Clay Soil Stabilization by Polymers

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Abstract: In this study the effect of various polymers on clay soil stabilization have been studied. Many polymers have been discussed; a comparative study has been prepared to evaluate their effectiveness.

1. Introduction: Chemical soil stabilization has been extensively used in USA since the end of World War II (ACI 1990).Chemical amendments are typically in liquid or powder form. Rapid soil stabilization of weak soils is a field of huge interest to military, construction, transportation industry .Over last decade nontraditional methods like polymers are applied. Polymer emulsion of required amount is applied to achieve the most efficient compaction of soil. In this paper, CL and CH soil types which are widely found at Texas and due to its inherent properties of swelling, low compressive strength and high plasticity have been discussed which need treatment to enhance the mechanical properties.

2. Objective: To collect information on polymer treatment of clay soils.

3. Discussion: We have studied the polymers which have used in past decades to improve the soil properties of CL and CH soil. When applied into soil, the chemicals assist with alignment of particle, alter the polarity which enhances the cohesive strength and modifies the structure of clay lattice .It leads to low sensitivity of water and binding action of soil particles is improved.

Addition of polyacrylamide polymer improved the clay stabilization and the drying rate of clay was reduced (Hilary I Inyang and Sunyoung Bae, 2005).Use of acrylic polymer on CL and CH was studied by (Naeini, Naderini and Izadi 2011) reported that ucs increased rapidly within 8 days for 4% of polymer as a percentage of OMC of dry soils. When polyurethane based polymers were used to sand -clay mix of various ratios, relative increment in ucs of soil was found, cohesive strength of samples increased and the stabilized specimen had an higher erosion resistance.

Furthermore, when poly-propylene was applied on CH soil (Waseim, 2014), decrease in plasticity index and compression index were noted. Intensity of crack were reduced and around 6% increase in diametrical and axial shrinkage was observed. However, successful realization of improvement of engineering properties needs identification of the soils likely to benefit from the stabilization. The application rates on selected soil types and moisture loss of treated soil are important factors in deciding the polymer.

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5. References

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Reference	Soil type(ll,Pl,PI,OMC)	Polymer	Dilution method and quantities.	Properties Studied	Remarks
1) Hilary I Inyang, Sunyoung Bae,2005	Montmorillonite,Kaolinite. NA	Polyacrylamide, hydrated with water.	0.5-5 % (g/l) prepared by adding polymer to distill water.1 gm of clay mixed 45 ml solution.	1) Viscosity. 2) Sorption Test. 3) X-ray Diffraction.	1) Clay amendment provides stabilization. 2) Drying rate of clay reduced. 3) Change in d spacing of treated clay observed.
2) Inyang, Bae, ,Park 2007	Na-Montmorillonite NA.	Sodium Methyl cellulose,Polyethylene oxide,Polyacrylamide Aqueous Polymer.	Clay (1g) was added to 50ml solution. Volume change recorded.	1) Swelling test 2) Sorption Test 3) X ray Diffraction	1) Polyacrylamide was most effective. 2) Evaluated sorption polymer molecules on clay. 3) Change in d spacing of treated clay observed.
3) Naeini, Naderinia, Izadii, 2011	CL(31,19,12,12), CL(41,22,19,13.3) CH(52,26,2614.4)	Acrylic Polymer. Aqueous Polymer.	Required polymers as percentage of OMC blended to dry soils. Amounts of aqueous polymer 2,3,4 &5	1) Curing time vs. ucs. 2) Polymer content on ucs. 3) Effect on PI.	1) Ucs increased rapidly 8 days. 2)4% Polymer has highest increase ucs. 3) PI plays a role stress-strain behavior of clay samples.
4) Jin Liu,Bin Shi,Kai Gu,Hongtao Jiang,Hilary I Inyang,2012	Sand-Clay Mix(1:1,1:3,1:5) Sand(D50=.34mm,Cu =2.24,Cc=1.3)-CH(ll-34.5,PI-17.6,Omc-16)	Polyurethane based polymers. Different aqueous concentration used.	Dilutant (3 and 5 g/cm^3) added was 10% dry soil, density-1.7g/cm^3.Samples compacted, then air dried at 25C for 48hr.21 combination.	1) Ucs 2) Shear Strength Parameters. 3)Erosion Resistance	1) Relative increment 45.41%, 43.06% and 67.225% in ucs. 2) Cohesion of (1:5 at 5g/cm^3) of samples 15.89, 14.02, 16.01 kpa compared 8.85 Kpa of untreated. 3) Stabilized specimen has higher ER.
5) Waseim Ragab Azzam,2014	CH(LL-50,PL-23,PI-27)	Poly-Propylene.	Amount of polymer added as percentage of dry mass (0, 3, 6 and 10).Samples remolded at OMC and MDD with proctor test.	1)Plasticity 2)Compressibility 3)Desiccation Crack	1) PI sharply decreased. 2) Compression index values were reduced. 3) Intensity of crack reduced.
Remarks	Study was made for CH and CL soil only.	All polymers used were environmentally suitable.	Dilution and sample preparation was different for each specimen studied.	Many test were performed but swelling test and ucs test were done on 60% of samples.	The effects of each polymer was on soil was discussed. Polyacrylamide is effective for volumetric control, acrylic polymer is effective in enhancing ucs and polyurethane increased the ucs of soil. Polypropylene decreased the PI and compression index. Selection of polymer will depend upon the required property of treated soil

PI –Plasticity Index, OMC-Optimum Moisture Content,
Ucs-Unconfined Compressive Strength.