The Executive Summary of Projects

Project title: Advice for controlled blasting at stone mine No. 4 of Arena Food & Agro Industries Pvt. Ltd., Sheikhpura, Bihar to keep ground vibrations, noise/air overpressure and flyrocks within safe limits **Project No.** CNP/4929/2019-20	**Executive Summary** This report relates to the scientific study conducted by the Rock Excavation Engineering Division of CSIR-Central Institute of Mining and Fuel Research (CSIR-CIMFR), Dhanbad at Stone Mine No. 4 of M/s Arena Food &Agro Industries Pvt. Limited, Sheikhpura, Bihar. The main objective of the study was to assess the blast design parameters being used in the mine and develop safe and optimum controlled blast design parameters for day-to-day blasting operations to keep ground vibrations, noise/air overpressure and flyrocks within safe limits. The field investigations were carried out at the mines during 22nd - 24th October 2019. Eight experimental blasts were conducted at different locations of the mine in Northern and Southern Blocks with varying design patterns and explosive loading parameters. Blast induced ground vibrations and air overpressure/ noise generated during the experimental blasts were monitored on ground surfaces at various distances in the direction of nearby structures. Flyrock generated during the experimental blasts were also observed and studied. The investigational works, observations, results of the experimental blasts conducted, analyses of the data, conclusions and recommendations made in the report are summarized below. (1) In total, eight experimental blasts were conducted at the mines on 23rd and 24th October 2019. Out of the eight blasts, four blasts each were conducted in Northern and Southern Blocks of the mines with varying hole depths and design patterns. (2) All the experimental blasts were conducted using 110 mm blasthole diameter. Large diameter cartridge explosive of 83 mm diameter, 2.78 kg weight per cartridge and Nonel (shock-tube) initiation system (Dualdet -

	17/250 ms, TLDs - 25 ms& 42 ms) were used in all the blasts. (3) In the four experimental blasts conducted in Northern Block, the number of holes in a blasting round varied between 6 and 17. The depth of holes varied from 7.8 to 8.5 m. The burden and spacing values were 3.0 m each in all the blasts. Top stemming column length varied from 3.0 to 3.5 m. The explosive charge per hole varied from 41.11 to 42.19 kg. The maximum charge per delay varied between 41.70 and 50.04 kg whereas total explosive charge in the blasting round varied between 246.64 and 717.24 kg. (4) In the four experimental blasts conducted in Southern Block, the number of holes in the blasting round varied between 4 and 11. The depth of holes varied from 7.7 to 9.0 m. The burden and spacing values were 3.0 m each in all the blasts. Top stemming column length varied from 4.0 to 4.2 m. The explosive charge per hole varied from 33.10 to 33.36 kg. The maximum charge per delay varied between 33.36 and 36.14 kg whereas total explosive charge in the blasting round varied between 136.22 and 366.96 kg. (5) Blast induced ground vibrations and air overpressures/noise generated during the different experimental blasts were monitored on compacted ground surface for both the northern and southern blocks using digital seismographs. The distances of ground vibration monitoring points from the experimental blast sites varied from 200 to 400 m. (6) For the blasts conducted in Northern block, the magnitudes of ground vibrations (Peak Particle Velocity, PPV) recorded at different locations varied from 0.648 to 4.953 mm/s and the peak dominant frequencies varied from 8.0 to 19.5 Hz. The distance of vibration monitoring points varied between 208 and 400 m. (7) In Northern block, the highest magnitude of ground vibration recorded was 4.953 mm/s with associated dominant peak frequency of 12.50 Hz. This was recorded on ground surface towards the mine office at 208 m distance from Blast No. B-5. The maximum charge per delay in the blasting round was 50.04 kg and total explosive charge was 717.24 kg. (8) For the blasts conducted in Southern block, the magnitudes of ground vibrations (PPV) recorded at different locations varied from 0.635 to 4.677 mm/s and the peak dominant frequencies varied from 8.75 to 28 Hz. The distance of vibration monitoring points varied between 200 and 380 m. (9) In Southern block, the highest magnitude of ground vibration recorded was 4.677 mm/s with associated dominant peak frequency of 15.38 Hz. This was recorded on ground surface near the office of Mine No. 4 at 200 m distance from Blast No. B-1. The maximum charge per delay in the blasting round was 36.14 kg and total explosive charge was 366.96 kg. (10) In all the eight blasts, the peak dominant frequency of ground vibration waves obtained at different vibration monitoring points were more than 8 Hz (i.e. 8.0 - 28.0 Hz). Hence, as per the DGMS Technical Circular No. 7 of 1997, the safe and threshold level of ground vibration for the safety of houses and structures nearby the mining area comes to 10 mm/s. (11) The ground vibration data recorded from all the trial blasts at different distances are all less than 10 mm/s. Therefore, the magnitudes of ground vibration data recorded from the experimental blasts are well within the safe limits as per DGMS ground vibration standards. (12) The levels of air overpressure recorded at different vibration monitoring

	points varied between 106.5 and 128.0 dB(L). The levels of air overpressure recorded are well within the safe limits as per International Standard. (13) No flyrock was observed in any of the experimental blasts. The throws of the blasted materials were also controlled and restricted within the blasting areas only. The control of flyrock was achieved through the proper blast design patterns, use of Nonel initiation system for bottom initiation along with proper implementation and supervision of the total blasting operations. (14) The propagation equation for prediction of blast-induced ground vibrations at Stone Mine No. 4 has been established and is given as ***Equation-7.1*** in the report. (15) The blasting operations can be carried out safely at the mines without damaging the residential structures present in nearby villages. The blast designs and explosive charging patterns being followed in the mines during the experimental blasts are safe and should be followed for day-to- day blasting operations at the mines. (16) The maximum explosive charge per delay for various distances from the residential houses/structures are recommended in ***Table 7.1*** in the report. These should be followed in the daily production blasting of the mines. However, the total quantity of explosives to be fired in a blasting round should not exceed 2.0 tons distributed in 20-30 holes.