Geotechnical Aspects of Overburden Materials for Stowing in Underground Coal Mines

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Abstract- **This paper deals with the geotechnical aspects of overburden material from Srirampur open cast mines of manchiryal and to investigate its suitability to be used as a stowing material. Backfilling, which is commonly known as stowing, provides stability of ground by preventing land subsidence and improving the coal production by increasing extraction of coal pillars. From last few decades, India is facing scarcity of river sand, the traditional stowing material owing to mining legislations and its heavy demand in infrastructure development. The existing coal mine overburden dumps might be a good alternative for sand and provide a sustainable mining practice. Geotechnical and physicoChemical characterization is required to evaluate the suitability of OB dump material to be used as an alternative. The properties such as specific gravity, particle size distribution, porosity, permeability have been determined. Sand being the traditional stowing material, all the properties the overburden material(OB) are compared in accordance to riverbed and processed overburden(POB).**

Keywords: Stowing. Processed overburden (POB), Overburden (ob)

I. INTRODUCTION

The choice of mining method is largely determined by the geology of the coal deposit. Opencast mining is a mining process that generates huge amount of rock waste. Waste rock material generated along with mining is called mine overburden (Prashant et al., 2010). During opencast mining, the overlying soil is removed and the fragmented rock is heaped in the form of overburden dumps (Ghosh, 2002). Open cast mines face serious problems of handling and disposal of the overburden produced as large storage area is required .Hence attempts are being made to utilize the overburden rather than to dump it. On the other side underground mining currently accounts for a bigger share of world coal production than opencast. Underground mining that accounts for about 15–20% of total coal production in India produces huge mine voids simultaneously (Sivakugan et al., 2004).Mine voids created during the underground mining should be stowed with suitable backfill material to avoid collapse of the overlying strata. Thus to provide ground supports to minimize the land subsidence problems and mine safety aspects, backfilling is the valuable part of mining (Kesimal et al., 2002; Barret et al., 1978). River sand is widely used, as a stowing material due to its easy availability and operational safety concern and the most important is its geotechnical properties. On the other hand, its overexploitation may cause negative impact to the riverine ecosystem as well as the productivity of nearby land mass. Thus an alternative of river sand for backfilling is required. Backfilling with mine overburden or waste rock material may provide an alternative for river sand. Utilisation of these nearby mine overburden dumps as backfilling material in underground mine voids might be a good alternative of river sand (Prashant et al. 2010). Backfilling with mine refuse and waste rock also includes the elimination of the environmental, health, safety and social problems associated with surface disposal (National Academy of Sciences, 1975).. For this, an in-depth understanding of the physical and engineering properties is needed. The study deals with the geotechnical aspects of overburden material from srirampur open cast mines of manchiryyal and to investigate its suitability to be used as a stowing material. The composite samples are collected at various depth 20m,60m 80m and the processed overburden is obtained from the processing plant situated near the OC .The properties such as specific gravity, particle size distribution, porosity , permeability have been determined. Sand being the traditional stowing material, all the properties are compared in accordance to riverbed.

II. MATERIALS AND METHODS

A. Materials

The hand-picked composite samples required for the investigation were collected from three different depth of 20m(SRP OC 20),60m (SRP OC 60) and 80 m(SRP OC 80) of Srirampur open-cast mines, Telengana. Processed overburden was collected from processing plants located near the open cast mines. The overburden samples were studied for their efficiency to be used as a stowing material without undergoing any treatment

B. Methodology

Certain properties such as specific gravity, particle size distribution, permeability are to be determined in the laboratory. The geotechnical properties are compared with the properties of river sand.

III. RESULTS AND DISCUSSIONS

The results of the physical and geotechnical characterization of the composite and processed overburden materials are as follows.

A. *Specific gravity*

The specific gravity of composite hand-picked and processed overburden samples are given below

Table1. Specific gravity of OB samples at various depth and processed OB samples

Sample	Specific gravity
River sand	2.65
SRP OC 20 m	2.52
SRP OC 60 m	2.54
SRP OC 80 m	2.63
Processed OB	2.67

B. *Particle size distribution*

The fractions above 20 mm are considered to be oversized and leads to pipe blockage and flow difficulties. Also the presence of finer particles causes permeability and settlement problems. Thus the material to be used for stowing has to be studied for its particle size distribution. Wet sieve analysis is conducted for estimating the fines percentage for each sample and dry sieve analysis is conducted for estimation of gradation properties. Fig.1 shows the percentage of fines of the processed overburden (POB) and composite overburden (OB) samples.

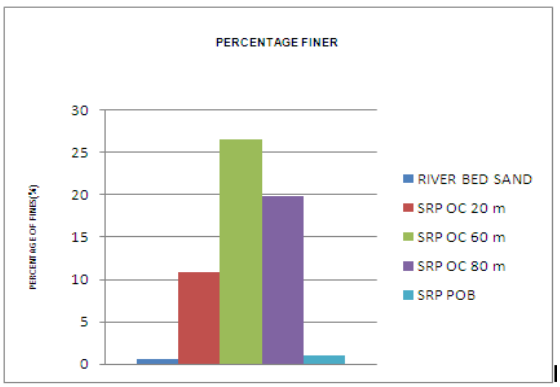

Fig 1. Percentage of fines of POB and ob at various depths

It is evident that composite samples at 60 m depth contains higher amount of fines. Presence of fines may cause water drainage and settlement problems

C. *Permeability*

Permeability is an important characteristic in hydraulic stowing. The results of the permeability test of srirampur open cast mine overburden samples show that the coefficient of permeability values of both the river bed sand and processed overburden samples is on the order of 10^{-3} cm/s to 10^{-4} cm/s which satisfies the equivalent permeability of stowing material. However, the permeability of processed overburden is higher than composite materials. SRP OC at 60 m possess the minimum permeability values in the order of 10^{-5} cm/s to 10^{-6} cm/s

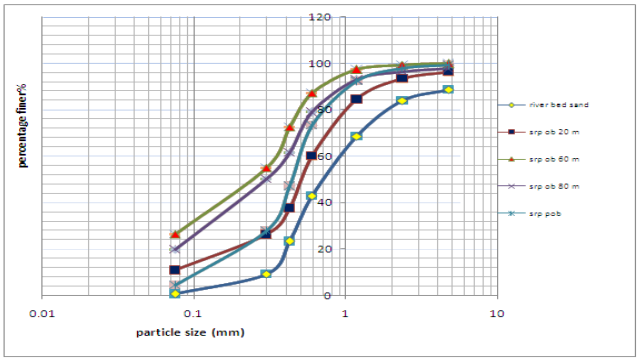

Fig 2. Particle size distribution of POB and OB at various depths

IV. CONCLUSION

In this study, we apply logic tree approach and fuzzy set theory to analysis seismic hazard of Warangal District. Calculations have been made for various combinations of variables with applying both fuzzy set theory and logic tree approach. The extracted outputs in the framework of fuzzy are defuzzified using mean of maxima method. Peak ground accelerations (Fig. 5) are estimated for 10% and 63% probability of exceedance in 50-year.

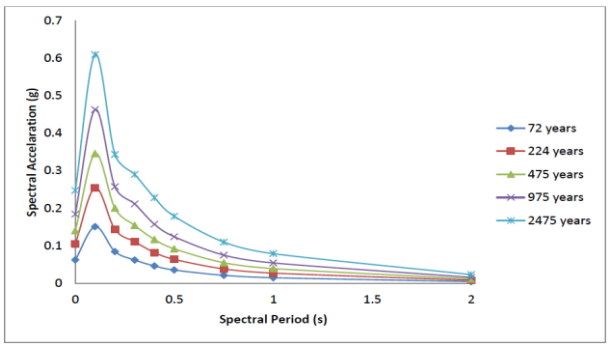

Fig. 5 Uniform Hazard Spectra for different return periods.

V. REFERENCES

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