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SOIL STABILISATION USING BY USING VARIOUS MATERIAL

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Abstract

This paper presents the problems of weak roads not having a hard-impervious surface (i.e.: not paved). There is no wearing course like bituminous course (B.C) and rigid pavement in an unpaved road. Only base course and subgrade is there along with surface course consisting of earthen material and some loose material so as to provide an even and smooth surface to the moving vehicular traffic. These roads are commonly familiar with rural communities. Unpaved roads have the advantage of lower construction costs than paved roads, require less equipment and skilled operators, like paved roads, dirt and gravel roads (unpaved roads) require less maintenance to keep them passable and safe. The major issues related to the rural roads are most of them are constructed in weak sub grade. There is an attempt on strengthening the sub grade soil using flyash gypsum and foundry soil in present study.

I. LITERATURE REVIEWS

Nalbantoglu (2004) used Class - C fly ash as a binder to stabilize an expansive soil, reducing its plasticity and swelling capacity. In India, about 6 million tons of waste gypsum such as phosphogypsum, flourogypsum etc., are being generated annually [Garg et. al. (1996)]. Phosphogypsum is a by-product in the wet process for manufacture of phosphoric acid by reaction of sulphuric acid on the rock phosphate during the production of ammonium phosphate fertilizer. Some attempts have been made to utilize phosphogypsum for manufacture of fibrous gypsum boards, blocks, gypsum plaster, composite mortars using Portland cement, masonry cement, and supersulphate cement [Gupta T.N. (1998)]. Gypsum was also used as a soil conditioner for calcium and sulphur deficient-soils as it has fertilizer value due to the presence of ammonium sulphate [Bhattacharyya et. al., (2004)]. The present study deals with the experimental investigation on unconfined compressive strength characteristics of soil mixed with various percentages of phosphogypsum with a fixed fly ash.

1.1 Material and Experimental Work

1.1.1FoundrySand

Most metal casting sand (FS) is high quality silica sand with uniform physical characteristics. It is a byproduct of the ferrous and nonferrous metal casting industry, where sand has been used for centuries as a molding material because of its unique engineering properties. In modern foundry practice, sand is typically recycled and reused through many production cycles. Industry estimates are that approximately 100 million tons of sand is used in production annually. Of that, four to seven million tons are discarded annually.

Sand used at foundries is of a high quality. Stringent physical and chemical properties must be met as poor quality sand can result in casting defects. Foundries and sand producers invest significant resources in quality control of their sand systems, with extensive testing done to maintain consistency. As a result, FS from an individual facility will generally be very consistent in composition, which is an advantage for most end user applications. Ally and are available to be recycled into other products and industries.

1.1 Foundry Sand

There are two basic types of foundry sand available, green sand (often referred to as molding sand) that uses clay as the binder material, and chemically bonded sand that uses polymers to bind the sand grains together. Green sand consists of 85 – 95% silica, 0 – 12% clay (bentonite, kaolin), 2 – 10% carbonaceous additives, such as sea coal, and 2 – 5% water, other minor ingredients (flour, rice hulls, starches, cereals, etc.) may be added to absorb moisture, improve the fluidity of the sand, or stiffen the sand based on the production needs of the individual foundry. Green sand is the most commonly used molding media in foundries. "It can be used interchangeably with natural gypsum in some applications. Gypsum also precipitates onto brackish water membranes, a phenomenon known as mineral salt scaling, such as during brackish water desalination of water with high concentrations of calcium and sulphate."

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1.1.2 Gypsum

Gypsum is a soft sulfate mineral composed of calcium sulfate dehydrate, with the chemical formula $CaSO4 \cdot 2H2O$. It is widely mined and is used as a fertilizer, and as the main constituent in many forms of plaster, blackboard chalk and wallboard. Gypsum is moderately water- soluble (~2.0–2.5 g/l at 25 °C and, in contrast to most other salts, it exhibits retrograde solubility, becoming less soluble at higher temperatures. When gypsum is heated in air it loses water and converts first to calcium sulfate hemi hydrated,

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if heated further, to anhydrous calcium sulfate (anhydrite).Synthetic gypsum is recovered via flue-gas desulfurization at some coal-fired power plants. It can be used interchangeably with natural gypsum in some applications.Gypsum also precipitates onto brackish water membranes, a phenomenon known as mineral salt scaling, such as during brackish water desalination of water with high concentrations of calcium and sulfate. Scaling decreases membrane life and productivity. This is one of the main obstacles in brackish water membrane desalination processes, such as reverse osmosis or nanofiltration. Other forms of scaling, such as calcite scaling, depending on the water source, can also be important considerations in distillation, as well as in heat exchangers, where either the salt solubility or concentration can change rapidly. "Some attempts have been made to utilize phosphogypsum for manufacture of fibrous gypsum boards, blocks, gypsum plaster, and composite mortars using Portland cement, masonry cement, and super sulphate cement"

Physical Properties of Gypsum

Chemical Classification	Sulphate
Color	White
Cleavage	Perfect
Mohs Hardness	2
Specific Gravity	2.3
Chemical Composition	Hydrous Calcium Sulphate, $CaSO4.2H2O$

Fig.1.2
Gypsum

Codification of samples -
Codes were assigned to each sample, for its easy identification. Following symbols were used in codifying the samples.

Symbol	Description
CBR	California Bearing Ratio

SS	Subgrade Soil
GF	Granular fill

List of samples prepared with their respective codes are as follows:

1	UCS_SS_FS_4	soil + 4% Foundry Sand
2	UCS_SS_FS_8	soil + 8% Foundry Sand
3	UCS_SS_FS_12	soil + 12% Foundry Sand
4	UCS_SS_FS_14	soil + 14% Foundry Sand
5	UCS_SS_FS_16	soil + 16% Foundry Sand
6	UCS_SS_FS_18	soil + 18% Foundry Sand
7	UCS_SS_FS_20	soil + 20% Foundry Sand
8	UCS_SS_FS_24	soil + 24% Foundry Sand
9	UCS_SS_FS_40	soil + 40% Foundry Sand
10	UCS_SS_FA5_G2	soil + 5% Flyash + 2% Gypsum
11	UCS_SS_FA5_G4	soil + 5% Flyash + 4% Gypsum
12	UCS_SS_FA5_G6	soil + 5% Flyash + 6% Gypsum
13	UCS_SS_FA5_G8	soil + 5% Flyash + 8% Gypsum

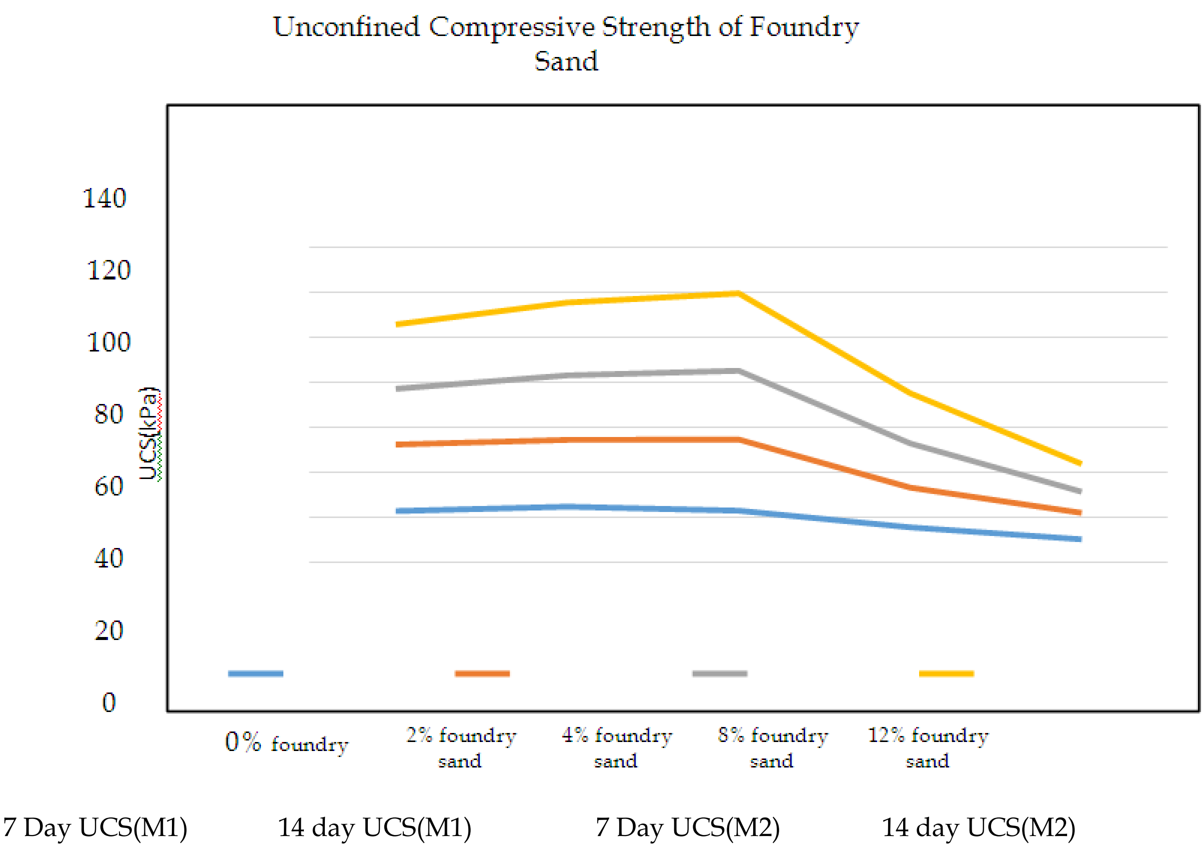

Figure 1.3: Axial Stress and Time (days)

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1.2 UCS Studies of Soil Sample Mixed with 5% Fly ash in Proportion with 0%, 2%, 4%, 8% and 12% Gypsum by M1 and M2 Curing Methods.

The UCS studies was done to find the values of Axial stresses and strains in the reference mix mixed with 5% fly ash in the proportion of 2%,4%,8%,12% of gypsum cured by M1 and M2 curing methods. A close examination shows that by M1 method of curing, the UCS value of reference mix was found to be 8.35 kPa for however, with the inclusion of 4% gypsum the value of UCS increased up to 9.9 kPa for 1.85% strain. Further, on increasing the inclusion percentage to 8%, the value of UCS was found to be 10.33 kPa . At last, on the inclusion of 12% of foundry sand the value of UCS was found to be 6.36 kPa . This shows that the maximum value of UCS was found at the inclusion of 2% of gypsum with M1 method of curing. Further, a close examination of that by M2 method of curing, the UCS value of reference mix was found to be 11.53 kPa . However, with the inclusion of 4% gypsum the value of UCS increased up to 11.76 kPa . Further, on increasing the inclusion percentage to 8%, the value of UCS was found to be 9.80kPa . At last, at the inclusion of 12% of gypsum the value of UCS was found to be 7.58 kPa.This shows that the maximum value of UCS was found at the inclusion of 4% of gypsum with M2 method of curing. The gypsum shrinkage's the soil particles and in presence of fly ash becomes soft and fly ash tend to decrease stiffness.

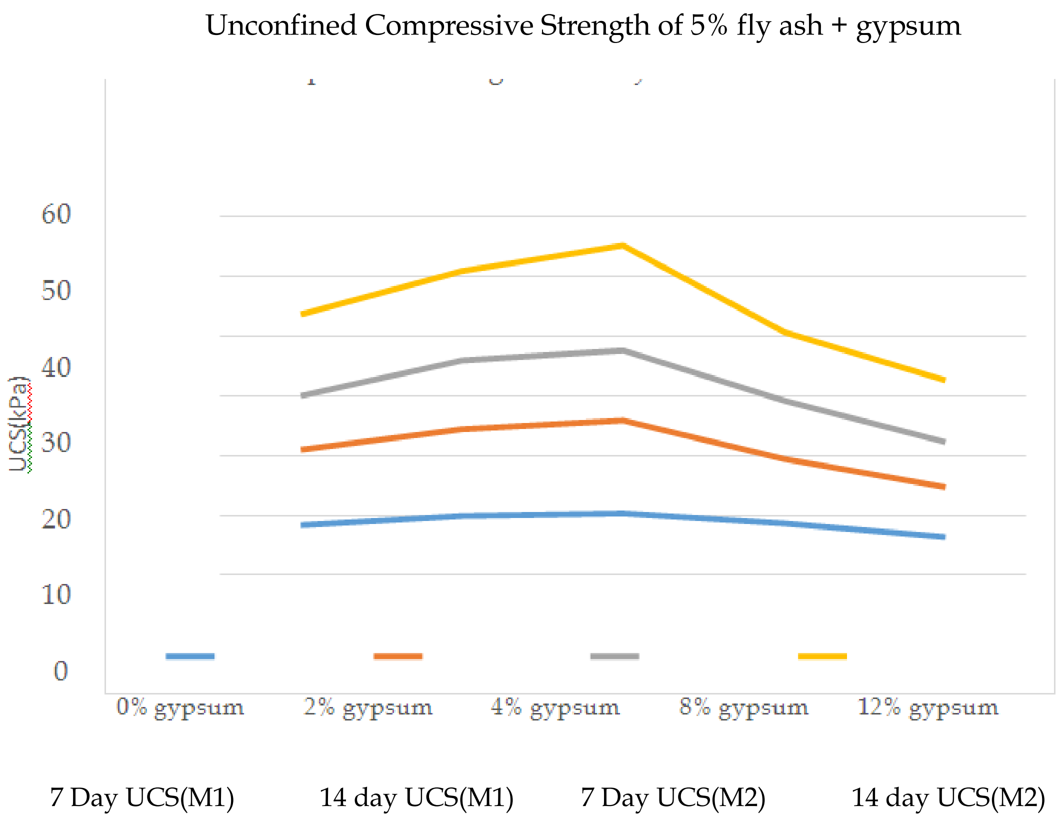

Figure 1.4: Axial Stress and Time (days)

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II. CONCLUSIONS

The UCS of fly ash and foundry sand increases with the addition of 2%,4%,6%, and decrease after 8% and 10% of addition of admixtures. The maximum value of UCS of foundry sand comes in 4% for 14 days which was 31.62 kPa. The maximum value of 5% fly ash and gypsum comes in 4% for 7 days which was33.35 kPa. maximum value of UCS was found at the inclusion of 4% of gypsum with M2 method of curing. The gypsum shrinkage's the soil particles and in presence of fly ash becomes soft and fly ash tend to decrease stiffness.

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