, various testing facilities like, CRI/CSR, Micum index, Shatter index, rheological properties of coal and point crushing strength for testing coal coke and briquettes.

Recently Coal Carbonisation Section has developed and established a bench scale **'Hot Stamping system of coal',** which makes coal cake of hot coke for charging in Non Recovery or By Product coke oven Plants. The developed technology has many technological advantages and is capable of accommodating inferior carbonaceous materials for the production of blast furnace grade coke. Further program has been initiated towards up scaling of bench scale developments to 250 kg per batch coke making pilot plant. Encouraging findings of bench scale studies, once validated and established at pilot scale would lead to have major breakthrough in coke making and come out handy to fulfil the objectives of **Atmanirbhar Abhiyan of Govt. of India** and also in indigenously augmenting fuel resources needed for enhanced steel production as projected in National Steel Policy 2017.

Improved Soft Coke Making Technology developed and patented by Coal Carbonisation Section has been transferred to about five MSME's in the year 2020-21. Coal Carbonisation Section has signed an agreement with M/s Tuaman Engineering Ltd., Kolkata and EPC company for transfer of Heat Recovery Type Non-Recovery Coke Ovens.

Transfer of Technology for Improved Soft Coke Making

Technology Transfer of Heat Recovery Type Non Recovery Coke Oven

Environment Emission and CRM

During the period 2020-21, Environment, Emission and CR Section was engaged in different R&D projects sponsored by DST, CSIR, ONGC, EID Parry, Chennai and also some in-house funded projects in the area of environmental management and sustainable utilization of industrial wastes.

Sustainable utilization of ash generated after combustion of biomass and spent wash is a huge challenge. Based on the success achieved during the 12 FYP project, and CSIR mission mode project for commercial deployment of potassium technology, CSIR-CIMFR has developed basic process for extraction of potassium from combustion wastes. M/S EID Parry, Chennai is interested in the technology and the process is now upscaled at industrial site in collaboration with EID Parry, Chennai.

A mission mode project was implemented with the aimed to explore lithium content in Indian coals and biomass as alternate source of Li. Run of mines coal samples (150 samples) were collected from different coal subsidiaries of India and their respective Li content were analysed. Li content in coal varied in a narrow range: BCCL (0.95 – 25.28 mg/kg), ECL (3.15 – 28.23 mg/kg), Singrauli (2.08 – 20.94), MCL area (0.35 – 33.75 mg/kg). Few coal ash samples from Talcher (18.0 – 63.25 mg/kg) and IB Valley (19.5 – 96.50 mg/kg) were also analysed. The Li content in the rock samples varied from 13.1 – 53.55 mg/kg. Among the different biomasses (0.2 – 16.72 mg/kg) studied, the Li content was higher for algae (16.72 mg/kg), Eichornia (13.5 mg/kg), and maize cob (12.5 mg/kg). Future studies will be focused on exploration of Li content in clay and rock samples from coal mines.

Detailed studies are being carried out to assess the mode of occurrence of Mercury/Heavy metals in Indian coals. various coal samples collected from Talcher and IB valley area were analyzed for Hg, trace elements content. Chemical fractionation of Hg in coal is under progress. Mercury content in Coal Bed Methane gas studied at ONGC Bokaro asset. Gas samples from CBM wells were collected (fig 1) and analysed for total mercury content.

Fig 1. Mercury sampling and analysis at ONGC site

Based on the request from Bureau of India Standards (BIS), CSIR-CIMFR is actively involved in preparation of Indian Standards for Solid Biofuels. About 30 biomass samples were collected covering different varieties of feed stocks like agricultural residues, weeds, aquatic plants, industrial wastes and MSWs. Biomass samples were analyzed for proximate, ultimate composition , major & minr elements, water soluble chlorides, Na, K, etc. Few ISO standards (sampling, sample preparation, determination of moisture, ash content, GCV) were reviewed and recommended for their adoption into BIS.

CSIR-CIMFR is also involved in development of a Certified Reference Material for Coal with certified parameters like Ash, VM, GCV, S, Hg. About 100 Kg Coal Sample was collected from Lingaraj, Talcher area and processed for preparation of CRM.

Biochar based composite fertilizer is being developed for amelioration of mine spoil. Biochar prepared from different organic wastes are being upgraded for their fertilizer and fuel properties.

Coal ash, coal washery rejects, Al dross and other raw materials are used for the preparation of nitride based fertilizers.Different combination of raw material mixtures was worked out to get the desired nitride. To enhance the efficiency of nitridation process, a fluidized bed nitridation reactor was designed and work in progress.

15. COAL AND MINERAL PROCESSING GROUP

1. Project Report

During April 2020 to March 2021, the Group has undertaken various projects on washability, sampling of indigenous and imported coals, flotation, etc.

The clients included SAIL, Kolkata, Singareni Collieries Company Ltd., Hyderabad, Bharat Coking Coal Limited, Tata Steel, Abhinav Group, Western Coalfield Ltd., JSW Steel Limited, NTPL Tuticorin, Tamilnadu, SAIL Collieries Division, Chasnalla.

Project : "Scientific and Technical service for quality evaluation of coal for its optimum utilization in power generation at NTPL, Tuticorin end, Phase -2" The main objective is to characterize the imported coals and Indigenous coal after collecting the representative samples during unloading at the port ends and preparation of samples for characterization as per the standard procedure and as desired by the sponsor. During the period 2020-21 the quantity sampled for indigenous coal was 2627156 tonnes approximately.

Figure: Vessel berthed at Tuticorin Port for sampling of coal while the cargo is unloaded from the hatches

Project : "Sampling and analysis of slurry/ Rejects lying at different coal washeries of Bharat Coking Coal Limited : CSIR - CIMFR was involved during the sample collection at different washeries like Bhojudih, Sudamdih, Patherdih, Madhuban etc from the heap/ponds. The sample preparation was done at the respective sites for the general analysis and the prepared samples were sent by the party to CIMFR for its complete characterization. During the period 2020-21 sampling was done at three sites of different washeries and the analytical report was submitted.

Figure: BCCL Coal Washeries : Coal Fines in the form of slurry and rejects

Project: "Sampling and Analysis of imported coal unloaded at Port ends for Steel Authority of India Limited"- CSIR - CIMFR was involved during the sample collection while the coal was discharged at the ports of Haldia, Paradeep, Damra and Vizag. The sample preparation was done at the respective sites for the general analysis and the prepared samples were sent by SAIL to CIMFR for its complete characterization. During the period 2020 - 21 sampling of total of three (3) vessels was carried out at unloading ports and the analytical report was submitted.

Figure : Sampling of Imported coal from Australia at Dhamra Port (Odisha)

Project: "Scientific and Technical Evaluation of Flotation Reagents through operation of Pilot Scale Flotation Plant". (TATA) :

Flotation reagents was developed by M/s TATA Steel Limited and before it is commercial used in the coal washeries, the efficacy of the reagents need to be tested in a pilot plant. CSIR – CIMFR, had carried out extensive studies using the 400 kg/hr flotation plant and demonstrated and compared both the standard and newly developed reagents for understanding the efficacy of the floatability of coal.

Figure : 400 kg/hr pilot scale flotation plant

Project: "Conducting washability test and of the related studies for Eleven numbers of coking coal seams of Topa, Pundi and Ara OC of Kuju mines, CCL".

The Central Coalfield Limited, Ranchi is proposing to set up a commercial coking coal washery and for this the primary importance is to understand the cleaning potentialities of the raw coal to be fed to the washery. Under this study CSIR-CIMFR had collected samples from seven coal mines and carried out detailed washability studies to achieve clan coal ash content of 14% and 18% respectively. Based on the detailed washability studies the theoretical recovery at the respective clean coal ash content and corresponding middlings and rejects were evaluated. The studies are in progress.

Figure : Pilot scale crushers for crushing the ROM coal to a suitable top size

Project : "Characterization of Graphite samples from lying at Lamdak and Bopi, Dist. Upper Subansiri Arunachal Pradesh (150 Nos.)". The bore core samples from different seams, outcrops were sent by the party and the samples were characterized with respect to proximate, density etc., and the analysis data showed that the quality of the graphite is poor and needs beneficiation, for its utilization.

16. GASIFICATION AND CATALYSIS RESEARCH GROUP

During the period of April 2020 to March 2021, the Gasification and Catalysis Research Group of CSIR-CIMFR has undertaken various R&D activities in the areas of gasification to develop oxy-blown pressurized fluidized bed gasifier andSyngas to Methanol.

1. Project Report:

- Gasification and Catalysis Research Group has developed and installed an "Oxy-blown Pressurized Fluidized Bed Gasification Pilot Plant Facility" having 1.5 TPD coal feed rate with in-house expertise. Indigenously developed 1.5 TPD PFBG Facility is a milestone achievement as a part of "Methanol Economy Program" and an important step towards "Atmanirbhar Bharat Abhiyan" of Govt. of India. This facility has been dedicated to the nation by Dr. Harsh Vardhan, Hon'ble Minister Science and Technology on 17/11/2020. PFBG facility will be utilized for successfully establishing operation with high ash Indian coal as well as maximization of performance by optimizing design, operating parameters and blending with biomass feed stock. The outcome from this program and experience gained by CSIR-CIMFR will be utilized to take decision about utilization prospects of PFBG to handle high ash coal. Further, the PFBG facility will dictate techno-economics, gasification performance vis-à-vis utilization prospects of the high ash Indian coal.
- The research group has initiated "Coal Syngas to Methanol (CoSynol) Program" under the CSIR Mission Directorate. In this program, the development of "250 kg/day "Syngas to Methanol Pilot Plant" and its integration with "1.5 TPD Oxy-blown PFBG Pilot Plant" is in progress. At the end of this program, Pilot Scale Integrated Technology

1.5 TPD Oxy Blown Pressurized Fluidized Bed Gasification Facility

for Coal to Methanol along with Basic Engineering Package (BEP) for "100 TPD Coal to Methanol Demo Plant" will be developed.

- In-house projects:
  - "Performance evaluation of high ash Indian coal in Oxy-Blown pressurized fluidized bed Gasifier" – completed.
  - "Development of catalyst for synthesis of methanol from syngas" - completed.
  - "Ash characteristics with respect to operational aspects in different types of gasifiers" – ongoing.
  - "Establishment of Fluidization Cold/Hot Set-up Experimental Facility" – ongoing.

17. INDUSTRY INTERFACE: Intellectual Property Rights

Patent Filed in India: 11

Sn	NFNO	Title	Inventors	Prov. Filing Date	Comp. Filing Date	Application No.
1	0149NF2019/IN	A Process for The Preparation Of Bio-Methane And Value Added Products From Coal Mill Rejects By Rare Archaea	Vetrivelanguselvi, Ashish Mukherjee, Ashok Kumar Singh, Pradeep Kumar Singh, Reginald Ebhinmasto, Piyush Srivastava, Rajiv Satyakam, Pranay, Satya Prakash	—	17/Jun/2020	202011025412
2	0028NF2018/IN	A System And Method For Real Time Convergence Monitoring Of Underground Drivages.	Kumbhakardilip, Banerjee Gautam, Mandal Sujit Kumar, Yadavakeshar Prasad, Chatterjee Aditi, Mahatoprem Chand	—	29/Jun/2020	202011027504

Sn	NFNO	Title	Inventors	Prov. Filing Date	Comp. Filing Date	Application No.
3	0002NF2020/IN	Digital Mine Using Internet Of Things	Chaulyaswades Kumar, Prasad Girendra Mohan, Mandal Sujit Kumar, Banerjee Gautam, Singh Pradeep Kumar, Chowdhury Abhishek, Preity, Naresh Kumar, Virendra Kumar, Singh Jitendra Kumar, Chandan Kumar, Panditdewangshu, Mitramitrabarun, Mishra Shyamsundar, Khusbhukumari, Mishra Richa, Kunalsaurabh, Deyprasanjit, Md. Nadim, Saw Gopaljee	—	10/ Jul/2020	202011029344
4	0083NF2020/IN	Graphitization Of Heat Altered Coal Waste In The Form Of Natural Coke	Ashok Kumar Singh, Pradeep Kumar Singh	—	15/ Jul/2020	202011030084
5	0006NF2020/IN	Portable Weather And Environment Monitoring System	Chaulyaswades Kumar, Prasad Girender Mohan, Mandal Sujit Kumar, Banerjee Gautam, Singh Pradeep Kumar, Chandan Kumar, Md. Nadeem, Panditdewangshu, Mishra Richa	—	30/ Aug/2020	202011037361
6	0167NF2019/IN	An Oven And Method For Complete Carbonization Of Volatile Matter	Manish Kumar, Gautam Kumar Bayen, Monalisa Gangopadhyay, Rajiv Ranjan, Tarun Pramanik, Ashish Mukharjee, Pradeep Kumar Singh	—	31/ Aug/2020	202011037374
7	0116NF2019/IN	Title: A DEVICE AND METHOD OF SPLITTING BLAST HOLES WITH DETONATING FUSE	MORE RAMULU, PARTHO BISWAPATI CHOUDHURY, PRADEEP KUMAR SINGH	—	15/ Oct/2020	202011045348

Sn	NFNO	Title	Inventors	Prov. Filing Date	Comp. Filing Date	Application No.
8	0123NF2020/IN	A Novel Process For The Determination Of Equilibrated Moisture In Coal	Ashok Kumar Singh, Sanjay Kumar Thakur, Pradeep Kumar Singh, Arnold Luwangusham, Prabal Boral, Bodhisatwahazra, Sujan Saha	—	19/ Oct/2020	202011045585
9	0137NF2020/IN	An Improved Process Of Beneficiation Of Washery Grade Vi Coal For Production Of Upgraded Coking Coals And Power Coals	Udaysankarchattopadhyay, Thonangigouricharan, Subhash Chandra Maji, Pradeep Kumar Singh	11/ Jan/2021	—	202111001135
10	0139NF2020/IN	Development Of Thermogravimetric Reactor (Tgr) To Study Weight Changes And A Process Thereof	Prakash Dhondiramchavan, Sujan Saha, Gajanansahu, Sudiptadatta, Vishal Chauhan, Nileshdhananjaydhaigude, Pradeep Kumar Singh	11/ Jan/2021	—	202111001133
11	0031NF2021/IN	A Process For Preparation Of Ammonium Nitrate Fuel Oil Explosives Composition By Recycling Waste Lubricant Oil	Firoj Ali, Murari Prasad Roy, Braj Mohan Pat Pingua, Pradeep Kumar Singh	—	31/ Mar/2021	202111014942

Patent Granted In India: 3

Sno	NFNO	Country	Lab	Title	Inventors	Prov. Filing Date	Comp. Filing Date	Application No.	Status	Grant Date	Patent No.
1	0241NF2014/IN	IN	CIMFR	A Process For Increasing Carbon Dioxide Concentration In Flue Gas	Ashis Mukherjee, Manish Kumar, Santi Gopal Sahu, Ashis Kumar Adak, Subhasis Biswas	—	28/Jan/2015	0232DEL2015	IF	20/Sep/2020	347184
2	0168NF2010/IN	IN	CIMFR	Road Dust Collecting And Briquetting System For Coal Mines	Lakshmi Kanta Bandyopadhyay, Swades Kumar Chaulya, Pankaj Kumar Mishra, Manoj Kumar Singh, Surajit Dey	02/Nov/2010	12/Sep/2011	2619DEL2010	IF	15/Oct/2020	349337
3	0190NF2011/IN	IN	CIMFR	Wireless Strata Information System For Underground Openings	Pankaj Kumar Mishra, Angad Kushwaha, Prabhat Kumar Mandal, Amalendu Sinha	—	08/Oct/2013	2993DEL2013	IF	02/Mar/2021	360035

Copyright Filing And Registration

S. N.	CR Number	Title	Authors	Date Of Filing	Registration Number	Registration Date
1.	012CR2020	Coal Characterization Matrix to Evaluate Gasification Potentiality	Sujan Saha, P.D. Chavan, G. Sahu, S. Datta	18/02/2020	L-91840/2020	05-Jun-20
2.	003CR2020	Hybrid Algal Race Way Photo-Bioreactor For High Rate Co2 Capture	V. Anguselvi, M Kumar, A. Mukherjee, P.K.Singh, A.K.Singh, E. Masto, T. Gouri Charan, S. Kumar, R. Yadav, P.Sinha	22.10.2020	L-99522/2021	16.02.2021
3.	004CR2020	Selection Matrix : Physico-Chemical Properties Of Solid Fuels Vis-À-Vis Suitable Type Of Gasifier	Prakash D. Chavan, S. Saha, S. Datta, G. Sahu	01.10.2020	———	———
4.	005CR2020	Pythonic Data Logging Software (Pdls)	Ranjan Kumar, Md. A. Hussain, D. Kumbhakar, P.K. Mandal, P.K.Singh	01.10.2020	———	———
5.	006CR2020	Internet Based Real Time Safety Analysis (Irtsa) Software	Ranjan Kumar, Md. A. Hussain, D. Kumbhakar, P.K. Mandal, P.K.Singh	06.10.2020	———	———
6.	007CR2020	Dm – Digital Mine Software	S.K.Chaulya, G.M.Prasad, S.K.Mandal, G. Banerjee, P.K.Singh, P.K.Mandal, A. Verma, D. Pandit, M.Mitra, K.Kumari, S.N.Mishra, P.Dey, C. Kumar.	22.10.2020	———	———
7.	008CR2020	Memp – Mine Environment Monitoring And Prediction Software	S.K.Chaulya, S.K.Ray, D. Mishra, G.M.Prasad, S.K.Mandal, G. Banerjee, P.K. Singh, C. Kumar, D. Pandit, M. Mitra, K. Kumari, P. Dey	22.10.2020	———	———
8.	009CR2020	Sustainable Development Tree Model	V. Anguselvi, A.K.Singh, A. Mukherjee, R.E. Masto, P.K.Singh	30-Sep-20	L-96797	19.11.2020
9.	015CR2020	Real Time Image Processing Method And Software	S.K.Chaulya, G.M.Prasad, S.K.Mandal, G. Banerjee, P.K. Singh, A. Chowdhury, S. Kumari, M. Choudhury, P. Dey, K. Kumari	22.10.2020	———	———
10.	016CR2020	Method and Software for Real Time Image Stitching and Object Detection	S.K.Chaulya, G.M. Prasad,S.K.Manda, G. Banerjee, P.K. Singh, V. Kumar, S.Kumari, M. Choudhury, P. Dey, K. Kumari	28-Oct-20	SW-13959/2020	09-Dec-20
12.	017CR2020	High Ash Indian Coals : Gasification Strategy	Prakash D. Chavan, S. Saha, S. Datta, G. Sahu	06.10.2020	L-97261/2020	08.12.2020

S. N.	CR Number	Title	Authors	Date Of Filing	Registration Number	Registration Date
13.	018CR2020	Csir-Cimfr Blast Guide Mobile App for Android Smartphone	Harsh Anand, Aditya Rana, Pradeep Kumar Singh	22.10.2020	SW-13981/2020	10.12.2020
14.	047CR2020	Gramin E-Bazar Software	S.K. Chaulya, G.M. Prasad, S.K. Mandal, G. Banerjee, P.K. Singh, V. Kumar, M.Mitra, R. Kumar	03.12.2020	SW-14135/2021	25.01.2021
15.	052CR2020	Integrated Rural Facilitation Software (Gramin Mitra)	S.K. Chaulya, G.M. Prasad, S.K. Mandal, G. Banerjee, P.K. Singh, V. Kumar, M.Mitra, A. Kumari, S.S. Mishra, R. Kumar	27.10.2020	SW-13961/2020	09.12.2020
16.	0062CR2020	Soil and Water Health Reporting Software	S.K. Chaulya, G.M. Prasad, R.S. Singh, D.B. Singh, K. Nikhil, G.C. Mondal, Preity, M. Mitra, A. Kumari, R. Kumar	05-Nov-20	SW-14170/2021	11.02.2021
17.	063CR2020	Craft from Coal Carving	V. Anguselvi, A. Mukherjee, S. Saha, P.K. Singh	04.12.2020	.....	.....

18. CSIR-CIMFR, RANCHI RESEARCH CENTRE

Ranchi Research Centre is one of the leading Scientific and Research Centre at CSIR-CIMFR, that undertakes various research projects on coal sample collection, preparation, quality analysis, quality monitoring, borehole coal core analysis, party sample analysis, as per the IS standard and Fuel Supply Agreement (FSA) at Mahanadi Coalfield Limited (MCL), Central Coalfield Limited (CCL), and various power plants of National Thermal Power Corporation Limited (NTPC), to improve the quality of life towards power utilization in India. The centre plays a key role in coal mining and power sector to support Indian Government.

The centre fosters partnerships with a network of coal mining and power plants, nationally on matters of continuous coal quality analysis and monitoring. During the financial year 2020-21, CSIR-Central Institute of Mining and Fuel Research, Research Centre, Ranchi has undertaken various coal quality monitoring project sponsored by various power plants and coal mining companies, such as Mahanadi Coalfields Limited (Lingaraj, Kaniha, Jagannath, Bharatpur, Lakhanpur, IB Valley, Basundhara, Hingula areas), Central Coalfields Limited (North Karanpura, Piparwar, Kujju, Barkasyal, Argada, Hazaribagh, Magadh & Amarapali, Rajrappa, Dhori, B & K,Kathara, Giridih areas, etc.) and Power utility's, Karnataka Power corporation Ltd, NLC Tamil Nadu Power Ltd, NTECL, Tamil Nadu Generation And Distribution Company Ltd, Andhra Pradesh Power Generation Corporation Limited, Simhadri Super Thermal Power Plant, Talcher Thermal Power Station, Talcher Super Thermal Power Station, Odisha Power Generation Corporation, Maharashtra State Power Generation Company Limited, Vedanta Power Limited Jharsuguda, Talwandi Sabo Power (TSPL), Jindal Power Ltd, Hinduja National Power Corporation Ltd, Haldia Energy Ltd, Haryana Power Generation Corporation Ltd, West Bengal Power Development Corporation Ltd, Adani Power Ltd, Damodar Valley Corporation, Durgapur Projects Ltd, Mauda Super Thermal Power Station, Solapur Super Thermal Power Project, Jhabua Power Ltd, Lara Super Thermal Power Station, Darlipali Super Thermal Power Station, Indira Gandhi Super Thermal Power Project, Bhartiya Rail Bijlee Company Limited, Kanti Bijlee Ulpadan Nigam Ltd, National Capital Power Project Limited (NTPC), Barh Super Thermal Power Project, Sipat Super Thermal Power Station(NTPC), Nation Capital Power Station

Dadri (NTPC), Tanda Thermal Power Station ,NTPC Ltd, ROSA Power Supply Company Limited (RELIANCE), Bajaj Energy Limited, Guru Gobind Singh Super Thermal Power Plant, Guru Nanak Dev Thermal Plant, Guru Hargobind Thermal Plant, Panki, Harduaganj, Paricha Thermal Power Plant, Patratu Thermal Power Station, Maithon Power Limited, Jhajjar Power Limited and Tenughat Thermal Power Station,NTPC-Badarpur,NTPC-Unchahar,Navinagar Power Generation Corporation Ltd, Dulanga, NTPC-Barauni and Gujarat State Electricity Co. Ltd.

The Research Centre Ranchi also involved and fully dedicated to quality assessment of the borehole coal core received from various drilling agencies like Mining Associate Pvt.Ltd, APC Drilling and construction Pvt.Ltd, Thriveni Earthmovers Pvt.Ltd, South West Pinnacle and Central Mine Planning & Design Institute (CMPDI) of various part of Jharkhand, Odisha, Chhattisgarh, West Bengal, Maharashtra, Madhya Pradesh and the coal fields namely Rajmahal (Bhalukasba, Mirzagaon), Raniganj (Kabitirtha, Lalgang, Shunuri, Itapara south, Jhanjra, Hingula,), Birbhum (Salbhadra Gomarpharil), East Bokaro (Chalkari Extension Angawali, Pichri), Auranga (Rajbar), IB Valley (Rampaia Dip Extn), Sohagpur (Chainpa, Shahdol, Jamui), Singrauli (Hatta Dhudhmania, Bandha North) and North Karanpura (Badam dip side, Dhadhu East), South karanpura (Sayal D), Jharia (kharkharee, Madhuband). Total coal core received in financial year 10520.68 meters and coal core logging has done, 13533 number of sample has generated for band by band analysis as per the advice. Based on band by band results we have received seam over analysis advice from client and generated 1249 number of samples for SOV and 1041 number of samples for GCV analysis. Special test significant quantity for the same bore holes, Ultimate Analysis (221 samples), CO2 (124 samples), Distribution of sulphur (55 Samples), Plastometric Test (34 Samples), Ash Fusion Temperatures (192 samples), Ash Analysis (188 samples), Hardgrove Grindability Index (198 samples), Phosphorus Analysis (61 Samples), Petrographic Test (25 Samples), Caking Index (155 Samples), LTGK coke type (196 samples), swelling index (191 samples), total sulphur (194 samples),and ROGA Index analysis (34 samples).

Based on CSIR - Central Institute of Mining and Fuel Research analytical data the coal resources and reserve estimation has been calculated and ore body modeling will be made by concern mining companies. These reserve estimation and ore body modeling will more effective to prepare mining scheme and mining plan in mining industries. And the special test analytical data will be used in power plants and steel plants for smooth functioning plant and to enhance the production in power sector as well as steel industries.

CSIR-CIMFR Ranchi also provide the consultancy services to government and private organization by analysis of coal samples received from different parties namely Punjab State Power Co. Ltd, Jharkhand State Mineral Development Co. Ranchi, Nabha Power Ltd, CCO, NTPC Kahalgaon, Vimul Dugdha Utpadak and Bihar State Milk Co. foundation. Ranchi etc. which helped them proper economic way of production and utilization of coal.

Ranchi Research Centre is well equipped with adequate infrastructure for testing and analysis of coal and providing services to various Industries. The sophisticated facilities available are Proximate Analysis both Air dried & 60% RH & at equilibrated basis, Determination of Moisture and Ash both AD & Equilibrated, AFT (Ash Fusion Temperature Range), CHNS & CHNSO, Direct Determination of Sulphur, Determination of Phosphorus % (by conventional method), Ash Analysis, Swelling Index SI, LTGK Type (Low Temperature Grey King Assay), Distribution of Sulphur etc.

Sample Collection and Preparation

(Automatic GCV Determination)

(Dual Furnace Proximate Analyzer)

(Coal Core logging)

(Automatic CHNSO Analyzer)

Running projects:

A. Project title: Characterization studies of coals from different coal field explored by CMPDIL, through Borehole Coal Core study. (SSP-7365, 7650, 8304, 8306, 8305, 8317, 8322.)

B. Project title: Scientific study of quality monitoring of coal at unloading of various power plants. (SSP-7698, 7805, 7914, 7915, 7976, 8106, 8107, 8145, 8348, 8361, 8362, 7700, 8113, 8360, 7728, 7835, 8088, 8146, 8439, 7729, 7910, 8057, 8001,8443)

C. Project title: Scientific study of quality monitoring of coal at loading end of MCL for different power plants. (SSP-7604, 7588, 7562, 7563, 7510, 7893, 7489, 7603, 7975, 7701, 7971, 7912, 7911, 8050, 7819, 8133, 7775, 7931, 7978, 7702, 7894, 8261, 7951, 7718, 8144, 8357, 8112, 8087, 8104, 8211, 8166, 8391, 8292, 8266, 8316, 8172, 8119, 8215, 8143, 8148, 8122, 8051, 8440, 8438, 8444, 8365, 8442,8531,8532.)

D. Project title: Scientific study of quality monitoring of coal at loading end of different areas of MCL. (SSP-7658, 8082, 7983, 8011, 8012, 7982, 7777, 7783, 8013, 8014, 7974, 7984, 7908, 8213, 8285, 8212, 8214, 8253, 8358, 8477, 8210, 8445, 8446, 8002, 8359,8528,8529)

E. Project title: Scientific study of quality monitoring of coal at loading end of CCL for different power plants.(SSP-8108, 8265, 8465)

F. Project title: Scientific study of quality monitoring of coal at loading end of different areas of CCL for different power plants (SSP-7618, 7704, 7705, 7801, 7802, 7810, 7841, 7842, 7843, 7865, 7886, 7887, 7888, 7889, 7890, 7891, 8001, 8054, 8081, 8105, 8108, 8114, 8115, 8120, 8121, 8129, 8141, 8142, 8265, 8277, 8330, 8465, 8465, 8441, 8443, 8466, 8467, 8508)

G. Project title: Scientific study on quality monitoring of coal at Dulanga Coal Mining Project Dulanga (SSP-8333, 8539)

Project Completed and submitted:

A. Project title and No.: Characterisation Testing and analysis of coal CC/T & A/RAN/2019-20.

B. Project title: Characterization studies of coals from different coal field explored by CMPDIL, through Borehole Coal Core study. (SSP-7577,7578)

C. Project title: Scientific study of quality monitoring of coal at unloading of various power plants. (SSP-7615, 7463, 7836)

D. Project title: Scientific study of quality monitoring of coal at loading end of MCL for different power plants. (SSP-7613, 7614)

E. Project title: Scientific study of quality monitoring of coal at loading end of different areas of MCL for different power plants. (SSP-7467, 7490, 7491, 7493, 7495, 7574, 7357, 7576)

F. Project title: Scientific study of quality monitoring of coal at loading end of CCL for different power plants.(SSP-7791)

G. Project title: Scientific study of quality monitoring of coal at loading end of different areas of CCL for different power plants (SSP- 7616,7473,7468,7371,7470, 7471,7716)

D. STAFF NEWS AND OTHERS

D. STAFF NEWS AND OTHERS

I. PAPERS PUBLISHED IN INTERNATIONAL JOURNAL

1. Agarwalla H., Senapati R.N. & Das T.B. (2021): Mercury emissions and partitioning from Indian coal-fired power plants. Journal of Environmental Sciences, Volume 100,Pages 28-33.https://doi.org/10.1016/j.jes.2020.06.035.
2. Ali F., Pingua B. M. P., Dey A., Roy M. P. & Singh P. K. (2021): Surface Functionalized Ammonium Nitrate Prills with Enhanced Water Resistance Property: Characterizations and its Application as Commercial Explosives. Propellants Explosives, Pyrotechnics, 46, 78-83. (Wiley-VCH).
3. Annesha Ghosh, Bhanu Pandey, Madhoolika Agrawal & S.B. Agrawal (2020): Interactive effects and competitive shift between Triticum aestivum L.(wheat) and Chenopodium album L.(fat-hen) under ambient and elevated ozone. Environmental Pollution, 265, 114764.
4. Anwita Ojha, Santanu Ghosh, Atul Kumar Varma, Vinod Atmaram Mendhe & Asutosh Mondal (2020): A composite microstructural and geochemical approach to quench the quest for hydrocarbon from Barren Measures shales of Jharia Basin, India. Journal of Natural Gas Science and Engineering (Elsevier: Impact Factor – 4.965), Volume 78, 103310. June 2020.
5. Azeem Uddin Siddiqui, Manish Kumar Jain & Reginald Ebhin Masto (2020): Pollution evaluation, spatial distribution, and source apportionment of trace metals around coal mines soil: the case study of eastern India. Environ Science and Pollution Research, 27, 10822–10834.
6. Bably Prasad, Abhay Kumar Soni, Anusha Vishwakarma, Ratnesh Trivedy & Krishna Kant Kumar Singh (2020): Evaluation of water quality near the Malanjhkhand copper mines, India, by use of multivariate analysis and a metal pollution index. Environmental Earth Sciences, 79, 1-23.
7. Behera, S.K., Ghosh, C.N., Mishra, K., Mishra, D.P., Singh, P., Buragohain, J., Mandal, P.K. & Sethi, M.K. (2020): Utilisation of lead–zinc mill tailings and slag as paste backfill materials. Environ Earth Sci 79, 389 (2020). https://doi.org/10.1007/s12665-020-09132-x.
8. Bhagirath Ahirwal, Rashmi Prasad, Sudhir Kumar Kashyap & Gautam Banerjee (2020): Stress analysis due to internal explosion pressure of designed flameproof enclosure for hazardous area, Process Safety Progress (American Institute of Chemical Engineers Journals), Vol 39, Issue 2, pp. 1-6, USA.https://doi.org/10.1002/prs.12100.
9. Bodhisatwa Hazra, Prasenjeet Chakraborty, Pinaki Sarkar, Ashok K Singh, Pradeep K Singh, Saroj Kumar (2021): "Thermal Behavior of some Indian coals: Inferences from Simultaneous Thermogravimetry – Calorimetry and Rock-Eval"; Natural Resources Research (NARR) ; vol .& Page no.; 30;2161-2177.
10. Chattaraj S., Upadhyay R., Mohanty D., Halder G. & Kumar T. (2021): Evaluating production behaviour of CBM wells from Raniganj Coalfield through reservoir characterization under constrained field data conditions. Journal of Natural Gas Science and Engineering, 92: 103969. https://doi.org/10.1016/j.jngse.2021.103969.
11. Chakraborty, P., Hazra, B., Sarkar, P., Singh, A.K., Singh, P.K. & Kumar, S., (2021): Thermal Behavior of Some Indian Coals: Inferences from Simultaneous Thermogravimetry–Calorimetry and Rock–Eval. Natural Resources Research, 1-17. I.F.: 3.708.
12. Chaulya, S.K., Singh, A.K., Singh, T.B., Mondal, G. C., Singh, S., Singh, S.K. & Singh, R.S. (2020): "Modelling for air quality estimation for a planned coal washery to control air pollution", Environmental Modeling & Assessment, 25(6), 775–791, https://doi.org/10.1007/s10666-020-09721-x.
13. Das T. B., Chattopadhyay U. S., Soni D., Singh K.& Singh P. K.,(2020): Preparation and Certification of Indian Reference Materialof Bituminous Coal. MAPAN https://doi.org/10.1007/s12647-020-00403-3.

14. Das T.B., Senapati R.N. & Agarwalla H., (2020): Mercury in Indian Thermal Coals. Bulletin of Environmental Contamination and Toxicology 105 (3), 502-512. doi: 10.1007/s00128-020-02945-3.

15. Debasish Basak & Sachchak Waghmare (2020): "Comparative study of 36 mm-diameter rope in five aerial ropeway installations using a non-destructive method", Insight, Vol. 62, No. 10, October, 2020, pp 598-600.

16. Debasish Basak (2020): "Performance Evaluation of 42 mm Diameter Stranded Ungalvanised Haulage Rope in a Mono-Cable Passenger Ropeway", Russian Journal of Nondestructive Testing, Vol.56, No.7, pp 592-594, @ Pleiades Publishing Ltd., 2020.

17. Dey, P., Kumar, C., Mitra, M., Mishra, R., Chaulya, S.K., Prasad, G.M., Mandal, S.K. & Banerjee, G. (2021): "Deep convolutional neural network based secure wireless voice communication for underground mine", Ambient Intelligence and Humanized Computing, DOI: https://doi.org/10.1007/s12652-020-02700-w.

18. Dipita Ghosh, Reginald Ebhin Masto & Subodh Kumar Maiti (2020): Ameliorative effect of Lantana camara biochar on coal mine spoil and growth of maize (Zea mays). 2020. Soil Use and Management, 36, 726-739.

19. Divya, Y., Gopinathan, P., Jayachandran, K. & Ayad M. Fadhil Al-Quraishi (2021): Color slices analysis of land use changes due to urbanization in a city environment of Miami Area, South Florida, USA. Modelling Earth System and Environment. 7, 537–546. https://doi.org/10.1007/s40808-020-00883-x.

20. Dubey, C.S., Usham, A.L., Mishra, B.K., Shukla, D.P., Singh, P.K. and Singh, A.K. (2021): "Anthropogenic arsenic menace in contaminated water near thermal power plants and coal mining areas of India" (2021): Environmental Geochemistry and Health, pp.1-29. Corresponding Author: A L Usham.

21. Gopinathan P, Parthiban S, Magendran T, Ayad M. Fadhil Al-Quraishi, Ashok K. Singh & Pradeep K. Singh (2020): Mapping of ferric and ferrous iron oxides distribution using band ratio techniques with ASTER data and geochemistry of Kanjamalai and Godumalai, Tamil Nadu, south India. Remote Sensing Applications: Society and Environment, 100306. https://doi.org/10.1016/j.rsase.2020.100306.

22. Gopinathan, P., Nandini, C. V., Parthiban, S., Sathish, S., Singh, A. K., & Singh, P. K. (2020): A geo-spatial approach to perceive the groundwater regime of hard rock terrain- a case study from Morappur area, Dharmapuri district, South India. Groundwater for Sustainable Development, 100316. https://doi.org/10.1016/j.gsd.2019.100316.

23. Gangopadhyay Monalisa, Bayen, Gautam K., Kumar Manish & Mukherjee Ashish (2020): Alternative Coke from Inferior Coal for Ferro-Alloy Industry. Solid Fuel Chemistry, 54. pp. 406-410.

24. Gangopadhyay Monalisa, Bayen, Gautam K., Kumar Manish, Mukherjee Ashish, Ranjan Rajiv & Kumar Saroj (2021): Preheating upto Tarrification Point and Compaction: A Promising Way for Coke Quality Enhancement. International Journal of Coal.

25. Gopinathan P, Parthiban S, Magendran T, Ayad M. Fadhil Al-Quraishi, Ashok K. Singh & Pradeep K. Singh (2020): "Mapping of ferric (Fe3+) and ferrous (Fe2+) iron oxides distribution using band ratio techniques with ASTER data and geochemistry of Kanjamalai and Godumalai, Tamil Nadu, south India" Remote Sensing Applications: Society and Environment, 2020;Vol. 18.

26. Gupta, P. K., Mahato, A., Oraon, P., Gupta, G. K., & Maity, S (2020): Coal fly ash-derived mesoporous SBA-15 as support material for production of liquid hydrocarbon through Fischer–Tropsch route. Asia-Pacific Journal of Chemical Engineering, 15(4), e2471.

27. Gupta, P.K., Kumar, V. & Maity, S. (2021): Renewable fuels from different carbonaceous feedstocks: a sustainable route through Fischer-Tropsch synthesis. Journal of Chemical Technology & Biotechnology, 96(4), 853-868.

28. Gupta, P. K., Mahato, A., Gupta, G. K., Sahu, G., & Maity, S. (2021): Fischer-Tropsch synthesis over Pd promoted cobalt based mesoporous supported catalyst. Oil & Gas Science and Technology–Revue d'IFP Energies nouvelles, 76, 21.

29. Hazra, B., Singh, D.P., Crosdale, P.J., Singh, V., Singh, P.K., Gangopadhyay, M. & Chakraborty, P. (2021): Critical insights from Rock-Eval analysis of vitrains. International Journal of Coal Geology, p.103717. I.F.: 5.692.

30. Hazra, B., Singh, D.P., Chakraborty, P., Singh, P.K., Sahu, S.G. & Adak, A.K. (2021): Using Rock-Eval S4Tpeak as thermal maturity proxy for shales. Marine and Petroleum Geology, p.104977. I.F.: 3.790.

31. Hazra, B., Vishal, V. & Singh, D.P., (2021): Applicability of Low-Pressure CO2 and N2 Adsorption in Determining Pore Attributes of Organic-Rich Shales and Coals. Energy & Fuels, 35, 1, 456–464. I.F: 3.421.

32. Himanshu Vivek Kumar, Roy M. P., Shankar R., Mishra A. K. & Singh P. K. (2021): Empirical Approach Based Estimation of Charge Factor and Dimensional Parameters in Underground Blasting. Mining, Metallurgy & Exploration, 38(2), 1059–1069. https://doi.org/10.1007/s42461-020-00374-8.

33. Jaiswal, V.P., Shukla, S.K., Sharma, L. Ishwar Singh, A. D. Pathak, Mona Nagargade, Arup Ghosh, C. Gupta, Asha Gaur, S. K. Awasthi, Raghvendra Tiwari, Abhay Srivastava & Ebhin Masto (2020): Potassium Influencing Physiological Parameters, Photosynthesis and Sugarcane Yield in Subtropical India. Sugar Tech (2020). https://doi.org/10.1007/s12355-020-00905-z.

34. Kalpana, P., Parthiban, S, Gopinathan, P. T. Subramani, P.D. Roy, S. Gautam & J. Brema (2020): Spatio-temporal estimation of rainfall patterns in north and north western states of India between 1901 and 2015: change point detections and trend assessments. Arabian Journal of Geo-science 13, 1116. https://doi.org/10.1007/s12517-020-06098-9.

35. Kumar, Manish (2020): Efficient utilization of Indian Coking Coal: Opportunities and challenges. Metallurgical Research and Technology, 117 (209). pp. 1-9.

36. Kumar, Manish & Tiwari, H. P. (2020): Assessment of Naphthalene Absorption Efficiency from Coke Oven Gas. Coke and Chemistry, 63 (10). pp. 500-512.

37. Kumari, K., Dey, P., Kumar, C., Pandit, D., Mishra, S.S., Kisku, V., Chaulya, S.K., Ray, S.K. & Prasad, G.M. (2021): "UMAP and LSTM neural network based fire status and explosibility prediction for sealed-off area in underground coal mine", Process Safety and Environmental Protection, 2020, 146, 837-852, DOI: https://doi.org/10.1016/j.psep.2020.12.019.

38. Kumar C., Kumaraswamidhas L.A., Murthy V.M.S.R. & Prakash A. (2020): Experimental investigations on thermal behavior during pick-rock interaction and optimization of operating parameters of surface miner. International Journal of Rock Mechanics & Mining Sciences. 133, 104360.

39. Kumari, N., Saha, S., Sahu, G., Chauhan, V., Roy, R., Datta, S., & Chavan, P. D. (2020): Comparison of CO 2 gasification reactivity and kinetics: petcoke, biomass and high ash coal. Biomass Conversion and Biorefinery, 1-14.

40. Manash Gope, Reginald Ebhin Masto, Aman Basu, Debopriya Bhattacharyya, Rajnarayan Saha, Raza Rafiqul Haque, PS Khillare & Srinivasan Balachandra (2020): Elucidating the distribution and sources of street dust bound PAHs in Durgapur, India: A probabilistic health risk assessment study by Monte-Carlo simulation. Environmental Pollution, 267, 115669. https://doi.org/10.1016/j.envpol.2020.115669.

41. Mandal, R., Maity, T., Chaulya, S.K. & Prasad, G.M. (2020): "Laboratory investigation on underground coal gasification technique with real-time analysis", Fuel, 275, 117865, https://doi.org/10.1016/j.fuel.2020.117865.

42. Mishra, R., Chaulya, S.K., Prasad, G.M., Mandal, S.K. & Banerjee, G. (2020): "Design of a low cost, smart and stand-alone PV cold storage system using a domestic split air conditioner", Journal of Stored Products Research, 89, 101720, 1-10, https://doi.org/10.1016/j.jspr.2020.101720.

43. Mishra P. K., Swain A., Kumar S. & Mandal S.K. (2021): Wireless paging system for underground mines, Radioelectronics and Communications Systems, 64(1), pp. 14-25.

44. M. Misz-Kennan, J. Kus, D. Flores, C. Avila, Z. Büçkün, N. Choudhury, K. Christanis, J.P. Joubert, S. Kalaitzidis, A.I. Karayigit, M. Malecha, M. Marques, P. Martizzi, J.M.K. O'Keefe, W. Pickel, G. Predeanu, S. Pusz, J. Ribeiroov, S. Rodrigues, A.K. Singh, I. Suárez-Ruiz & I. Sýkorová (2020): " Development of a petrographic classification system for organic particles affected by self-heating in coal waste. (An ICCP Classification System, Self-heating Working Group – Commission III) International Journal of Coal Geology; Vol.220.

45. Mohalik, N. K., E. Lester & I.S. Lowndes, (2020): Development of a Petrographic Technique to Assess the Spontaneous Combustion Susceptibility of Indian Coals, International Journal of Coal Preparation and Utilization, Volume 40, Issue 3, PP-186-209. http://dx.doi.org/10.1080/19392699.2017.1360874.

46. Mousumi Mallick, Swapan Kumar Mitra, Debasish Basak, Nirmal Kumar Roy & Joydeep Maity (2021): "A novel approach of high-voltage low-current electric energy input to synthesise cost-effective ultra-strong ductile material", Philosophical Magazine, 2021, Vol. 101, No. 5, pp 555-575, https://doi.org/10.1080/14786435.2020.1849843.

47. Mukesh Kumar Mahato & Abhay Kumar Singh (2020): Evaluation of atmospheric dust deposition rates and their mineral characterization in copper and iron mining areas, Singhbhum, India. Journal of the Air & Waste Management Association, 70(12), 1378-1389.

48. Mukhopadhyay S, Sarkar P, Masto, R.E, Singh, A.K & Singh P.K.(2021): Investigation on the combustion characteristics of different plant parts of Cassia siamea by DSC-TGA, Journal of Thermal Analysis and Calorimetry, 1-13 In Press https://doi.org/10.1007/s10973-021-10709-2.

49. Paswan, R.K., Roy, M.P., Shankar, R. & Singh, P. K. (2021): Blast Vibration and Fragmentation Control at Heavily Jointed Limestone Mine. Geotech Geol Eng. 39:3469–3485. https://doi.org/10.1007/s10706-021-01705-2.

50. Pal Roy P., Sawmliana C., Prakash A. & Singh R. K. (2020): Safe exploitation of developed pillars of a coal seam above fire affected areas - a case study. Mining Technology, 129:4, 206-216, DOI: 10.1080/25726668.2020.1834972.

51. Pal M, Gope M, Basu A, Laha T, Masto RE, Labar R, Kundu TK, Hoque RR, Khillare PS & Balachandran S. (2021): Indoor Quality of Residential Homes and Schools of an Industrial Area in Asansol: Characterization, Bio-accessibility and Health Risk Assessment of Potentially Toxic Elements, Nature Environment and Pollution Technology, 20(1), 13-28.

52. Paul A., Murthy V.M.S.R., Prakash A. & Singh A.K. (2020): Estimation of rock load for junctions based on roof failure cases for safe mining operation. Arabian Journal of Geosciences. 13:1069.

53. Paul, A., Murthy, V.M.S.R., Prakash, A. & Singh, A.K. (2020): Estimation of rock load for junctions based on roof failure cases for safe mining operation. Arabian Journal of Geosciences, 13:1069, doi.org/10.1007/s12517-020-06045-8.

54. Payal Banerjee & Bably Prasad (2020): Determination of concentration of total sodium and potassium in surface and ground water using a flame photometer. Applied Water Science, 10(5), 1-7.

55. P. Gopinathan, C.V. Nandini, S. Parthiban, S. Sathish, Ashok K. Singh & Pradeep K. Singh (2020): " A geo-spatial approach to perceive the groundwater regime of hard rock terrain- a case study from Morappur area, Dharmapuri district, South India", Groundwater for Sustainable Development; Vol. 10.

56. Pramod Kumar & Abhay Kumar Singh (2020): Hydro-geochemistry and quality assessment of surface and sub-surface water resources in Raniganj coalfield area, Damodar Valley, India. International Journal of Environmental Analytical Chemistry,1-24.

57. Prasad Bhukya & Debasish Basak (2020): "Nondestructive Evaluation of Track and Haulage Ropes of Aerial Ropeway Installation in India – A Case Study", Russian Journal of Nondestructive Testing, Vol. 56, No. 11, pp 927-935, @Pleiades Publishing Ltd., 2020.

58. Preity, M., Chaulya, S.K.& Banerjee, G. (2021): "A proposed data acquisition system and algorithm for signal processing of moving-coil geophone's output", SN Applied Sciences, 3: 331, DOI: 10.1007/s42452-021-04330-z.

59. Raghuvanshi, G., Chakraborty, P., Hazra, B., Adak, A.K., Singh, P.K., Singh, A.K. & Singh, V. (2020): Pyrolysis and combustion behavior of few high-ash Indian coals. International Journal of Coal Preparation and Utilization, 1-21. I.F.: 2.03.

60. Reginald E. Masto*, Ankita Pandit, Sandeep Kumar, Sreemanta Datta, Sangeeta Mukhopadhyay, Vetrivel A.Selvi, Pashupati Dutta & Pinaki Sarkar (2020): Comparative evaluation of aquatic biomass feedstocks for energy application and potential for extraction of plant nutrients from their ash, Biomass and Bioenergy, 142, 105783, https://doi.org/10.1016/j.biombioe.2020.105783.

61. Runcie Paul Mathews, Vivek Kumar Mishra & Saurabh Gautam (2021): Palaeobotanical and biomarker evidence for Early Permian (Artinskian) wildfire in the Rajmahal Basin, India by Srikanta Murthy, Vinod Atmaram Mendhe, Dieter Uhl, Journal of Palaeogeography, (Springer: Impact Factor – 2.40), 5 (2021). March 2021.

62. Sahu, G., Saha, S., Datta, S., Chavan, P. D., Chauhan, V., & Gupta, P. K. (2021): Production of biodiesel from high free fatty acids content Jatropha curcas oil using environment affable K–Mg composite catalyst. Asia-Pacific Journal of Chemical Engineering, e2620.

63. Sangeeta Mukhopadhyay, R Ebhin Masto, Ashok K Singh & Pradeep K Singh (2020): " Impact of the Combined Application of Biochar and Compost on Mine Soil Quality and Growth of Lady's Finger" Bulletin of Environmental Contamination and Toxicology; Publisher: Springer US; Page No.: 1-7.

64. Santosh Kumar Ray, Asfar Mobin Khan, Niroj Kumar Mohalik, Debashish Mishra, Nikhil Kumar Varma, Jai Krishna Pandey & Pradeep Kumar Singh (2020): Methodology in early detection of conveyor belt fire in coal transportation, Energy Sources, Part A: Recovery, Utilization, and Environmental Effects. Published online on 29th September 2020. DOI: 10.1080/15567036.2020.1823527.

65. Saurabh, K., Chaulya, S.K., Singh, R.S., Kumar, S. & Mishra, K.K. (2020): "Intelligent dry fog dust suppression system: an efficient technique for controlling air pollution in mineral processing plant", Clean Technologies and Environmental Policy, DOI: https://doi.org/10.1007/s10098-020-01991-z.

66. Sawmliana C., Singh R. K., Hembram P. & Dawngliana Orizen MS (2021): Ground vibration generated by hydraulic rock breakers and its impact on the safety of nearby earthfill dam in a graphite mine. Quarterly Journal of Engineering Geology and Hydrogeology, Geological Society of London, 19th March 2021, https://doi.org/10.1144/qjegh2020-113.

67. Seema Ashishan Topno, Lalit Kumar Sahoo & B.S. Umre (2021): Energy efficiency assessment of electric shovel operating in opencast mine, Energy, Volume 230, 2021,120703, ISSN 0360-5442, https://doi.org/10.1016/j.energy.2021.120703.

68. Sawmliana C., Hembram P., Singh R. K., Banerjee S., Singh P. K. & Pal Roy P. (2020): An investigation to assess the cause of accident due to flyrock in an opencast coal mine: A case study. Journal of Institution of Engineers India-Series D, Springer Publications, (January–June 2020) 101(1):15–26, https://doi.org/10.1007/s40033-020-00215-4.

69. Senapati R. N., Pathak D. D.& Dutta P. (2020): A Versatile VMPO Catalyst Prepared In-Situ for Oxidative Ammonolysis of Isomeric Picolines and Xylenes, Russian Journal of General Chemistry, Vol. 90, No. 2, pp. 292–298. https://doi.org/10.1134/S1070363220020218.

70. Sharma, P., Kumar, A., Shams, N., Verma, A.K., Kumar, D., Singh, A.K., & Ram, S.(2021): Parametric stability analysis for optimum size of rib/snook in mechanized depillaring. Arabian Journal of Geosciences, 14:247. doi:10.1007/s12517-021-06555-z.

71. Shyamal Chandrakar, P.S. Paul & C. Sawmliana (2021): Influence of void ratio on "Blast Pull" for different confinement factors of development headings in underground metalliferous mines, Tunnelling and Underground Space Technology 108 (2021) 103716.

72. Sidhharth Singh, Bhanu Pandey, Lal Babu Roy, Sameer Shekhar & Ranjeet Kumar Singh (2021): Tree responses to foliar dust deposition and gradient of air pollution around opencast coal mines of Jharia coalfield, India: gas exchange, antioxidative potential and tolerance level. Environmental Science and Pollution Research, 28(7), 8637-8651.

73. Singh P., Singh, V.A., & Chaulya, S.K. (2020): "Numerical analysis of LSPR based fiber sensor for low refractive index detection", Optik, 224, 165704, https://doi.org/10.1016/j.ijleo.2020.165704.

74. Singh, P, Chaulya, S.K. & Singh, V.A. (2020): "Development of microwave radar based periphery surveillance system in a selected mining area", Journal of Electromagnetic Waves and Applications, 2021, 35(4) 529-548, DOI: https://doi.org/10.1080/09205071.2020.1847694.

75. S. K. Chaulya, A. K. Singh, T. B. Singh, G. C. Mondal, S. Singh, S. K. Singh & R. S. Singh (2020): Modelling for air quality estimation for a planned coal washery to control air pollution. Environmental Modeling & Assessment, 25(6), 775-791.

76. Singh R. K., Sawmliana C. & Hembram P. (2021): Time-constrained demolition of a concrete cofferdam using controlled blasting. Innovative Infrastructure Solutions, Springer Publications, 6, 20 (2021). https://doi.org/10.1007/s41062-020-00387-8.

77. Singh, A.K., Kumar, A., Kumar, D., Singh, R., Ram, S., Kumar, R., & Singh, A.K. (2020): Coal pillar extraction under weak roof. Mining, Metallurgy & Exploration, 37(5):1451-1459. doi: 10.1007/s42461-020-00277-8.

78. S. Kumar, G. Kaushik, and R. E. Masto (2020): Evaluation of the Fuel Value and Soil Application Potential of the Cadmium Contaminated Biochar Obtained after Water Treatment. Solid Fuel Chemistry, 2020, Vol. 54, No. 6, pp. 411–417.

79. Soma Giri & Abhay Kumar Singh (2020): Human health risk assessment due to metals in cow's milk from Singhbhum copper and iron mining areas, India. Journal of food science and technology, 57(4), 1415-1420.

80. Soma Giri, Mukesh Kumar Mahato, Santanu Bhattacharjee & Abhay Kumar Singh (2020): Development of a new noncarcinogenic heavy metal pollution index for quality ranking of vegetable, rice, and milk. Ecological Indicators, 113, 106214.

81. Soma Giri, Abhay Kumar Singh & Mukesh Kumar Mahato (2020): Monte Carlo simulation-based probabilistic health risk assessment of metals in groundwater via ingestion pathway in the mining areas of Singhbhum copper belt, India. International journal of environmental health research, 30(4), 447-460.

82. Sudhir Kumar Kashyap, Lalan Kumar, Kumar Gaurav, Rahul Kumar Singh & Bipllab Chakraborty (2020): "Failure Analysis of FRP Composite Bonded Socket Joint" International Journal of Advanced Materials Manufacturing and Characterization, Vol.10, Issue.1 (2020), PP 29-35.

83. Vallu Ramakrishna, Ashok K. Singh, G. K. Bayen, R. E. Masto, R. K. Meena, Pradeep K. Singh, M. Arya, S. Jyoti & Arnold L Usham (2021): "Torrefaction of agro-wastes (palmyra palm shell and redgram stalk): characterization of the physicochemical properties and mechanical strength of binderless pellets". (2021). Biomass Conversion and Biorefinery (2021).

II. PAPERS PUBLISHED IN NATIONAL JOURNAL

1. Aditya Rana, N. K. Bhagat, G. P. Jadaun, S. Rukhaiyar, A. Pain, P.K. Singh (2020): Predicting Blast-Induced Ground Vibrations in Some Indian Tunnels using decision tree. Society of Mining Engineering. Aug 2020, Vol.72 Issue 8, p47-48.

2. Aditya Rana (2021): "Expediting the Construction of Himalayan Border Roads". Vijnana Bharti, Science India. Jan 2021, Vol.19 Issue 59, p33-34.

3. A.K.Ghosh (2020): "Theoretical and experimental examinations to substantiate the structure of coal derived asphaltene by formation of complex with o-chloranil" Fuel. 276 (2020).

4. Bhanu Pandey, Sidhharth Singh, Lal Babu Roy, Sameer Shekhar, Ranjeet Kumar Singh, Bably Prasad and Krishna Kant Kumar Singh (2021): Phytostabilization of coal mine overburden waste, exploiting the phytoremedial efficacy of lemongrass under varying level of cow dung manure. Eco-toxicology and Environmental Safety, 208, 111757.

5. Chaulya, S.K., Prasad, G.M., Mitra, S., Mishra, P., and Nadeem, M. (2021): "Development of a digital mine for safe and efficient mining", BCREC Engineering & Science Transaction, 2(1): 1-21.

6. Debnath, S., Nath, H., & Chauhan, V. (2020): CFD modeling of a typical fluidized bed column. Materials Today: Proceedings.

7. Bharti A.K., Prakash A., Singh K.K.K. and Verma A. (2020): Assessment of near surface by 2D Electrical Resistivity Tomography over hard rock terrain: A case study. Minetech. 41(4), Oct.-Dec., 9-15.

8. N. K. Bhagat, A. K. Mishra, M. M. Singh, A. Rana, P. K. Singh (2020): Innovative Directional Controlled Blasting Technique for Excavation of Unstable Slopes Along a Busy Transportation Route: a Case Study of Konkan Railway in India. Mining, Metallurgy & Exploration. Vol. 36(3), pp. 833-850.

9. N. K. Bhagat, A. K. Mishra, M. M. Singh, A. Rana, P.K. Singh (2020): Directional controlled blasting technique for excavation of unstable slopes along the Konkan Railway route. Mining Engineering. Vol. 72 (7), pp. 5-6.

10. Himanshu Vivek Kumar, Yadav R.S., Roy M. P., Paswan R.K., Sawmliana C., Singh P. K. (2020): धात्विक अयस्क के भूमिगत उत्खनन में हाल की तकनीकियों में प्रगति. MineTech, vol 41, No. 02, pp 45-54.

11. K.M.P. Singh, T. Gouri Charan, K.M.K. Sinha, G.V. Ramana, Lingaraj Sahu and Pradeep k Singh (2020): "Online Coal Washability Analyser for Treating Indian Coals" Mine tech, Vol.41 No.3, July-Sept'2020, Special Issue in R&D in Coal Sector, 25 – 32.

12. Pal Roy P., Sawmliana C. and Singh R. K. (2020): Protecting structural damage and human annoyance during blasting in sensitive hilly-terrain. Minetech, 2020, Vol. 41, No. 1, pp 48-57.

13. Pallabi Das, Suman Dutta and Krishna Kant Kumar Singh (2021): Insights into membrane crystallization: A sustainable tool for value added product recovery from effluent streams. Separation and Purification Technology, (257) 117666.

14. Pallabi Das and Krishna Kant Kumar Singh (2021): Broad-spectrum contaminant removal from water using sustainable pressure assisted osmosis. Journal of Environmental Chemical Engineering, 9(1), 104594.

15. Prakash A. and Ray A. (2021): Criticality in computation of volume excavated by opencast mining: some key observations. Indian Journal of Engineering.18 (49),48-57.

16. Prakash A., Murthy V.M.S.R., Singh K.B., Kumaraswamidhas L.A. and Kumar C. (2020): A methodology for designing cutting drum of surface miner to achieve production of desired chip size. S-dhan-. June, 45:143.

17. Prakash A., Verma A. and Kumar A. (2020): Apprehension of subsidence over old workings: A case study. Minetech. 41(2), April-June, 9-20.

18.Paul, T. R., Nath, H., Chauhan, V., & Sahoo, A. (2020): Gasification studies of high ash Indian coals using Aspen plus simulation. Materials Today: Proceedings.

19. Paul, A., Kumar, N., Kumar, P., Singh, A.K. (2020): Application of CMRI-ISM RMR for stability analysis of development workings for Ballarpur underground coal mine - An empirical and numerical approach. Journal Geological Society of India, 96:163-170.

20. Ranjeet Kumar Singh, Debjit Pal, Shailendra Kumar Singh, Nimisha Tripathi, and Raj Shekhar Singh (2021): Utilization of Iron Ore Tailings for Brick Manufacture from Donimalai Mines of Karnataka, India. Journal of Scientific and Industrial Research (JSIR), 80(03), 210-220.
21. Roy M P, Singh P K, Kumar S & Paswan R K. (2020): Blast Design Parameters for Rock Fragmentation – A Key to Productivity. Minetech, CMPDIL Ranchi, July-September 2020, Vol. 41(3), pp 33-43.
22. Roy P.P., Sawmliana C., Prakash A. and Singh R.K. (2020): Safe exploitation of developed pillars of a coal seam above fire affected areas – a case study. Mining Technology. 129(4), 206-216.
23. Sahu, G., Saha, S., Khuman Y.S.C., Datta, S., Chavan, P.D. (2020):Transesterification of Jatropha curcas Oil by using K impregnated CaO Heterogeneous Catalyst. Journal of Scientific and Industrial Research (JSIR), 79(12), 1080-1086.
24. S. K. Chaulya, A. Chowdhury, Sunil Kumar, Raj Shekhar Singh, Shailendra Kumar Singh, Ranjeet Kumar Singh, G. M. Prasad, S. K. Mandal, and G. Banerjee (2021): Fugitive dust emission control study for a developed smart dry fog system. Journal of Environmental Management, 285, 112116.
25. Sudhir Kumar Kashyap, Lalan Kumar & AVLN Rao (2020): "Coal Sampling Machine for Instant Coal Ash & Moisture Analysis from Trucks" Minetech, Vol.41, No.3, July-Sept.2020, pp19-24
26. U.S.Chattopadhyay and T.Gouri Charan (2021): "Utilization of High Ash, Low Volatile Coking Coals of Jharia Coalfields, India for Coke Making" Coke and Chemistry, 2021, Vol. 64, No. 1, pp. 12–17.
27. U.S. Chattopadhyay, S.C. Maji, Sanjay Choudhuri and T. Gouri Charan (2020): "Cleaning Potentialities of High-Ash non-coking coal of SCCL coalfields through washability investigations", Minetech, Vol.41 No.2, pp 3 – 8, April-June' 2020.

III. PAPERS PRESENTED IN NATIONAL SEMINARS/SYMPOSIA/CONFERENCES

1. सुधीर कुमार कश्यप, "अभियांत्रिकी पदार्थ की जांच एवं परीक्षण" सीएसआईआर-सिंफर में हिन्दी सप्ताह समारोह (07-14सितम्बर,2020)के दौरान विशिष्ट व्याख्यान
2. Sudhir Kumar Kashyap, "Testing of Engineering Materials"Key Note paper presentation at one day webinar at GIET University Gunupur (Odisha).
3. Sudhir Kumar Kashyap," A Journey from Concept to Commercialization through Academia" Key Note paper presentation at two day 3rd International Congress on Advances in Mechanical Engineering (webinar mode) at VCE (Autonomous) Hyderabad, on 27-28 August 2020.
4. Sudhir Kumar Kashyap, "Knowledge base for Robotics vis-à-vis Automation" Chief Speaker in the TEQIP-III sponsored workshop on "Automation and Robotics in Construction Industry (ARC-2021) (15-19th March,2021) organized by Department of Production & Civil Engineering, IGIT Sarang.

IV. BOOK PUBLISHED/ CHAPTERS IN BOOK

1. Aaditya Chaturvedi, Bhanu Pandey, Aneet Kumar Yadav, Shubham Saroj (2021). An overview of the potential impacts of global climate change on water resources. Water Conservation in the Era of Global Climate Change, 99-120.
2. Ashok K. Singh, Reginald Ebhin Masto, Bodhisatwa Hazra, Joan Esterle, Pradeep K. Singh, (2020). "Ash from Coal and Biomass Combustion" , Springer, Switzerland, 2020, ISBNN; 978-3-030-56981-5.
3. Bhavna Jaiswal, Arideep Mukherjee, Bhanu Pandey, Madhoolika Agrawal (2020). Emission of Greenhouse Gases from Soil: An Assessment of Agricultural Management Practices. In Plant Responses to Soil Pollution (pp. 221-248). Springer, Singapore.
4. Gupta, N. K., Chauhan, V., Singh, R., Sahu, G., & Gupta, S. K. (2020). Heteroatom modified carbon nanomaterials as metal-free catalysts for lignocellulosic carbohydrate valorization. In Advanced Functional Solid Catalysts for Biomass Valorization (pp. 121-140). Elsevier.

5. Kumar, A., Kumar, D., Singh, A.K., Ram, S., Kumar, R., & Singh, A.K. (2020):Developments made for mechanised extraction of locked-up coal pillars in Indian geomining conditions. IntechOpen. Mining Techniques - Past, Present and Future. Ed. Dr. A. K. Soni. doi: 10.5772/intechopen.93636.

6. Pallabi Das, Suman Dutta and Krishna Kant Kumar Singh (2020). Forward Osmosis membrane for water purification. In Synthetic polymeric membranes for advanced water treatment, gas separation, and energy sustainability (pp 159-172). Elsevier.

7. Singh A K., Masto RE., Hazra B., Esterle J., Singh PK., (2020), Springer International Publishing,118 pages, Springer Nature (ISBN: 978-3-030-56980-8) https://doi.org/10.1007/978-3-030-56981-5.

V. HONOURS

1. Dr. Santosh Kumar Ray, Senior Principal Scientist has been appointed as a Member, Board of Mining Examinations (Coal) at Directorate General of Mines Safety, Dhanbad for a period of three years vide Gazette Notification of Ministry of Labour and Employment, Government of India on 8th October 2020.

2. Dr. Abhay Kumar Singh delivered lecture on “Mining impacts on environment and its management” in 4th Refresher Online Course in Environmental Studies organised by Jawaharlal Nehru University during September 7th - 19th, 2020.

3. Dr. Abhay Kumar Singh is nominated as a member of BIS Sectional Committee: CHD 36 (Water Quality) and WRD 14 (Water Conductor Systems).

4. Dr. Abhay Kumar Singh is serving as an Associate Editor for Springer Group Journal “Mine Water and the Environment”.

5. Dr. Abhay Kumar Singh name has appeared in the list of top 2% World’s most-cited Scientists released by Stanford University in the disciplines of Environmental Science and Engineering.

6. Dr. Abhay Kumar Singh was invited as reviewer for International Journals-: Applied Water Science, Energy Exploration & Exploitation and Environmental Science and Pollution Research.

7. Dr. M.S. Alam is nominated as IQAC member of P.K. Roy Memorial College, Dhanbad.

8. Dr. M. S. Alam is nominated as IQAC member of R.S. More College, Dhanbad.

9. Dr. Bhanu Pandey was invited as reviewer for International Journals-: Journal of Soil Science and Plant Nutrition and Science of The Total Environment.

10. Dr. Siddharth Singh was invited as reviewer for International Journals-: Atmospheric Research and Science of The Total Environment.

11. Ms. Pallabi Das was invited as a reviewer for International Journal -: Environmental Science and Pollution Research.

12. Dr. D. Basak is Member of BIS Committee on “Continuous Bulk Conveying, Elevating, Hoisting, Aerial Ropeways and Related Equipment Sectional Committee, MED-06”.

13. Dr. D. Basak is Member of Panel – 1 on ‘Aerial Ropeways’, MED 06 and contributed in the work related to the cause of standardization/revision of following Indian Standards: (1) IS 17405: 2020 (July): Calculation for Design of Ropeway Installation Intended for Transportation of Passengers – Code of Practice and (2) IS 17406:2020 (July): Transportation, Storage, Installation and Tensioning of Wire Ropes for Passenger Ropeway –Code of Practice.

14. Dr. D. Basak is Alternate Member of BIS Committee on “Wire Ropes and Wire Products Sectional Committee, MED-10”.

15. Dr. D. Basak is a Member of the Editorial board for “Amity Journal of Operations Management (AJOM)”.

16. Dr. D. Basak is Member of the Editorial Team for "Journal of Mechanical Engineering Research"
17. Dr. D. Basak is Reviewer of following international peer reviewed journals: Information Sciences, NDT & E International, Global Advanced Research Journal of Engineering, Technology and Innovation, Educational Research, Mechanical Engineering Research, The European Journal of Finance and Materials Evaluation
18. Dr. D. Basak was Invited as a member in judging panel of " Nav Ujjwale-innovation hackathon" held from 4-6 August, 2020 by model club, BIT Sindri , Dhanbad.
19. Dr. D. Basak is Member ,in organizing committee of International Conference on Mining and Geology (ICMM -2021) , to be held on July 01-03 ,2021 at Munich, Germany.
20. Dr. D. Basak Got Appreciation Letter from Dean , School of Engineering and Technology, GIET University, Gunupur, Odisha for enthusiastic presentation as Keynote Speaker to grace one day webinar on 13th June 2020
21. Dr. D. Basak was Selection as Invited MEMBER of Advisory Committee in a two day on line "International Conference on Innovation in Design and Manufacturing Engineering" (ICIDME-2021) date 22-23 January 2021 by Department of Mechanical Engineering, GIET University , Gunupur, Odisha
22. Dr. D. Basak was selected as MEMBER of Advisory Committee in a two day "Third International Congress on Advances in Mechanical Engineering" (ICAMS-2020) held on 27-28 August ,2020 by Department of Mechanical Engineering, Vardhaman College of Engineering (Autonomous), Hyderabad, INDIA.
23. Dr. D. Basak was selected as MEMBER of Advisory Committee in two day International Conference on Intelligent and Smart Computing in Industrial Application(ISCIA-2021) held on 8-9 March,2021 by Department of Production Engineering and Civil Engineering, IGIT (An autonomous institute of Govt. of Odisha), Sarang, Odisha, India.
24. Dr. D. Basak was invited as Keynote Speaker by GIET University, Gunupur (Odisha) to grace one day webinar on 13th June 2020.
25. Dr. D. Basak was invited as Keynote Speaker by Vardhaman College of Engineering (Autonomous), Hyderabad to grace "Third International Congress on Advances in Mechanical Engineering " (ICAMS-2020) held on 27-28 August, 2020 in online mode.
26. Dr. D. Basak was invited as Speaker by Department of Mechanical Engineering of GIET University, Gunupur (Odisha) for Faculty Development Programme (FDP) series 2of 2 on " Application of Artificial Intelligence and Machine Learning in Digital Manufacturing" in association with AICTE AQIS 2019-20 during 1-14, December 2020.in online mode.
27. Dr. D. Basak was invited as Chief Speaker in the TEQIP-III sponsored workshop on "Automation and Robotics in Construction Industry (ARC-2021) (15-19th March,2021) organized by Department of Production & Civil Engineering , IGIT Sarang.
28. Dr. B. Ahirwal is a member in organization Committee of Workshop on "Self Reliant India : Science and Technology (सृष्टि)" held on 29/1/2021 at CIMFR jointly organised by IEI, India and CIMFR, Dhanbad.
29. Dr. S.K. Kashyap was invited as a member in judging panel of " NavUjjwale-innovation hackathon" held from 4-6 August, 2020 by model club, BIT Sindri , Dhanbad.
30. Dr. S.K. Kashyap was invited as a Member ,in organizing committee of International Conference on Mining and Geology (ICMM -2021) , to be held on July 01-03 ,2021 at Munich, Germany.
31. Dr. S.K. Kashyap got Appreciation Letter from Dean , School of Engineering and Technology, GIET University, Gunupur, Odisha for enthusiastic presentation as Keynote Speaker to grace one day webinar on 13th June 2020
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38. Dr. S.K. Kashyap was invited as Chief Speaker in the TEQIP-III sponsored workshop on "Automation and Robotics in Construction Industry (ARC-2021) (15-19th March, 2021) organized by Department of Production & Civil Engineering , IGIT Sarang.

VI. AWARDS

1. Dr. K. N. Sinha Award (Highest IF of papers published in SCI Journals for scientific staff members, 3rd), from CSIR-CIMFR, Dhanbad was conferred to Mr. Santosh Kumar Behera.
2. Dr. Santosh Kumar Ray, Senior Principal Scientist received Best Research Award for the contribution and honourable achievement in Innovative Research by Science Father on October 2020 (https://youtu.be/BLFO8KyaNv0).
3. Dr. Avinash Paul has been nominated for ROCHA medal award 2022 from India.

VII. ATTAINMENT OF QUALIFICATION

1. Dr. Avinash Paul, Senior Principal Scientist has earned his (Doctoral) Ph.D., degree from Indian Institute of Technology (Indian School of Mines), Dhanbad, Jharkhand, India. The title of his thesis was "Development of Rock Mass Classification (RMRdyn) for rock load estimation in coal mine development headings of Bord and Pillar workings".
2. Aaditya Chaturvedi has been awarded Ph.D. degree on the topic "Geo-environmental study of groundwater resources of Subarnarekha River Basin with special reference to pesticides and heavy metal distribution" under the supervision of Dr. Abhay Kumar Singh.
3. Mr. Ashok Kumar, Scientist has submitted his Ph.D. thesis to Indian Institute of Technology (Indian School of Mines), Dhanbad, Jharkhand, India. The title of his thesis is "Development of design norms for rib/snook during mechanised depillaring by continuous miner".

VIII. PATENTS

1. Retractable bed cover and dust collector for transport vehicles", 0184NF2020; dated 11.11.2020; Chaulya, S.K., Roy, S.K., Prasad, G.M., Mandal, S.K., Banerjee, G., Singh, P.K., Dey, S., Virendra Kumar, Preity, Mishra, R., Rajak, K.K.
2. Slope stabilization and monitoring technique using geo-synthetic concrete cement mat and IoT devices", 0030NF2021, dated 12.02.2021; Chaulya, S.K., Roy, S.K, Rana, A, Singh, P.K. Saurabh, Kabra, P. and Kabra, V.P.

3. Method for excavation of slot raise and rings simultaneously in underground stope using drilling and blasting; Patent Application No. 0033NF2021; Murari Prasad Roy, Vivek Kumar Himanshu, Ranjit Kumar Paswan, Suraj Kumar, Chhangte Sawmliana, Pradeep Kumar Singh.
4. A process for preparation of ammonium nitrate fuel oil explosives composition by recycling waste lubricant oil" Patent Application No. 202111014942, March 31, 2021; F. Ali, M.P. Roy, B.M.P. Pingua, P.K. Singh.
5. An Improved Process of Beneficiation of washery grade VI Coal for production of upgraded coking coals and Power Coals; Application No: 202111001135,: Prov. Filing Date : 11/JAN/2021; Udayshankar Chattopadhyay, Thonangi Gouricharan, Subhash Chandra Maji & Pradeep Kumar Singh.
6. Development of Thermogravimetric Reactor (TGR) to study weight changes and process thereof; NF Number 0139NF2020/IN. Application No 202111001133, Filing date: 11/Jan/2021; Prakash D. Chavan, Sujan Saha, Gajanan Sahu, Sudipta Datta, Vishal Chauhan, Nilesh D. Dhaigude, Pradeep Kumar Singh.
7. "Oil immersed (Ex o) cum Increased Safety (Ex e) Transformer with observation window, Ex hooter and other safety features for use in Hazardous Areas of Oil Mines and areas where similar hazards are encountered", 0152NF2020; Dated:27-Aug-2020; Bhagirath Ahirwal & Gautam Banerjee.
8. "Purge and pressurized (Ex p) protected variable speed drives (VSDs) suitable for use in Hazardous Areas", 0029NF2021; Dated: 23-Feb-2021; Bhagirath Ahirwal & Gautam Banerjee.
9. Graphitization of heat altered coal waste in the form of natural coke, Ashok K. Singh & Pradeep K Singh (2020): (File No.: IPR/CIMFR/NA (01)/06 (1)/20), Indian Patent Application No. 202011030084, NF Number (CSIR internal): 0083NF2020).

IX. COPYRIGHTS:

Sl. No.	Developers	Title	Copyright No.
1.	Chaulya, S.K. Prasad, G.M., Mandal, S.K., Banerjee, G., Singh, P.K., Kumar, V., Mitra, M., Kumar, A., Mishra, S.S. and Kumar, R.	Integrated Rural Facilitation Software (GraminMitra)	SW-13961/2020, dated 09.12.2020
2.	Chaulya, S.K. Prasad, G.M., Singh, R.S., Singh, D.B., Nikhil, K., Mondal, G.C., Preity, Mitra, M., Kumari, A. and Kumar, R.	Soil and Water Health Reporting Software	SW-14170/2021, dated 11/02/2021
3.	Chaulya, S.K. Prasad, G.M., Mandal, S.K., Banerjee, G., Singh, P.K., Kumar, V., Mitra, M. and Kumar, R.	Gramin E-Bazar Software	SW-14135/2021, dated 25.01.2021
4.	Debashish Mishra, Jai Krishna Pandey, Santosh Kumar Ray, Niroj Kumar Mohalik, Pradeep Kumar Singh, Raj Priyadarshi	CIMFR-PSYCHRO	
5.	Debashish Mishra, Santosh Kumar Ray, Jai Krishna Pandey, Niroj Kumar Mohalik, Pradeep Kumar Singh, Raj Priyadarshi	FIRE INDICATOR	
6.	Santosh Kumar Ray, Debashish Mishra, Jai Krishna Pandey, Niroj Kumar Mohalik, Pradeep Kumar Singh, Raj Priyadarshi	MINE-EXPLO	
7.	Pallabi Das, Ranjit Siddharth Rangari, Krishna Kant Kumar Singh, Pradeep Kumar Singh.	Process Intensified Integrated chemical dosing filtration assembly	
8.	Prakash D. Chavan, Sujan Saha, Sudipta Datta, Gajanan Sahu	High Ash Indian Coals: Gasification Strategy.	L-97261/2020. CR No. 017CR2020.

Sl. No.	Developers	Title	Copyright No.
9.	Sujan Saha, Prakash D. Chavan, Gajanan Sahu, Sudipta Datta P.D. Chavan, S. Saha, S. Datta & G. Sahu	Coal Characterization Matrix to evaluate Gasification Potentiality	L-91840/2020. CR No. 012CR2020
10.	Prakash D. Chavan, Sujan Saha, Sudipta Datta, Gajanan Sahu	Selection Matrix: Physico-chemical properties of Solid Fuels vis-a-vis Suitable Type of Gasifier	004CR2020. Date of Filing 01.10.2020

X. LIST OF RESEARCH COUNCIL

1.	**Prof. E.S. Dwarakadasa,** Former Professor, Department of Metallurgy, Indian Institute of Science, Bangalore and Chairman Karnataka Hybrid Micro Devices Ltd., Plot 103, 4th Cross, Electronic City, Bangalore – 560 100	Chairperson
2.	**Prof. Rudra Pratap,** Deputy Director, Indian Institute of Science, CV Raman Road, Bengaluru - 560012	External Member
3.	**Prof. Kamal K. Pant,** Professor, Department of Chemical Engineering, Indian Institute of Technology, Hauz Khas, New Delhi - 110016	External Member
4.	**Prof. Sunil Kumar Singh,** Director, National Institute of Oceanography, Dona Paula, Goa - 403004	External Member
5.	**Shri Ramesh Babu V,** Director (Operation), National Thermal Power Corporation Limited, NTPC Bhawan, SCOPE Complex, Institutional Area, Lodhi Road, New Delhi – 110 003	External Member
6.	**Shri Bhola Singh,** Director, Technical (Project & Planning), Central Coalfields Limited, Darbhanga House, Kutchery Road, Ranchi – 834029 (Jharkhand)	External Member
7.	**Shri Rajendra Dashora,** SBU Director, Rajpura Dariba Complex, Hindustan Zinc Limited, Vendanta Resources, Yashad Bhawan, Udaipur- 313004	Agency Representative
8.	**Dr. Suman Kumari Mishra,** Head, Human Resources, CSIR-National Metallurgical Laboratory, Jameshedpur – 831007	DG's Nominee
9.	**Dr. N. Kalaiselvi, Director,** CSIR-Central Electrochemical Research Institute, CECRI, Nagar, Karaikudi – 623006	Sister Laboratory
10.	**Dr. Pradeep Kumar Singh,** Director, CSIR - Central Institute of Mining and Fuel Research, Dhanbad - 826015	Director
11	**Dr. Rama Bansal,** Head, International S&T Affairs Directorate, Council of Scientific and Industrial Research, Rafi Marg, New Delhi – 110 001	CSIR Hqrs. Invitee
12	**Dr. Siddharth Singh,** Sr. Principal Scientist, CSIR - Central Institute of Mining and Fuel Research, Dhanbad - 826015	Secretary

XI. LIST OF MANAGEMENT COUNCIL

Sl. No	Name & Designation	Portfolio
1	**Dr. Pradeep Kumar Singh,** Director, CSIR-CIMFR, Dhanbad	Chairman
2	**Dr. K. Muraleedharan,** Director, CSIR-CGCRI, Kolkata	Member
3	**Dr. R.V.K. Singh,** Chief Scientist & Head, BDIL, CSIR-CIMFR	Member
4	**Dr.Sujit Kumar Mondal,** Chief Scientist, CSIR-CIMFR	Member
5	**Dr. Ashok Kumar Singh,** Sr. Principal Scientist, CSIR-CIMFR	Member
6	**Dr. P. B. Choudhury,** Sr. Principal Scientist, CSIR-CIMFR	Member
7	**Dr. V. Anguselvi,** Principal Scientist, CSIR-CIMFR	Member
8	**Sri Dayakant Kumar,** Finance & Account Officer, CSIR-CIMFR	Ex-Officio Member
9	**Sri Rakesh Kumar Singh,** Sr.Technical Officer (1), CSIR-CIMFR	Member
10	**Sri Dasmath Murmu,** Administrative Officer, CSIR-CIMFR	Ex-Officio Member-Secretary

XII. STRENGTH OF STAFF OF CSIR-CIMFR AS ON 31-03-2021

Group / Grade	Total
Director	01
Group IV	122
Group III	139
Group II	45
Group I	72
Administrative	136
Total	515

XIII. EXPENDITURE FOR THE YEAR 2020-21

Head		**Amount (Rs. in Lakh)**
Capital	=	739.670
Revenue	=	7203.500
Staff Quarters	=	48.260
Total	=	7991.430

XIV. GLIMPSES OF PHOTOGRAPHS

Inauguration of newly built pathway inside the campus of CIMFR-Digwadih by Dr. P.K. Singh, Director, CSIR-CIMFR on 15.08.2020. Dr Ashish Mukherjee, Dr. T. Gouri charan, Dr. A.K. Singh and others are also seen

On Independence Day i.e. on 15.08.2020 Dr. P.K. Singh, Director, CSIR-CIMFR hoisted tricolnu in front of main building of CIMFR-Digwadih Campus. Shri Amarjeet Singh, Security Officer is assisting to the Director

Puja function for opening of newly built staff canteen at CIMFR- Digwadih Campus on 26.09.2020. Smt. Usha Singh along with Dr. P.K. Singh, Director, CSIR-CIMFR performing Puja as jajman in side the canteen premise. Dr. Ashish Mukherjee, Dr. T. Gouri charan and others are also seen

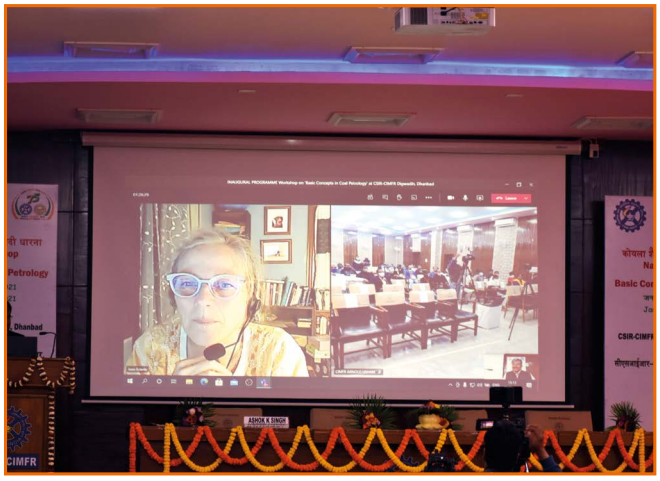
Smt Usha Singh planting a sapling of a tree in the campus of CIMFR- Digwadih Campus on 26.09.2020. Dr. R.E. Masto and others are also seen

Under Swach Bharat mission program CIMFR staff assembled in front of main building of CIMFR- Digwadih Campus to Celebrate birth day of Mahatma Gandhi on 02.10.2021. Dr Ashish Mukherjee, Dr. T. Gouri charan, Dr. A.K. Singh, Dr. S.K. Bharti on the left side while Shri T.B. Das, Dr. A.K. Raman and Dr. Pinaki Sarkar on the right side of the portrait of Mahatma Gandhi

Shri T.B. Das, Chief Scientist of CIMFR-Digwadih Campus administering the oath to the staff members for Anti Corruption Day on 27.10.2020

On the eve of New Year's day on 1st January 2021, Dr. P.K. Singh, Director, CSIR-CIMFR is meeting with the staff of CIMFR-Digwadih Campus. Smt Rita Dutta, Smt. Krishna Chattopadhyay, Smt Jiamuni Murmu are also seen

Inauguration of workshop on Basic Concepts in Coal Petrology on 18.01.2021. Dr. Shekhar C. Mande, Director General, CSIR, New Delhi at the podium. On the dias (L to R) Dr. P.K. Singh, Dr. R.K. Pandey, V. C., Ranchi University, Ranchi and Dr. A. K. Singh



On the occasion of inauguration of workshop on Basic Concepts in Coal Petrology during 18-19 January 2021. Dr. Joan Esterle from Australia participating on line on 18.01.2021

Lecture by invited speaker Shri Ravi Venkata Krishnan, Market Development Manager, Leica on the occasion of workshop on Basic Concepts in Coal Petrology on 18 January 2021

Training is going on for the participants of workshop on Basic Concepts in Coal Petrology on 18 January 2021

Participants of workshop on Basic Concepts in Coal Petrology visited Coal Characterisation Laboratory on 19 January 2021. Laboratory equipments are being demonstrated by Mr. Abhishek Mahato and Mr. Om Prakash Kumar

Visit of Coal Carbonization Laboratory by participants of workshop on Basic Concepts in Coal Petrology on 19.01.2021. Shri G.K. Bayen, Scientist is demonstrating the Plant

Visit of Pilot Plant of Coal Preparation laboratory by participants of workshop on Basic Concepts in Coal Petrology on 19.01.2021. Dr. K.M.K. Sinha, Scientist is demonstrating the Pilot Plant

Giving away Certificate to the participant of the workshop on 19.01.2021 on Basic Concepts in Coal Petrology during 18-19 January 2021. Shri Dilip Kumbhakar is giving certificate. Dr. A.K. Singh is assisting him

On the occasion of Republic Day celebrating on 26.01.2021. Dr. P.K. Singh, Director, CSIR-CIMFR, delivering speech after flag hoisting in front of main building of CIMFR- Digwadih Campus. Shri Amarjeet Singh, Security Officer is also seen

On the occasion of inauguration of Summit on Women in Technology-Role of Women in Sustainable Technology and Climate Change on 08.03.2021. On the dias (L to R) Dr. V. Anguselvi, Smt. Usha Singh, Dr. Sridevi Annapurna Singh, Director, CFTRI, Mysore, Dr. Gautam Banerjee and Dr. Babli Prasad

Dr. Amalendu Sinha, Ex. Director, CSIR-CIMFR lighting the lamp on 16.03.2021 on the occasion of workshop on Basic Concepts of Coal Sampling and advanced Technique of Coal Sampling through mechanical Auger. Dr. Gautam Banerjee, Shri Dilip Kumbhakar and Dr. A.K. Singh are also seen

Dr. A.K. Singh, Head, RQA is lighting the lamp on 16.03.2021 on the occasion of Basic Concepts of Coal Sampling and advanced Technique of Coal Sampling through mechanical Auger. Dr. Amalendu Sinha, Dr. Gautam Banerjee and Shri Dilip Kumbhakar are also seen

Inauguration of Workshop on Basic Concepts of Coal Sampling and advanced Technique of Coal Sampling through mechanical Auger on 16.03.2021. Dr. A. K. Singh, Head RQA on the podium. On the dias (L to R) Dr. Gautam Banerjee and Amalendu Sinha

Facilitation to Mr. Prashant Kumar, G.M. Quality Control, Eastern Coalfield Ltd., Sanctoria, W.B. with a shawl by Dr. Gautam Banerjee at the end of Workshop on Basic Concepts of Coal Sampling and advanced Technique of Coal Sampling through mechanical Auge on 16.03.2021. Dr. A. K. Singh and Ashish Mukherjee are also seen

Inauguration of workshop on Concepts of Coal Sampling Techniques at CIMFR-DC, Raniganj Unit on 17.03.2021. On the dias (L to R) Dr. A. K. Singh, Dr. Gautam Banerjee, Dr. Amalendu Sinha and Shri P. Kumar

Training Program at the site of Railway Coal dispatch siding, Mugma, ECL, Dhanbad under the workshop on Concepts on Coal Sampling Technique on 17.03.2021

Inauguration of Skill Development Program on Analytical Chemistry and Application in Soil and Water Analysis on 23.03.2021. On the dias (L to R) Dr. R.E. Masto, Dr. Ashish Mukherjee, Shri Dasrath C. Das, Shri Lalit K. Das and Shri Dilip Kumbhakar

MoU signed between CSIR-CIMFR and BRO at New Delhi on November 25, 2020

Proud moment for CSIR-CIMFR Team with Director General of CSIR after signing MoU with BRO

" I visited CSIR-CIMFR, Dhanbad as I have taken over as the Director (additional charge) along with my usual work as the Director, IMMT Bhubaneswar. This is one of the best CSIR Lab in terms of ECF generation & perhaps true considering all R&D labs under different Ministries. I visited all the research groups - extra ordinary facilities have been created over the years."

सीएसआईआर - केंद्रीय खनन एवं ईंधन अनुसंधान संस्थान
(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद्)
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