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Utilization of Mining Waste in Geotechnical Engineering

Prof. Atul Gautam[1], Atit Raghuwanshi[2], Sukhadash Chauvan[3], Aniket Chaudhari[4], Sharad Gabhane[5], Nikhil Meshram[6], Ms. Nikhita Khandwaye[7]

Assistant Professor, Department of Civil Engineering[1]

Students, Department of Civil Engineering[2,3,4,5,6,7]

J D College of Engineering & Management, Nagpur, Maharashtra, India

Abstract: *This paper investigates the effect of fly on geotechnical properties of soil. Fly ash collected from the hopper attached to an electrostatic precipitator when coal was changed at a coal fired power plant. Concerning the major challenges regarding the safe reuse, management and disposal of these wastes an attempt has been made to mix fly ash at 5, 10, 15, 20, 25, and 30% on the basis of dry weight with local clay soil. To understand the behaviour of fly ash with soil, numbers of laboratory experiments were performed on the local soil (clay) and contaminated soil with varying percentage of fly ash.*

Keywords: Ggeotechnical properties, Concrete, Fly ash

I. Introduction

Coal is a major source of nonrenewable energy in India. Most of the Industries depend on the coal to meet the energy demand of the country. Coal mining is invariably associated with the generation of voids. The voids so generated are often filled with overburden (OB) and waste materials. To enhance the utilization, fly ash (FA) is also being used for filling the voids. However, these operations inevitably require excessive planning and control to minimize the environmental impact of mining. In order to evaluate the impact of backfilling the voids with coal mine wastes and fly ash, Overburden and fly ash materials have been collected from coalfield and Power Plant. The geotechnical characterization study of overburden (OB) sample and fly ash samples have been carried out separately for backfilling. After addition of fly ash, it is observed that the permeability is increased but liquid limit, plastic limit, and plasticity index (PI) of the OB are decreased.

Fly ash is mainly being utilized for making cement, bricks, concrete, roads and small quantity in mine void filling. The consumption of fly ash in construction activity has reached to almost saturation level and there is not much potential to consume more fly ash in these segments. Mining sector like mine void filling, underground stowing and mixing with overburden of open cast mine are the only potential area where bulk quantity of fly ash can be utilized so that 100% utilization target can be achieved. There are more than 165 opencast coal mines in India and many are near to thermal power stations. Opencast mining plays a major role in meeting the demand of coal for thermal power generation. The stability of overburden dumps stands at high priority from the safety and economic perspective. In Our Project Work we have to investigate the suitability of fly ash to be disposed of by mixing it with overburden (OB) dumps to increase the slope stability in coal mines.

Presently in India, there is reported 7.2million tone hazardous waste generation from more than40,000 registered industries according to Controller and Auditor General's report(CAG-2012)[1]and there is no estimate of unregistered hazardous waste generating industries. According to Dixit et al. (2016)[2], Contamination of land may be due to the disposal variety of wastes and chemicals on or in the soil. Sources of land contamination could be several. In India, During 2005-06 about 112 million tons of ash has been generated in 125 power station sand the ash production is expected to be about 72 million tons by 2012 and about 100 million tons by 2017[3].

II. Materials and Methods

In this study the local clay soil and fly ash are used to study the geotechnical properties. The locally available clay soil, fly ash samples and soil-fly ash mixed samples containing fly ash of 5, 10, 15, 20, 25 and 30% on the basis of dry weight and total seven numbers of samples are used for present investigation. The following laboratory test was carried out as per IS-2720.The test were carried out on both normal soil and soil fly ash mixed sample:

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1. Atterbergs limits
2. Grain size analysis
3. Specific gravity
4. Proctor compaction

III. Result And Discussion

The experimental results of different geotechnical properties of soil with different percentage of contamination with fly ash were presented in Table1.

Table 1: Variation of geotechnical properties with different percentage of contamination

%of fly ash as a contaminant	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	Shrinkage Limit (%)	Specific gravity	Optimum moisture content (%)	Maximum Dry Density(Kg/m^3)
0	36.95	24.44	12.51	10.57	2.63	19.33	16.48
5	36.80	24.88	11.92	10.51	2.60	20.08	16.45
10	36.50	24.97	11.53	9.28	2.58	21.03	16.44
15	35.66	24.19	11.47	8.56	2.55	21.43	16.40
20	35.01	24.15	10.86	7.30	2.53	21.83	16.53
25	34.92	24.39	10.53	7.02	2.40	21.97	15.75
30	34.72	24.60	10.12	6.30	2.33	22.37	14.93

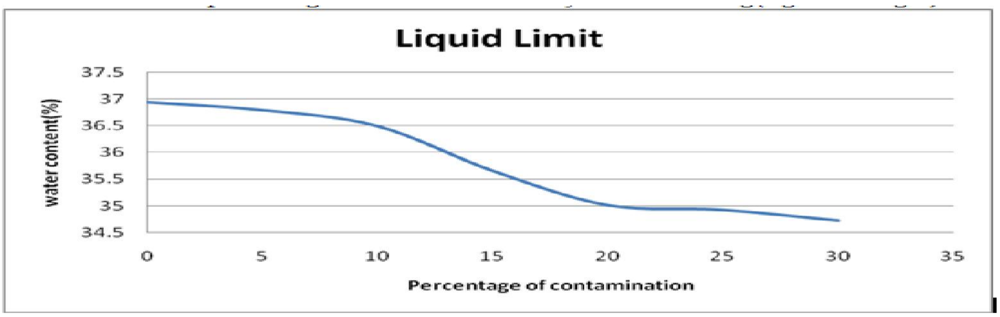

Figure 1: Variation of liquid limit with different percentage of fly ash contamination.

Figure 2: Variation of plastic limit with different percentage of fly ash contamination.

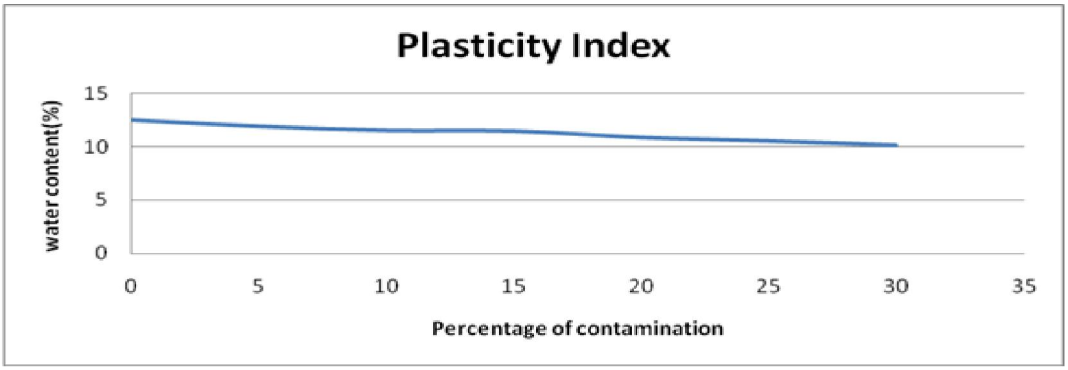

Figure 3: Variation of plasticity index with different percentage of fly ash contamination.

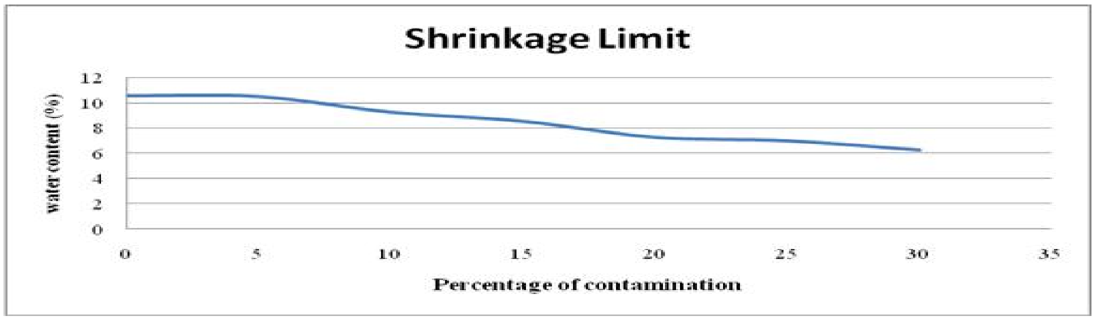

Figure 4: Indicates that shrinkage limit of soil was decreasing with increase of contaminant quantity.

The specific gravity values were decreases as the fly ash content increases in the soil(fig.5).

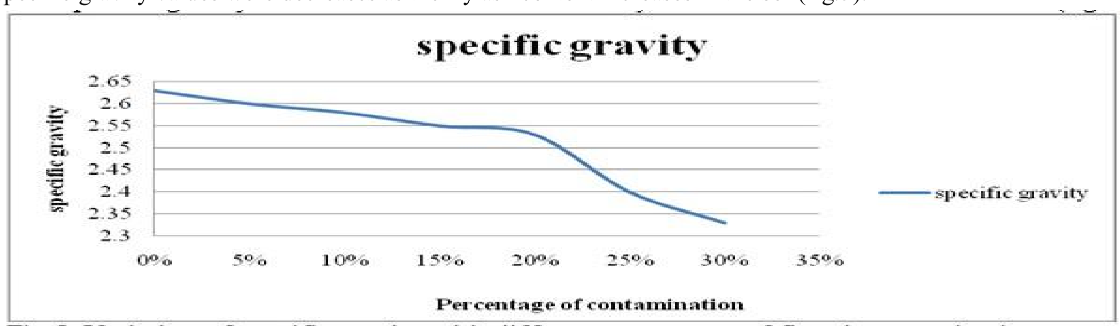

Figure 5: Variation of specific gravity with different percentage of fly ash contamination.

Compaction effort is one and only parameter that controls the compaction characteristics i.e. dry density and moisture content at optimum state. Moisture content and dry density relation from standard Proctor compaction tests for the local clay soil and soil-fly ash mixed sample are shown in table1.

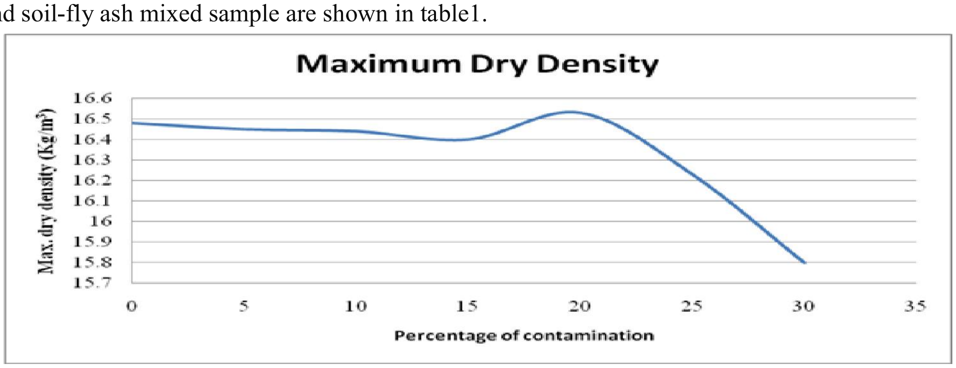

Figure 6: Variation of maximum dry density with different percentage of fly ash contamination

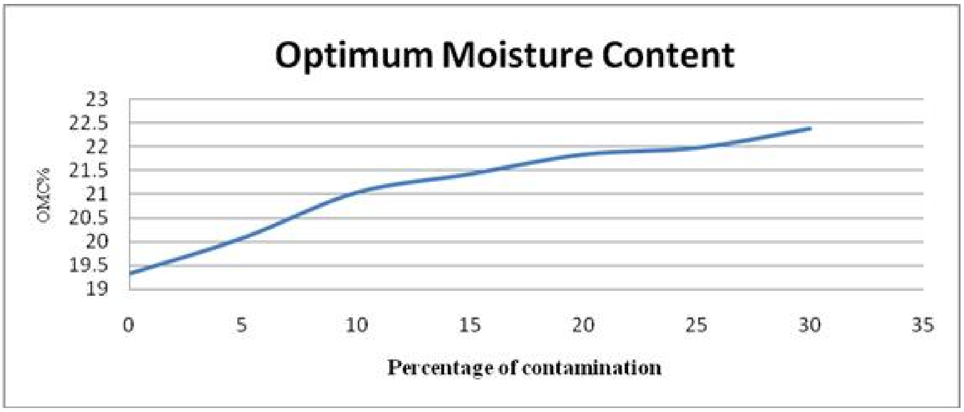

Figure 7: Variation of optimum moisture content with different percentage of fly ash contamination.

IV. Conclusion

The following conclusions are made based on the above results and discussions.

- In general, decrease in values of specific gravity, plasticity index and shrinkage limit in the soil-fly ash mix samples irrespective of fly ash mix.
- With the increase of ash content in the soil-ash mix samples, MDD decreases and OMC increases irrespective of fly ash mix.
- 30% of fly ash contents or above in local clay soil-fly ash mixed sample, this material may be used as land filling and embankments in the field of geotechnical engineering construction.

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