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APPLICATION OF COAL ASH-BENTONITE MIXTURE AS LANDFILL LINER

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ABSTRACT: Landfills are extremely Engineering restraint systems, designed to minimalize the influence of soiled unused on the surroundings, and human health. In circumstance of economically emerging countries the design of a lining fluctuates, that hinge upon number of aspects such as potential of the landfill contaminating the land and water surroundings, the local hydrogaology and mateorology, and the obtainability of appropriate ingredients and financial resourced. Landfill is a land dumping location for unused and its Preparation, organization and control necessity be of the uppermost standard to minimalize the hazards to human health and the environment. Well- erected and sustained landfills are innocuous than open dumping locations. Landfill linings are bare to numerous kinds of physical, organic and bio-logical progressions which becomes affected by leachete formed from the de-composition of unused landfills. Suitable lining is designed to shelter the surroundings from waste by minimalizing the passageway of leachete into the ground-water. To certify this the significant characteristics of linings were selection of materials, hydro-conductivity, strength, compress and pollutant retantion capacity. Normally, soil rich in clay minerals were used as compacted lining materials for their low hydro-conductivity which is essential should be less than 10^{-8}mm/s. The manufacting of fly ash has significantly surpessed its dumping because of its little consumption in numerous fields. Fly ash and bottom ash formed by the plant is commonly disposed of a pond ash in the form of slurry, which might be termed as ash pond. Fly ash is produced in tons as a by-product from burning of charcoal in the power plant. Component of fly ash vary according to the kind of coal being used burn. chemical weathering of volcanic ash is the cause to produce of bentonite. It consists mostly of smeactite mineral, regularly montmorillonite. Bentonite provides as a self-sealing because of its swelling properties, low permiability hydro barrier.

KEYWORDS: Permeability, bentonite, fly ash, landfill liner, pond ash

INTRODUCTION

Landfill are extremely Engineering restraint systems, made to minimize the influence of solid waste on the surrounding and human health. Waste is accommodate by a direct system and the main purpose of these direct system is to detach the landfill material from the environment in order to keep the soil and ground water from pollution originating from the landfills. Leachete may alter from the polluted soil and ground water, therefore presenting a thread to human and environmental health. frequently soil rich in clay minerals are used as compacted lining materials for their low inflated conductivity which is obligatory to be less than 1.00×10^{-8}mm/s.

MATERIALS USED

Fly ash

Fly ash is small sized, glassy powder filtrate as a result of charcoal ignition in power plants. It is pozzolanic and consist mostly of alumina, iron and silica, e-materials are oven dried at 104˚C-115˚C, former to the tests. Fly ash used for the experiment is carried from Chenab valley power project (CVPP Ltd) in Jammu and Kashmir.

Physical parameter	Fly ash	Pond ash	Bentonite
Color	Grey	Light grey	Cream
Shape	Round/sub-rounded	Round/sub-rounded	Platy
Uniformity coefficient	4.71	7.25	-
Coefficient of curvature	1.37	0.73	-
Specific gravity	2.83	2.15	2.78
Plasticity Index (%)	Non plastic	Non plastic	248

Table 1 Physical property of fly ash, pond ash and bentonite

Pond ash

Pond ash is found from the damp disposal of fly ash along with bottom ash as slurry, in engineering structures called pond ash. It is a left-over product from cisterns and contains relatively harsher particles. The ash pond used for this work is composed from (CCPP Ltd) Jammu and Kashmir.

Bentonite

The bentonite used for the project work is Sodium bentonite which is obviously occurring hydra aluminum silicate clay. It is extremely plastic soil and revelries tremendously high swelling and water penetrability properties. Grain size distributions of these materials and Physical properties of these materials are shown in figure 1 and Table 1. respectively

TEST RESULTS AND DISCUSSION

Shrinkage limit

Sample preparation elaborate taking about 25g of dry sample passing through 425 µ IS sieve and systematically mixing with distilled water, which was left standing for 24 hrs. The consistency of the paste was practicable enough to place it in the shrinkage saucer without entrapping air bubbles. Subsequently bentonite was being tested, the water added was about 6% to 10% more than the water taken while liquid limit.

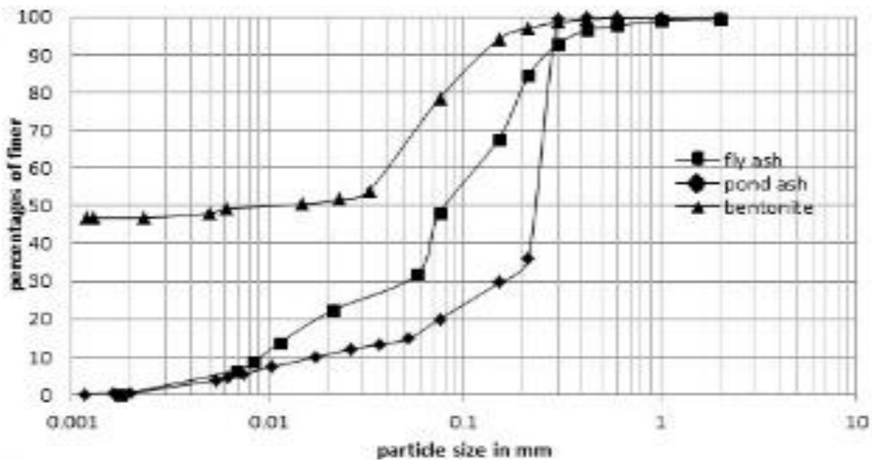

Fig. 1 Grain size distribution curve of fly ash, pond ash and bentonite

Bentonite	Bentonite fly ash mixture Bentonite pond ash mixture			
(%)	Linear shrinkage	Diff free swell	Linear shrinkage	Diff free swell
0	41.5	-	27	-
2	41	-	26	-
4	40	32.5	25	51
8	39	87	24	120
12	37	136	22.5	193
20	35.5	177	20.5	250

Geotechnical properties of bentonite-fly ash mixture and bentonite- pond ash mixture.

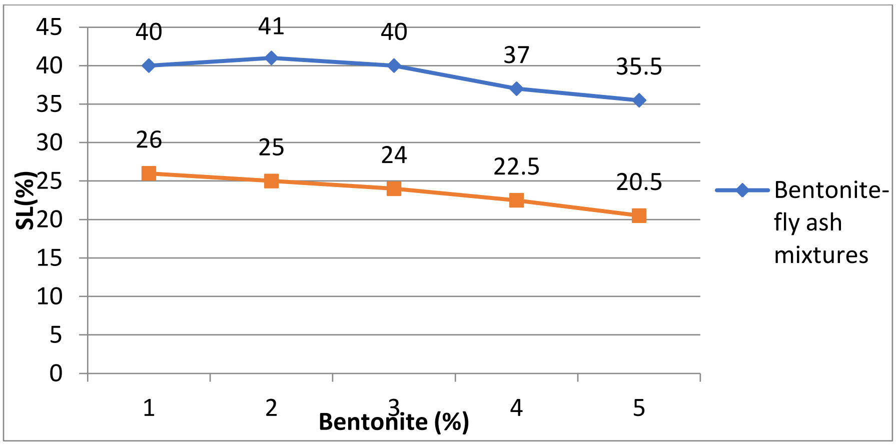

Fig.3 Variation of Shrinkage Limit with bentonite content

Determination of Differential Free Swell

Strenuous water was used to fill one cylinder & kerosene was used to fill another, up to the 100 ml. In-case of bentonite 10 gms of sample were reserved for the test. The DFS of bentonite is found to be 55%. Bentonite shows high swelling behavior as of its projecting cation exchange capacity. Final reading of volume of soil was taken after 24 hrs. to calculate free swell index. Adapted Free Swell was determined acc to IS 2730 (part 11) 1978. For the test of two oven dried sample passing through 0.425 mm IS sieve weighing 20 grams each were placed particularly in two 100 ml marked cylinder.

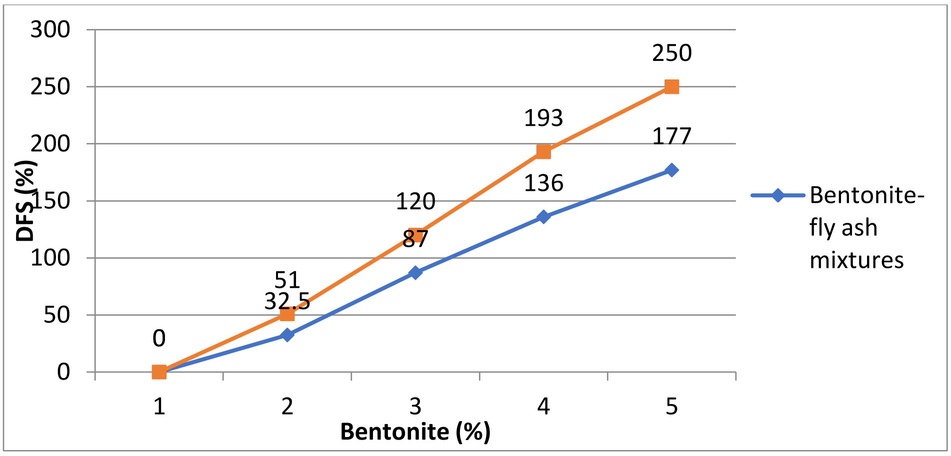

Fig. 4 Variation of DFS with bentonite content

Bentonite	Bentonite fly ash mixture		Bentonite pond ash mixture	
0	OMC	MDD	OMC	MDD
2	39	1.158	27	1.185
4	38	1.194	26	1.222
8	36	1.222	22	1.270
12	34	1.248	21	1.32
20	33.5	1.261	20.5	1.356
0	32	1.0	20	1.37

Table 3 Compaction characteristics of bentonite fly ash ash-bentonite mixtures.

Linear Shrinkage Index (Ls)

Situation of bentonite, development of shrinkage cracks is the main issue to be undertaken while considering it for unused containment lining. Bentonite used for the project work had a high shrinkage index of 45.75 % and showed protuberant dehydration cracks. When mixed with ash of coal, there was an outstanding reduction in the shrinkage of the mixture. The linear shrinkage Index (L_S) remained with-in 10 persent for both the coal ash bentonite mixture. The disparity is presented in the figure 5.

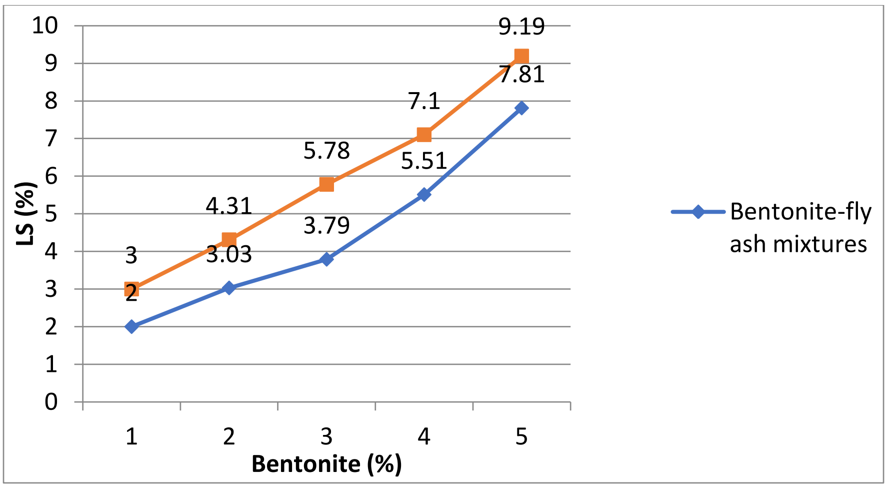

Fig. 5 Variation of LS with bentonite content

Compaction Characteristics

Light compaction test was approved out on specimens as per IS-2720 (Part 07) 1980. These OMC and MDD values found from laboratory compaction test provide a orientation point while estimating the definite water content of the field compacted soil lining. The compaction curves for fly ash bentonite mixture and that of pond ash bentonite mixture was found and the OMC and MDD values are given in Table 3. The variation of MDD and OMC of the compacted coal ash bentonite mixtures are shown in the figure 6 & figure 7.

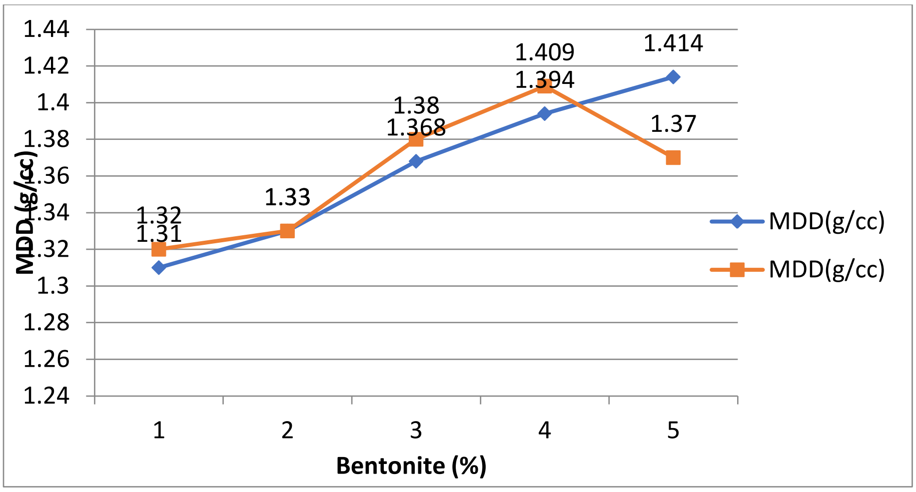

Fig. 6 Variation of MDD with bentonite content under Light Compaction

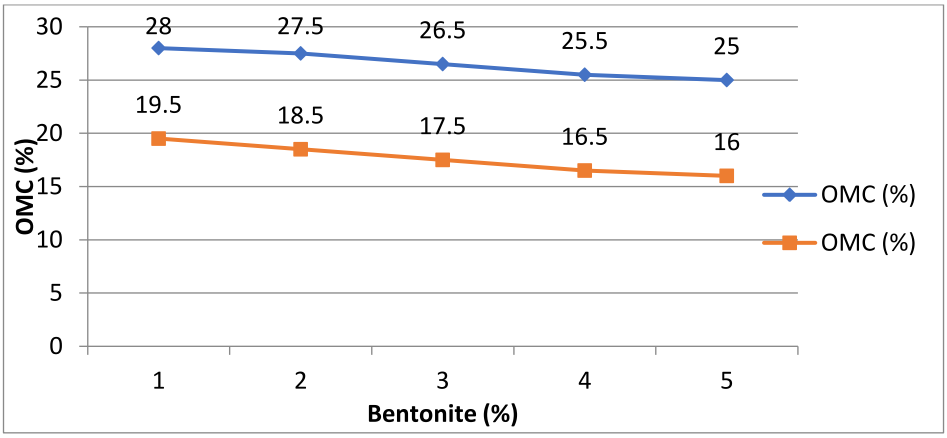

Fig. 7 Variation of OMC with bentonite content under Light Compaction

Unconfined Compressive Strength

Unconfined compressive strength tests were approved out on specimens prepared by compacting coal ash bentonite mixtures at MDD and OMC at a compactive energy of 583 kJ/m^3. Effect of adding bentonite on the UCS value of the mixtures represented in the figure 8

Bentonite	UCS in KPa content	
(%)	Bentonite fly ash mixture	Bentonite pond ash mixture
0	290.277	47.579
2	323.619	52.876
4	335.387	79.952
8	347.155	137.34
12	355.98	215.82
20	423.647	289.395

Table 4 UCS of bentonite fly ash and bentonite pond ash mixture

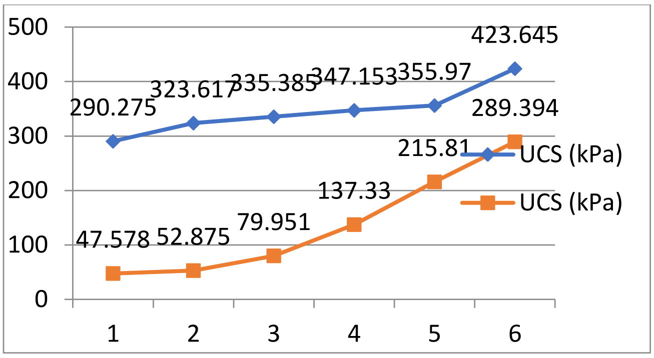

Fig.8 Variation of UCS with bentonite content.

CONCLUSION

On bentonite content increased in the compacted mixture, permeability decreased. 20% bentonite-fly ash mixture presented a permeability less than 1 $\times 10^{-8}$ mm/sec, which satisfied the standards for landfill liner. Although for pond ash, it was achieved at 12 present bentonite content in the mixture. On increase in bentonite content of 12 % to 20 % encouraged plasticity in the coal ash bentonite mixture which controlled to be better bonding b/w particles upon compaction. The Differential Free Swell of the mixture improved with the addition of bentonite, resulting as a better sealant. There was a variation in Shrinkage Limit and Linear Shrinkage in the coal ash-bentonite mixture with the addition of bentonite, without development of protuberant shrinkage cracks. In case of fly ash bentonite mixture, the distinction of shrinkage limit fell in the range of 42 % to 35.5 %. For pond ash combined with bentonite the range was 26% to 20.5%. The UCS of compacted coal ash bentonite mixture increased at a persistent rate with the increase in bentonite gratified. Based on the experiments done on compacted charcoal ash modified with bentonite subsequent results were obtained. Maximum dry density of both the coal ash increased and the OMC decreased with increase in bentonite content. Pond ash bentonite mixture similar value of MDD was achieved with a lower OMC of 25 present than that of fly ash bentonite mixture.

REFERENCES

1. Alam J. Alam M.M. and Ahmad A. (2012), “Seepage characteristics and geotechnical properties of fly ash mixed with bentonite”, International Journal of Scientific and Engineering Approach, Vol. 4
2. Bello A.A. (2013), “Hydraulic conductivity of three compacted reddish-brown tropical soils”, J. Civil Eng., Vol. 17, No. 5, pp. 939-948
3. Benson C.H., Jhai H. and Wang X. (1994), “Estimating hydraulic conductivity of compacted clay liners.” J. Geotech. Eng., Vol. 120, No. 2
4. Benson C.H. and Trast J.M. (1995), “Hydraulic conductivity of thirteen compacted clays.”, Clays and Clay minerals, Vol. 43, No. 6, pp. 669-681
5. Coruh S. and Ergun O.N. (2010), “Use of fly ash, phosphogypsum and red mud as a liner material for the disposal of hazardous zinc leachate residue waste.”, J. Hazardous Materials, Vol. 173, pp. 468-473
6. Ghosh A. and Subbarao C. (1998), “Hydraulic conductivity and leachate characteristics of stabilized fly ash”, J. Env. Eng., Vol. 124, No. 9

