COMPARATIVE STUDY ON GEOTECHNICAL PARAMETERS OF MINED AND UNMINED AREA

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ABSTRACT

Contamination is a present threshold issue whether it might be soil, air or water and this present study deals with the aim of decontaminating the soil. Agriculture, urbanization, mining activities and industrialization are the key reasons from which heavy metals in the soil come from. Mine action is taken as one among the most anthropogenic actions in world ,among which the Arsenic is life threating and is commonly found in soil at two oxidation states: arsenate+5 in aerobic soils, and arsenate+3 in anaerobic (wetland) soils (Alker et al., 2000).So for our study we have collected virgin soil from mudabool , shahapur taluk(16.42ºN, 76.50ºE) and arsenic contaminated soil from hatti (16.1977ºN, 76.6470ºE) and from 5km away medinapur. atomic absorption spectroscopy (AAS) has been carried out to know the concentration of arsenic present in mining soil and it is found out to be 5.96ppm,for 5km away it is found out to be 2.32ppm and the concentration of arsenic in virgin soil is nill. Index Properties was carried out on all the three soils, like Moisture content, Grain size analysis, atterberg limits, OMC, and MDD. Engineering properties like UCS was carried out. Soil was solidified with 4%,8% and 12% of lime. OMC got increased when compared with virgin soil and also MDD got decreased when compared to virgin soil.

Keywords: *contamination, virgin soil, arsenic, mining, hatti, AAS, Index and Engineering properties*

1. INTRODUCTION

Soil is vitally important for life on Earth including the life of humans. Soil contamination affects both the health of humans and agriculture as a result of the entrance of heavy metals and minerals into the food chain and groundwater. Soil contamination can also affect the fertility of plants which in turn affects food production

In many places, mining activity has led to soil pollution especially where heavy metals have contaminated the soil. In this research, soil samples collected from polluted mining areas have been fully characterised, tested and analysed.

Environmental issues that pose a threat to soil health include erosion, a decline in organic matter content and biodiversity, contamination, sealing, compaction, salinization, and landslides in Karnataka. contamination is recognized as a major threat to soil. In recent years, there have been numerous review and research articles providing assessments of various kinds of soil contamination, including urban soil contamination, agricultural soil contamination, and soil contamination in mining areas. Several studies have also provided a comparison of the results of different methods for the assessment of soil contamination. Such studies help to raise public awareness of soil contamination and to facilitate research on contamination and contamination control strategies. However, the status and trends of soil contamination, especially at regional scales, have not been well described. Knowledge of soil geochemistry is fundamental to assessing soil contamination at the regional scale.

In this project, a wide range of soil samples are collected from different mining areas like bellary, kolar, Bagalkot, raichur. and conducted so many tests to compare soil contamination with mining free areas like lingasgur, sandur, hospet and srinivaspura. they include index properties, like water content, specific gravity, grain size distribution, atterberg limits tests, and engineering properties like shear strength, permeability, California bearing ratio test and also include atomic absorption spectroscopy test. By this project we come to

know about what are the different minerals are contaminating the soil in mining areas and how it effects on human health and how we can overcome from this problem.

2. OBJECTIVES

- To study the amount and nature of contaminant present in the mining area soil.
- To study the index and Engineering properties of contaminated solidified soil.
- To compare soil contamination between mining and mining free areas.
- To study on solidification of the contaminated soil.
- To study the effect of mining on human health.

3. LITERATURE SURVEY

In general addition of various binders to stabilize/solidify contaminated soils were carried out in the literature study. Different binders such as fly ash, sulfur,Portland cement, Gypsum etc were used. In some cases contaminated or polluted soil was been taken from site such as municipal solid waste and industrial etc.In later case spiking of soil was done by artificial contamination,after contaminating the soil crystalline mineral phases which were responsible for different heavy metals for immobilization was done through adding binders. Also the leachability tests were carried out. Experimental analysis to determine the physic-chemical properties of soil were generally carried out on contaminated soil and solidified soil to determine the changes occurred between these two soil samples

Adelekan and Abegunde (2011) studied heavy metals contamination of soil. They collected soil from several villages and a control side in Ibadan, Nigeria were analysed for selected heavy metals namely Cd, Cu, Pb, Cr and Ni. Soil samples were obtained in triplicates and at depths of 0 to 15, 15 to 30, 30to 45 and 45 to 60 cm. the heavy metals was done in an atomic absorption spectrophotometer (AAS model 210 VGP). The recommendations of the study include execution of some form of phytoremediation measures at the villages, the enforcement of other environmental protection regulations to arrest the ongoing build-up of these metals on those location.

Liu et al., (2005) studied the metal contamination of soils and crops affected by the Chenzhou lead/zinc mine spill at four sites and found that the maximum allowable concentration levels for Chinese agricultural soils highly exceeded, particularly for As and Cd with mean concentrations of 709 and 7.6 mg/kg respectively.
Beth C.Fleming et al. (1992) presented that Solidification/stabilization of the chromium contaminated soils was influenced by oxidation state of chromium. Physical tests were conducted which included unconfined compressive strength , moisture content ,wet/dry, permeability ,durability, Atterberg limits, bulk density, Proctor density, specific gravity, cracking ,slump, resistance to penetration and bleed water. Chemical tests like Monofilled Waste Extraction Procedure (MWEP-l), and Toxicity Characteristic Leaching Procedure (TCLP) and bulk chemistry analyses was carried out on the untreated and treated soils .Results concluded that Binders increase the strength even up to greater then 50 psi .A TCLP criteria of 5.0 mg/L was passed by virgin and treated specimens.Neither virgin nor treated samples passed MWEP-l Limit of 0.05 mg/L .Hexavalent chromium might be reduced to the trivalent chromium by the inclusion of reducing agents.

Jung-Wook Kim et al.(2010)examined the solidification of heavy metals in the mix by use of blast furnace slag and cement. The mix and OPC:SG ratio was taken to be 7:3 After curing period the UCS test was carried out.Increased strength for 28 days cured solidified material was found for 20 % of water content. Results indicated that solidification/stabilization using a tailing ratio of 7:3 and a 1:1 mix of the OPC : SG with 20% of the Water Content is one among the best technique for the remediation of heavy metal and arsenic in tailings

4. METHODOLOGY

Soil; Black cotton soil is one of major soil deposits of India. They exhibit high rate of swelling and shrinkage when exposed to changes in moisture content and hence have been found to be most troublesome from

engineering consideration. Black soils are formed by lava basaltic rocks. Among the in situ soils of India, the black soils found in the lava-covered areas are the most conspicuous. Those soils are often referred to as regular but are popularly known as "black cotton soils," since cotton has been the most common traditional crop in areas where they are found. The locally available soil were procured and used for the present study from hatti , raichur district which is quite expensive in nature.

About the contaminant: As is a gray element with atomic number 33 and atomic weight 75. Common forms are metallic arsenides and other organic and inorganic arsenides. As compounds have no smell or taste (US DHHS, 1993). Arsenic is commonly found in soil at two oxidation states: arsenate+5 in aerobic soils, and arsenite+3 in anaerobic (wetland) soils (Alker et al., 2000). As is found in nature in compounds with oxygen, chlorine, and sulfur. As bonds with carbon and hydrogen to for organic compounds in plants and animals. These compounds are not as dangerous as inorganic As forms (US DHHS, 1993). Methylated and other organo-arsenicals exist in seafood, where As is present as non-toxic arsenobetaine (Thomas et al., 1998).

5. RESULTS AND DISCUSSION

ARSENIC CONTENT IN SOIL

The arsenic content in contaminated soil is 5.96ppm and another sample 5km away is 2.36ppm.[AAS]

TESTS CONDUCTED ON VIRGIN SOIL

The moisture content of soil was found to be 30.60,with a dry density of 1.38gm/cc.Grain size analysis was carried out and the soil having uniform coefficient of 5.757 and coefficient of curvature 0.689 With the Standard proctor test the OMC came to be about 14% with a dry density of about 1.542.Specific gravity came out to be 2.4

Variation of Consistency Index

When atterberg tests were conducted the liquid limit for virgin soil came to be 56.4% and plastic limit to be 33%, Shrinkage limit as 68.74%.this demonstrated that the soil was inorganic clay of high plasticity.

LOW CONTAMINATED SOIL

The moisture content of soil was found to be 26%,with a dry density of 1.407gm/cc. Grain size analysis was carried out and the soil having uniform coefficient of 5.786 and coefficient of curvature 1.080 With the Standard proctor test the OMC came to be about 18% with a dry density of about 1.536.Specific gravity came out to be 2.38.

Variation of Consistency Index

When Atterberg tests were conducted the liquid limit for 5km away soil came to be 41.67% and plastic limit to be 40.35% ,Shrinkage limit as 89.44%. this demonstrated that the soil was inorganic clay of high plasticity.

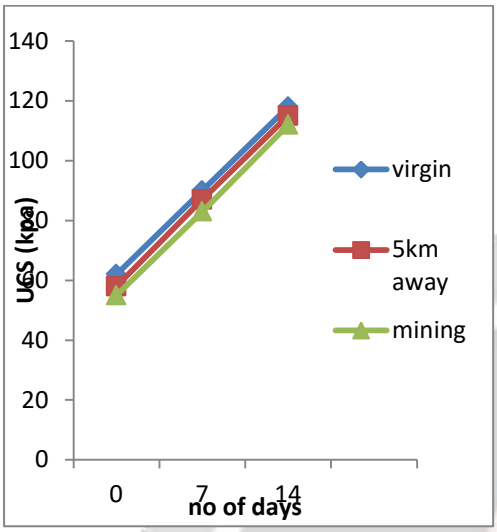
HIGH CONTAMINATED SOIL

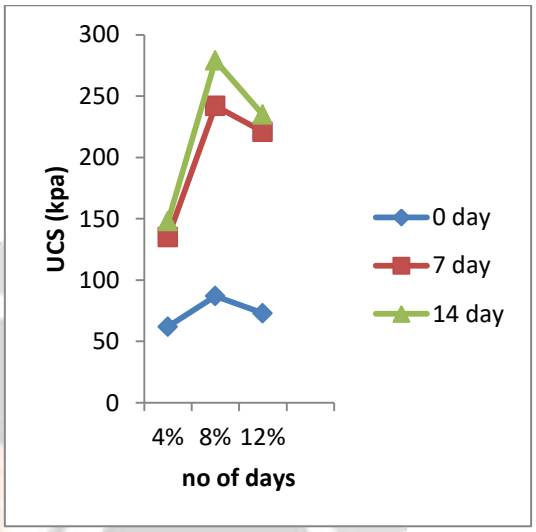
The moisture content of soil was found to be 30.89%,with a dry density of 1.474gm/cc. Grain size analysis was carried out and the soil having uniform coefficient of 6 and coefficient of curvature 0.74 With the Standard proctor test the OMC came to be about 20%with a dry density of about 1.647.Specific gravity came out to be 2.56

Variation of Consistency Index

When Atterberg tests were conducted the liquid limit for contaminated soil came to be 61.13% and plastic limit to be 52%,Shrinkage limit as 96%. this demonstrated that the soil was inorganic clay of high plasticity.

Unconfined Compressive Strength test:





Variation in results before adding Lime binder **Variation in results after adding Lime binder**

6. CONCLUSION

On addition of lime to arsenic contaminated soil there was decrease in liquid limit, and plastic limit, plasticity index when compared to virgin soil, also for arsenic contaminated soil there was no much variation in liquid limit, plastic limit, and plasticity index when solidified with lime, there is no variation in consistency limits with the increase of binder dosages and variation of concentration of arsenic strength was seen to be increasing for lime added soil when compared to both virgin and contaminated soil. However for 5.96ppm concentration the strength obtained by lime addition was same when compared to the contaminated soil. Also when there was a comparative study conducted on strength gain of different curing period (0,7,14days), a early gain strength was noticed by the addition of lime. also a maximum strength was achieved for optimum dosage of 8% lime. There was no much variation in strength with varying contaminant concentrations. There was a very high strength gain in lime solidified samples when compared to other binders.

7. SCOPE FOR FUTURE WORK

The present work might be carried out for varying heavy metals, with different concentrations and contact period with other combination of binders for solidification. The extension of geotechnical properties of contaminated soil on dynamic conditions can also be analysed. The present work might be carried out for heterogeneous soils with varying water table. Also this work might be carried out for different depths of contaminated soil. The present work might be carried out for different freeze and thaw conditions. The global activation energies for the uncontaminated and contaminated soils can also be studied.

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