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# TREATMENT AND REUSE OF PERIYAR SEDIMENTED SOIL USING NANO CHEMICALS

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**Abstract -** *Severe floods affected the south Indian state of Kerala, due to unusually high rainfall during the monsoon season on Aug 8, 2018. It was the worst flood in Kerala in nearly a century. The overflow of Periyar River resulted in large losses during and after the flood. Among which the disposal of dredged mud from the building was the major problem. The dredged waste collected from various building in Cochin which is dumped on the banks of the river is the major problem in the region. Here introducing a proper solution for the satisfactory and suitable solution for the treatment and reuse of this dredged waste. The method involved is by treating the soil with Nano chemicals along with flyash which can improve characteristics as well as improve the stability of the soil. The treated soil with the Nano chemicals can be used as a sub grade for pavement construction. The Nano chemicals used were zycobond and terracil from zydex industries. These chemicals were added in various percentages such as 0.05%, 0.06%, 0.07%, 0.08% and 0.1% along with flyash to obtain optimum dosage.*

***Key Words*: *Nano chemicals, landfill, subgrade, dredged waste, Landfill Liner***

## 1. INTRODUCTION

On 8 August 2018, due to unusually high rainfall a severe flood affected the God's own country. It was the worst flood in Kerala in nearly a century.Mostly affected areas are Chengannoor,Pandanad,Edanad, Aranmula, Kozhencherry, Ayiroor Ranni, Pandalam, Kuttanad, Malappuram, Aluva, Chalakudy, Thiruvalla, Eraviper oor, Vallamkulam, North Paravur, Vypin Island and Palakkad chellanam. The aftereffects of these floods became more crucial in the case of proper disposal of the waste from the building which was deposited as a result of overflow of Periyar River as in fig 1. Cleaning of flood-hit houses, shops and flats was a very big challenge. The cleaned wastes from various buildings were deposited infront of the houses, but could not find an effective solution for disposal of this soil waste in a proper manner. This study indicates a method for the proper disposal and reuse of these dredged materials in a suitable manner using nano chemicals and flyash.

The main objective of the study is to take away the waste which is removed from buildings in the flood affected areas. But through this study it is determined to utilise this waste soil as an effective and economical subgrade material. The principal aim is to protect the environment and enhance public health, while optimizing the cost. Use of such materials typically results in considerable cost savings. Since such material is often very inexpensive.

Fig 1 Soil sample collected from Aluva

## 2.MATERIALS

### 2.1 Soil

The soil taken from the front yard of Jewel homes (flat), Aluva, Kochi which is clayey in nature.

**Properties of soil**

| PROPERTIES | VALUES |
|---|---|
| Natural water content(%) | **40** |
| Specific gravity | **2.66** |
| Clay percentage (%) | **32.34** |
| Silt percentage (%) | **46** |
| Sand percentage (%) | **21.66** |
| Liquid limit (%) | **45** |
| Plastic limit (%) | **28** |
| Shrinkage limit (%) | **18.9** |
| Plasticity index(%) | **17** |
| Optimum moisture | **28.5** |

| | |
|---|---|
| content(%) | |
| Maximum dry density(g/cc) | **1.485** |
| Soil classification | **CI** |
| Free swell index(%) | **16.66%** |
| Organic content(%) | **0%** |
| UCC strength(kg/cm$^2$) | **0.6135kg/cm$^2$** |
| Shear strength (kg/cm$^2$) | **0.3067(kg/cm$^2$)** |
| Permeability(m/s) | **4.41X10$^{-5}$cm/s** |
| PH | **5.25** |

### 2.1 Nano chemicals

Nano chemicals are materials that are manufactured at a scale that is 10 thousand times smaller than the size of human hair. The nano chemical used here is Zycobond and terrasil from zydex industries private Ltd, Gujarat.

Zycobond nano materials are nanopolymer that chemically binds soil particles together into a flexible crosslinked network. The chemical binding and nano size of the polymer leads to improved load bearing capacity and flexibility of the soil base, water-soluble, reactive soil modifier. It can reduce water permeability of soil bases, whilst maintaining 100% vapour permeability.

Terrasil is easy to apply as soil modifier that permanently eliminates infiltration of water in to soils. Terrasil is a reactive soil modifier that permanently modifies the soil surface, making it hydrophobic. It chemically converts water absorbing hydroxyl groups to water resistant alkyl groups. It is a nonleachable and safe chemistry, and works with all soil types. It is designed to be utilised with ZycoBond. Terrasil treated soil bases remain significantly dry throughout periods of rain and allows the escape of any trapped water in the soil base in the form of vapour. lt also reduces expansiveness by up to 90 % . It also improves the ease of compaction.


Fig 2 Zycobond sample from Zydex industries


Fig 3 Terrasil sample

### 2.2 Flyash

Flyash is a coal combustion product that is composed of the particulates (fine particles of burned fuel) that are driven out of coal-fired boilers together with the flue gases. fly ash includes substantial amounts of silicon dioxide (SiO2) (both amorphous and crystalline), aluminium oxide (Al2O3) and calcium oxide (CaO), the main mineral compounds in coal-bearing rock strata. Flyash of class F is used for the study.

Fig 4 class F flyash

## 3. RESULT AND DISCUSSION

- **Unconfined compressive strength test for flyash and soil mix**

UCC test was conducted for soil and flyash mixes at various percentages such as 2%, 4 % and 6% to determine the optimum dosage of flyash.

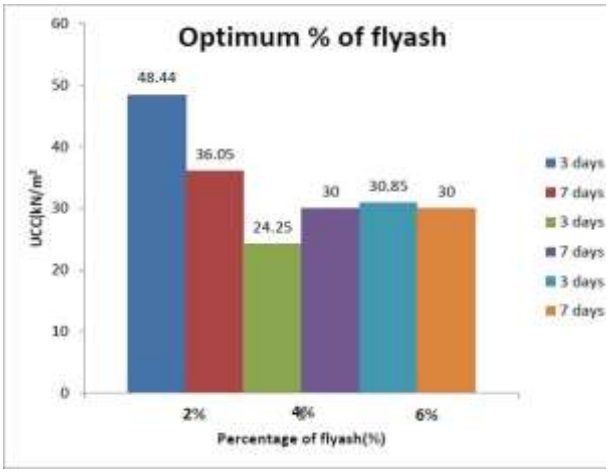


**Chart 1** Variation of strength with % of flyash upon curing.

From the graph the compressive strength of 2% addition of flyash was 48.44kN/$m^2$ upon 3 days of curing which gave maximum strength value.

The optimum dosage of flyash was fixed as 2% with 3 days of curing. It was found that the strength decreased as the percentage of flyash increased.

- **Unconfined compressive strength results for flaysh nano chemical and soil mix**

Unconfined compressive strength test was done to determine the threshold ratio of Nano chemical and flyash mix. Since nano chemicals are required to add in a small percentage. The nano chemicals were added in percentages of 0.07, 0.08, 0.09 and 0.1 % the following results were obtained.

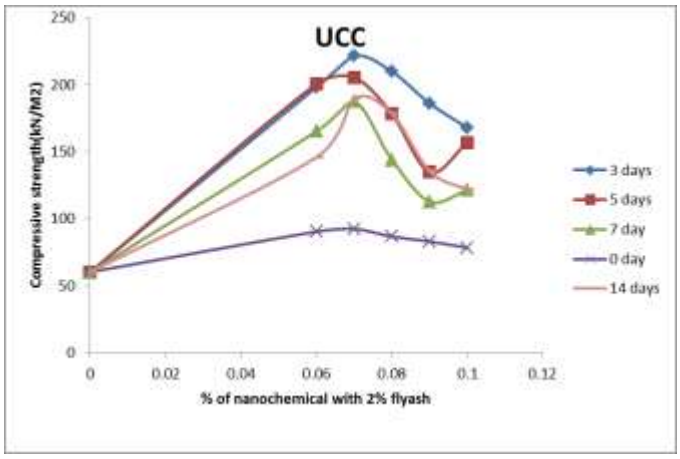


**Chart 2** Variation of strength with various percentages of nano chemicals.

The ucc strength is maximum for 0.07 % of nano chemical upon 3 days of curing. The value of strength decreased with further addition of the chemical as well as days of curing.

- **Proctor compaction results**

Proctor compaction tests are done with the same mix chosen for ucc tests. The variation of maximum dry density is shown in figure

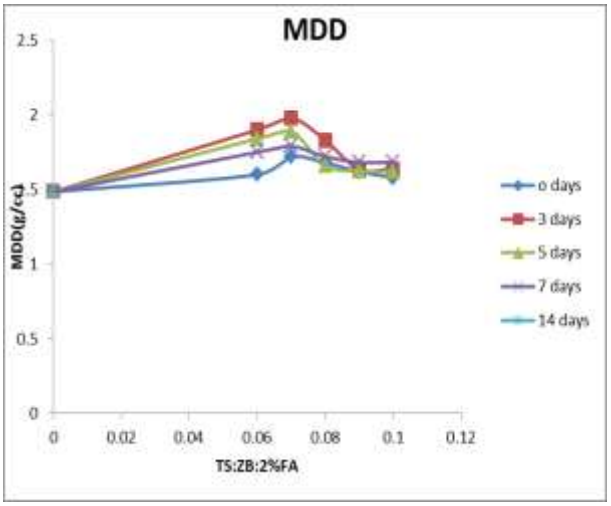


**Chart 3** variation of MDD with % of Nano chemicals

Maximum dry density decreased as the percentage of addition of chemical increased. The Maximum dry density value at 0.07%=1.85g/cc. The variation for 0.08 and 0.09% are almost equal. Maximum dry density increased by 33.4%

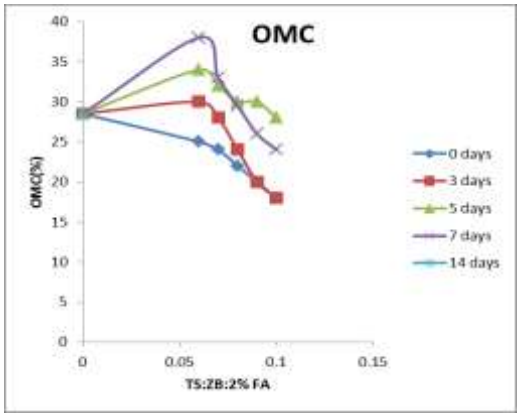


**Chart 4** Variation of optimum moisture content with % of nano chemicals

Optimum moisture content decreased with increase in MDD. Optimum moisture content was highest for 0.09 % optimum moisture content for 0.07% =26% for 3 days curing. Optimum moisture content increased with increse in curing period may be due to easy drying up of the surface of treated treated soil.

- **CBR results**

The variation of CBR is as in figure.

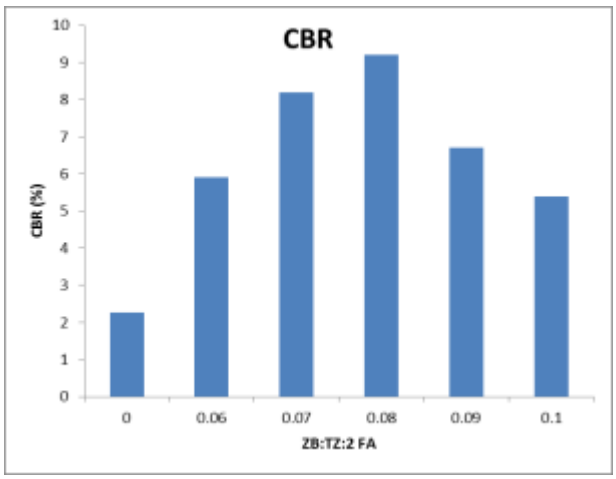


**Chart 5** The variation of CBR

The CBR value increased from 2.27% to 9.2% at 0.08% of nano chemical with 2% flyash. Hence can be effectively used for subgrade construction.

## 4. CONCLUSION

The objective of the study was to investigate the reuse of the wasted sedimented soil as a result of flood with the addition of nanochemical and flyash, thereby effectively utilizing the soil additive mix for the construction of subgrade. The main focus was on determining the optimum ratio of the nano chemical flyash mix. For that the maximum dry density, optimum moisture content, strength, permeability, and CBR values are determined.

From the test results

· The OMC decreased and maximum dry density increased

· CBR value increased to 305.28% at 0.08% Nano chemical

· The unconfined strength of the soil increased at 0.07% of nano chemical

· The ratio of nano chemical flyash mix that can be effectively used as the subgrade material was determined as 0.07:2 with a curing period of 3 days.

Through the results in the paper it can be concluded that 0.07:0.07:2 terrasil- zycobond-flyash mix could be effectively used as a subgrade material. Due to the high CBR value, the thickness of subgrade can be reduced.

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