

# EFFECT OF KAOLIN BASED GEOPOLYMER ON VALLARPADAM DREDGED SOIL

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**Abstract** - Large amount of sediments are dredged from harbours and seaports for construction of the marine structures and for maintenance of the shipping channels. The dredged soil requires large area for disposal. Offshore dumping causes disruption in the aquatic environment. This soil cannot be used directly in construction processes directly since it exhibits properties such as low shear strength, high natural water content and high compressibility. Attempts were made to stabilize the soil for embankment construction and for landfill. This paper describes the effect of Kaolin based geopolymer on dredged soil from Vallarpadam.

**Key Words:** (Dredged soil, Stabilisation, California Bearing Ratio.

## 1. INTRODUCTION

Dredging is an activity of removing the sediments from the bottom portion of the rivers, lakes and sea beds. Due to the dredging operation large amount of sediments are generated, which cannot be used for the construction activities because of its poor geophysical properties such as high water content and presence of organic matter. Open dumping causes long term damaging pollution to the surrounding environment. In order to improve the geotechnical properties of dredged soil, stabilization technology can be adopted. If the dredged soil is used for any beneficial use then the environmental impact due to the open disposal can be avoided. Dredged soils are usually fine grained soil type and generally consist of clay and silt sized particles. Because of its high compressibility and low bearing capacity, it cannot be directly used for civil engineering applications such as road construction and back filling activities. So some attempts have been made to the modification of the properties of the dredged soil with various industrial wastes. The treated material showed improved strength, hence suitable for various civil engineering applications. Dredging is important to remove materials from the bottom of rivers and other water bodies. Dredging activities are needed to maintain or enlarge river and port channel, flood control, waterfront construction and access to harbours (Dubois, Abriak, Zentar, & Balivy, 2009). The term dredged marine soils refers to the sediment that has been dredged from a water body (Permanent International Association of Navigation Congress [PIANC], 2006).

Dredged soils are heterogeneous and can be characterized by grain size distribution, density, water and organic matter contents (Mulligan et al., 2001). In general, dredged soils are microcrystalline in nature. Clay minerals like chlorite, kaolinite and illite and non-clay minerals like quartz and feldspar are present in the soils (Rao, Anusha, Pranav, & Venkatesh, 2012). Particle size is one of the main key physical properties of the material to be used. Harrington & Smith, (2013) reported that a mixture of both coarse and fine-grained, of low moisture and clay contents with low permeability are the properties of material to be used for landfill cover. The objective of this study is to assess the suitability of dredged sample as a pavement construction material.

## 2. MATERIALS AND METHODOLOGY

### Materials

Materials used in this study are Vallarpadam dredged soil and Kaolin based geopolymer.

**Dredged Soil:** The study was conducted on dredged soil which was taken from Vallarpadam, Ernakulam. According to soil classification, it was classified as clay of intermediate plasticity (CI). Properties of soil were given in table 1.

### Properties of dredged soil

soil properties	values
Specific gravity	2.72.6
Liquid limit (%) (IS 2720 PART 5 1985)	44
OMC (%) (IS 2720 PART 7 1985)	30.5
Dry density (g/cc) (IS 2720 PART 7 1985)	1.49
IS classification	CI

### Kaolin based geopolymer.

Kaolin based geopolymer was obtained from RAMBO industries, Coimbatore. The physical properties of geopolymer is as shown in Table 2.

**Physical properties of Geopolymer**

Properties	Values obtained
Specific gravity	2.52
Coefficient of uniformity, Cu	1.37
Coefficient of curvature, Cc	1.567

**Methodology**

*Compaction test.*

The test to determine the optimum moisture content and maximum dry density were done using standard proctor test according to IS 2720. 1980 (Part VIII). The variation in optimum moisture content and maximum dry density was studied with the addition of various percentages (0, 5, 10, 15, 20%) of Kaolin based geopolymer on dredged soil.

*California Bearing Ratio test.*

The California bearing ratio (CBR) test is done for calculating the suitability of dredged soil in pavement construction, California bearing ratio(CBR) tests were conducted to determine the strength of the original soil as well as for the soil mixed with different percentage of Kaolin based geopolymer (i.e. 0%, 5%, 10%, 15% and 20 %) by weight of the soil. The test was conducted in accordance with IS: 2720 (Part 16) 1987.

**RESULTS**

*Effect of Kaolin based geopolymer on compaction characteristics of Vallarpadam dredged soil*

IS Light compaction test was carried out on various proportions of Kaolin based geopolymer and dredged soil in accordance with IS: 2720-VII-1980. From the standard proctor test, it can be observed that the Maximum Dry Density (MDD) increases and optimum moisture content decreases.

Variation of OMC with Geopolymer addition in Dredged soil

Geopolymer (%)	0	5	10	15	20
O.M.C (%)	30.5	29	27.3	26	27.8

Variation of MDD with geopolymer addition in dredged soil

Geopolymer (%)	0	5	10	15	20
M.D.D (%)	1.49	1.55	1.61	1.68	1.56

*Effect of Kaolin based geopolymer on California Bearing Ratio (CBR) of Vallarpadam dredged soil*

The California Bearing Ratio (CBR) test was performed on soil mixed with varying percentages of Kaolin based geopolymer by weight of soil to study the load bearing capacity as per IS:2720 (Part 16) 1987.

CBR value increased with addition of Kaolin based geopolymer . The estimation of CBR increases from 2.59% to 5.64 % for 15% geopolymer and then decreased to 3.35%.

Variation of CBR with Geopolymer addition in Dredged soil

Geopolymer (%)	0	5	10	15	20
C.B.R (%)	2.59	3.2	4.8	5.64	3.35

**3. CONCLUSIONS**

The study has dealt with the influence of Kaolin based geopolymer on dredged soil and evaluation of its suitability to be used in embankment construction. The conclusions that can be derived from the study are:

- The values of maximum dry density were found to increase and optimum moisture content decrease upon Kaolin based geopolymer addition. This was found in agreement with the standard compactive effort.
- The California Bearing Ratio (CBR) increased with increase in concentration of Kaolin based geopolymer and reached a peak value and then decreased.
- Optimum and most economical percent of Kaolin based geopolymer were evaluated.

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