Characterization of Coal Mine Refuse as Mine Filling Material a Sustainable Approach of Mining

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Abstract: This paper reviews the characterization of mine waste rock in underground mine filling, as an alternative of river sand. A huge mass of waste rock is generated along with open cast mining process termed as overburden (OB) material. With few exception most of the OB waste is dumped over valuable land mass cause's different environmental problems. On the other hand underground mining requires million tons of river sand annually for backfilling in mine voids. In lack of adequate amount of river sand mine voids are leaved unfilled that may leads to land subsidence and mine fire problems. Utilization of OB as an alternative of river sand in underground mine backfilling may solves all these problems. Characterization of OB as backfilling material requires different physical and geotechnical characterization as grain size analysis, specific gravity, porosity, permeability, compressibility, viscosity, flowability parameters and comparative analysis between the both.

Keywords: Overburden material (OB), Backfilling, Mine fire, Land subsidence

1. INTRODUCTION

Huge mass of waste rock is generated along with open cast mining practices as called as overburden material causes different environmental and ecological problems (Cherfas 1992; Chaoji 2002; Deka Bourah 2008). OB materials are temporarily dumped on valuable land as external dump or internal dump created by in-pit dumping (IPD), mine voids created during extraction of coal. Dumping of OB has some serious problems (Upadhyay, O. P., Sharma,) as requirement of additional land, involves very high trans-port and rehandling cost which will increase the cost of coal production substantially, stability and reclamation at the site. On the other hand mine voids created during the underground mining needs to be filled with suitable materials. River sand which is dominantly used as backfilling material due to its easy availability and unique geotechnical properties is under threat due to overexploitation. It also causes some negative impacts over river ecosystem and nearby land area. To restrict the overexploitation of the river sand some legal aspects are there also. In this way due lack of sand sometimes mine voids left unfilled that leads to mine subsidence and mine fire accidents. But as backfilling is mandatory part of underground mining thus there is big challenge for mining industries to find an alternative of river sand.

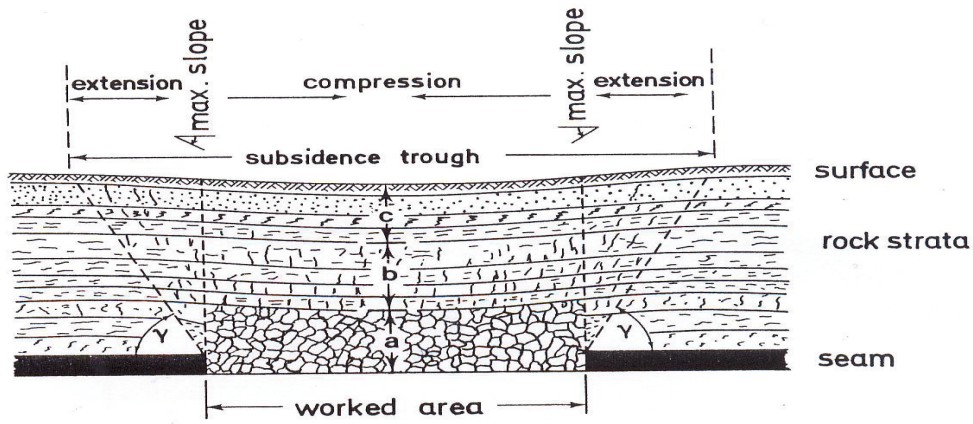

Figure: Cross-section of subsidence trough, a Zone of shattered roof beds over mine excavation; b fissured intermediate zone; c surface zone; γ limit angle from edge of working to trough margin (after Kratzsch, 1983).

1.1 Mine filling

Mine filling is an integral part of mining (Ayhan et al, 2004). This is why because unfilled mine voids may leads to different environmental problems as mine fire and land subsidence (Chen Li Ding, 1999). River sand is found to be best material as backfilling and widely used worldwide (Prashant Ghos and Mandal.2010). Coal mining industry felt scarcity of river sand in last few decades due to frequent mining and huge demand for river sand in civil sector. Different other materials have been tested and used for backfilling in some mines as an alternative of river sand. Mill tailings, waste rock, coal refuge, waste foundry sand are some important of them (Lokhnde. RD, Singh K.B et al (2005).

1.2 Fly ash as backfilling material

Fly ash is produced in huge amount in India and worldwide from thermal power plants. It has been used frequently in different manners either alone or mixed with binding agents (lime or gypsum). Typically it has been used for soil stabilization (Chu et al., 1955), as an embankment material (Raymond, 1961), structural fill (Digioia and Nuzzo, 1972), as injection grounting (Joshi et al., 1981). Master et al. (1975) reported successful studies on fly ash-cement mixture for subsidence control. Fawconnier and Korsten (1982) reported that the use of pulverized fly ash filling provide an effective stabilization to the coal pillars and minimize the risk of subsidence. Galvin and Wagner (1982) observed improved strata control using fly ash. Palariski (1993) reported the use of fly ash, mill tailings, rock and binding agents to make consolidated backfill material to improve extraction percentage in coal mines. Devi Prasad Mishra and Samir Kumar Das (2010) have

performed a study on Talchar coal fly ash to check their suitability as stowing material for underground mines.

1.3 Waste foundry sand (WFS) as stowing material

Waste foundry sand is another alternative material frequently used for mine filling, An Deng, J. Paul & Tikalsky 2007, have performed a geotechnical and physical analysis of WFS to check their suitability as mine filling that is approximately 9 metric tons disposed annually in USA. Beneficial utilization of WFS have been practiced in different sectors earlier as related to infrastructure engineering and rehabilitation works as highway embankment construction (Ham et al., 1990; Javed and Lovell, 1994a,b; Mast and Fox, 1998; Kleven et al., 2000; Abicou et al., 2004), ground improvement (Vipulanandan et al.,2000) flowable fill (Bhat and Lovell, 1996. 1997; Naik and Singh, 1997a,b; Naik et al., 2001; Tikalsky et al., 1998, 2000; Dingrando et al., 2004), all of these alternative and beneficial uses of waste are economically as well as environmental friendly but are not economically cheap.

2. CHARACTERIZATION OF CRUSHED ROCK AS UNDERGROUND MINE FILLS:

Prashant, Ghos and P.K Mandal, (2010) have reported coal mine waste as crushed rock can be considered as good alternative of river sand with proper investigation. They performed a brief geotechnical analysis of waste rock and formulated a design for the same. They performed Physical properties viz. specific gravity, bulk density, porosity & grain size analysis and water percolation characteristics, settlement characteristics etc.

2.1 Backfilling suitability assessment (BSA)

J Kortnik (2003) postulated a brief description about suitability assessment for the waste materials to be used as backfilling in mine voids this includes the following partial approaches.

- Assessment of the suitability of waste materials (WM)
- Assessment of the suitability of Waste material composite (WMC) as backfilling materials
- Assessment of the rock as a geological/technical barrier after backfill installation
- Assessment of the geotechnical properties of installed backfill.

3. CONCLUSION

From above literature review it is quite clear that mine waste as overburden dump is a big environmental issue. It has number of environmental implication that negatively impacts social activities also. Different material have been implemented as underground mine fill but river sand is still most suitable material. Overexploitation of river sand has some negative impacts over river ecosystem. Overburden dump waste might be a good solution for the same. It requires a brief investigation of geotechnical and physical parameters. From my side there is need of mineral

composition analysis of OB material because presence of some material may negatively impacts underground conditions.

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