Analogy of River Sand With CDW-Sand And Effect of Paraffin Wax

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Abstract- *Sand is used for the different items of the construction depending on its fineness. Due to an increase in construction projects, natural sand which is usually available from local river beds or pits is becoming more difficult to get and in cost also. Many hectares of fertile streamside land are lost annually, as well as valuable timber resources and wildlife habitats in the riparian areas. The demand for sand has increased tremendously, causing deficiency of suitable river sand in most part of the word. Due to the depletion of good quality river sand for the use of construction we are replacing the river sand with crushed construction and demolished waste (CDW).Experimental results on CDW shows that it is better replacement for sand. Its permeability and shear strength values are good for construction purpose. This paper also aims to improve the properties of the crushed sand by adding paraffin wax as reinforcing material and make economical and to maintain environmental balance, and avoid problems of contamination*

Keywords- CDW, Permeability, Paraffin Wax, Shear Strength

I. INTRODUCTION

Construction activities demand huge quantity of materials like aggregates, masonry units, cement, steel, water etc. The energy consumed in production and procurement of these materials is considerable, leading to negative impacts on the environment. Demolition of old structures to make way for new and modern ones is common features in metropolitan areas due to rapid urbanization. Very little demolished concrete is recycled or reused. Due to strict environmental laws and lack of dumping sites in urban areas, demolished waste disposal is a great problem. Disposal of waste is a challenge for all developing countries mainly due to the increasing generation of waste, the high costs associated to its management and the lack of understanding over a diversity of factors that affect the different stages of waste management.

To have a sustainable solution, low cost alternatives and energy efficient materials need to be explored and adopted. The 3R's (reduce, re-use, recycle) of sustainability is one such means. The present study attempts to utilize construction and demolition (C&D) waste in the form of crushed as an alternative to sand and fine aggregate in construction works . Natural Sand is being used as fine aggregate in concrete making and is preferred as fine aggregate. It is mostly mined from the river beds and indiscriminate mining of sand has reportedly causing damages to the environment. We also see that dependency on this source has led to high material costs also. Now there is high scarcity of natural sand. Due to this shortage of good quality natural sand and heavy dependency on this, for concrete manufacturing, there has been seen usage of poor quality natural sands for construction. Thus it becomes almost obligatory to find alternatives to natural sand and evaluate these alternatives for use in concrete production. Out of the many available alternatives, CDW has emerged as the most easily available material.

An attempt has been made to use paraffin wax as reinforcing material and make economical and to maintain environmental balance, and avoid problems of contamination.Paraffin wax (petroleum wax) is a soft colourless solid derived from petroleum, coal or shale oil that consists of a mixture of hydrocarbon molecules containing between twenty and forty carbon atoms. It is solid at room temperature and begins to melt above approximately 37 °C (99 °F), and its boiling point is above 370 °C (698 °F). Common applications for paraffin wax include lubrication, electrical insulation, and candles; dyed paraffin wax can be made into crayons. It is distinct from kerosene and other petroleum products that are sometimes called paraffin.

II. OBJECTIVES

The main objective of this experimental study is to study the geotechnical properties of crushed sand (CDW) and to compare it with the properties of river sand. Project also aims to improve the properties of the crushed sand by adding paraffin wax as reinforcing material and make economical and to maintain environmental balance, and avoid problems of contamination. An attempt has been made to use paraffin wax for improving the strength and geotechnical properties of CDW-sand. Very mostly, use of plastic is environmentally accepted.

To achieve the whole project, some experimental investigation is needed in laboratory on both CDW sand and river sand. The experiments to be conducted are specific gravity and grain size distribution analysis to identify the material and relative density test to obtain dry density of samples, direct shear test for obtaining shear strength of the samples and permeability test for obtaining hydraulic conductivity of the samples. So, the main objective is to study the properties of CDW-sand and to increase the permeability of it by the addition of wax of various percentages.

III. MATERIALS AND METHODOLOGY

Construction and Demolished Waste

It is generated whenever any construction/demolition activity takes place, such as, building roads, bridges, fly over, subway, remodelling etc. It consists mostly of inert and non-biodegradable material such as concrete, plaster, metal, wood, plastics etc. A part of this waste comes to the municipal stream. It is estimated that the construction industry in India generates about 10-12 million tons of waste annually.

The collected construction and demolition waste was crushed using universal testing machine and sieve through 4.75mm and retained in 75 micron(Fig.1). It was initially air dried in open atmosphere prior before testing. For finding the basic properties of CDW-sand also, the same IS Code specifications for sand was followed.

Fig.3.1: C&D Waste

River Sand

River sand is used in the construction industry mainly for concrete production and cement-sand mortar production. It is obtained by dredging from river beds. It has the major characteristics that since it has been subjected to years of abrasion, its particle shape is more or less rounded and smooth, and since it has been subjected to years of washing, it has very low silt and clay contents. The use of river sand would, for a given workability requirement, reduce the water demand and/or super plasticizer demand, and thus allow a lower water content and a lower cement content to be adopted in the mix design.

Fig.3.2: River Sand

The sand(Fig.2) used in the entire laboratory testing was locally available river sand. Sand was collected from Chittattukara, Thrissur. It was easily collected from the bank of the river .The sand was initially air dried in open atmosphere prior before testing. The basic properties of sand was determined as per IS Code specifications.

Paraffin Wax

Paraffin wax emulsions have gained immense attention as a cheap, environment-friendly, and aroma-free material for preparing super hydrophobic coatings.

Paraffin wax powder was collected from a wholesale candlewax working at Nayarangadi, Thrissur. It was white colored fine material as shown in figure 3.3.

They were obtained by crushing of plastic during its recycling process. It was sieved trough 425mm sieve for the use. Experiments were done with wax content of 0.1%, 0.2% and 0.3% by its weight.

Fig.3.3 Paraffin Wax

METHODOLOGY

Various experiments conducted using collected sand and CDW-sand and the CDW-sand stabilized with paraffin wax powder are explained. The various experiments conducted on the samples are the following:

- Specific gravity determination
- Sieve analysis
- Dry density determination
- Permeability test
- Direct shear test

Firstly, the above tests were conducted on plane soil sample of sand and then on CDW-sand to determine its properties. Thereafter, certain percentage of paraffin wax powder is added to the CDW-sand sample to stabilize it, and the percentage at which the paraffin wax powder produces the optimum shear strength of CDW-sand was found out.

IV. RESULT AND DISCUSSION

Specific Gravity

From the data obtained specific gravity of the soil can be determined from equation. Specific gravity of river sand is obtained as 2.58 and for CDW-sand it is obtained as 2.696. The data shown in Fig.4.1

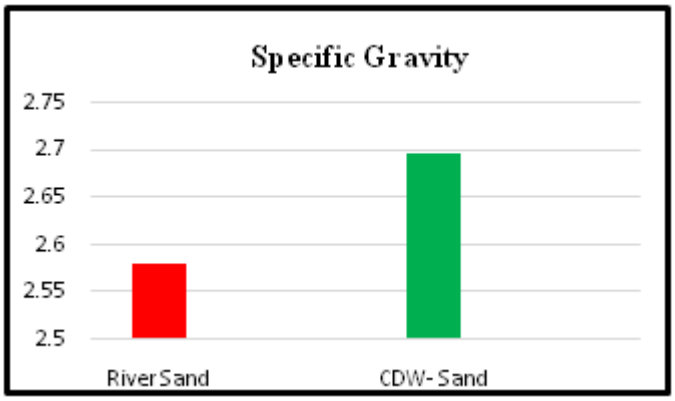

Fig.4.1: Graphical Representation of Samples

Sieve Analysis

From the particle size distribution graph, the coefficient of uniformity obtained was 1.7 and the coefficient of curvature obtained was 1.0. As the coefficient of uniformity value is less than 6 and coefficient of curvature value is not within the limit of 1 to 3, the parent soil can be confirmed as poor graded soil. Table.I given below shows the data obtained from the test also the comparison shown in Fig.4.2

Table.4.1: Sieve Analysis of Samples

	River sand	CDW-Sand
Coefficient of uniformity	1.7	9.88
Coefficient of curvature	1.0	2.9

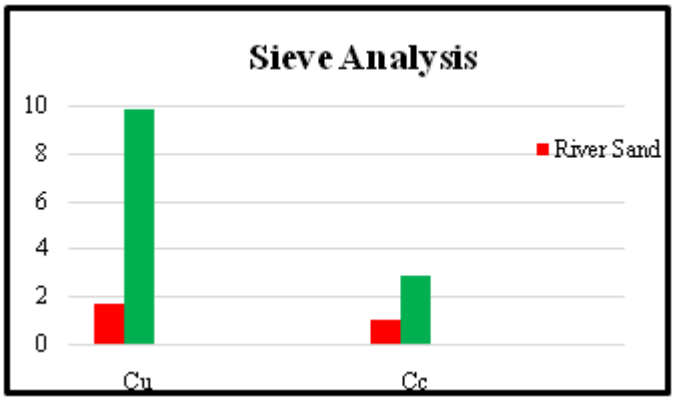

Fig.4.2: Graphical Representation of Samples

Relative Dry Density

Relative density test is done for river sand and manufactured sand to find out the dry density. Both the samples were tested in initial conditions of loose, medium and dense. Table.4.2 given below shows the dry density of the samples in different initial conditions, also Fig.4.3 shows the graphical representation of the samples.

Table.4.2: Relative Density of Samples

Initial condition	Dry density (in g/cc)	
	River sand	CDW-Sand
Loose	1.74	1.80
Medium	1.749	1.82
Dense	1.757	1.848

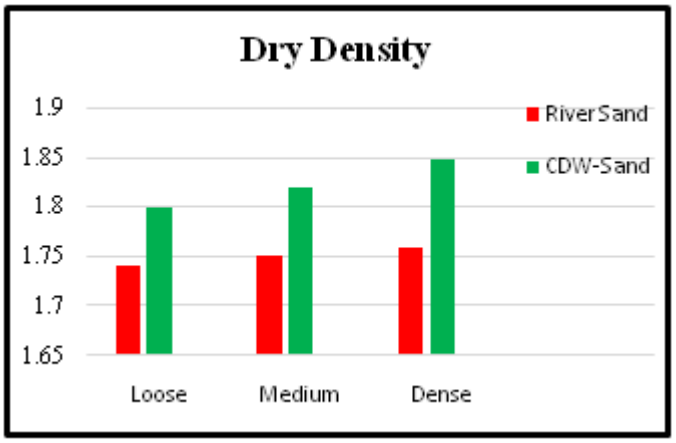

Fig.4.3: Graphical Representation of Samples

Direct Shear Test

Direct shear strength of sand and manufactured sand were found out using direct shear test. The test was conducted in different initial conditions as loose, medium and dense.
Test result obtained for CDW sand and river sand is shown in the Table.4.4 given below, also Fig.4.4 shows the graphical representation of the samples.

Table.4.3: Shear Strength of Samples

Shear strength(kg/ cm^2)			
	Loose	Medium	Dense
CDW sand	2.21	1.8	2.25
River sand	1.175	0.975	1.182

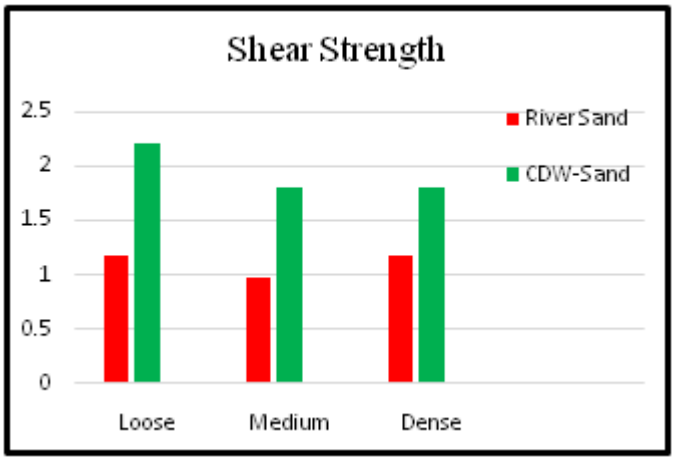

Fig.4.4: Graphical Representation of Samples

Permeability Test

The permeability of sand and manufactured sand was found using the permeameter apparatus by variable head method. The coefficient of permeability for CDW sand and river sand is shown in the Table.4.5 given below and Fig.4.5 shows the graphical representation of the samples.

Table.4.4: Permeability of Samples

Coefficient of permeability	CDW sand	$1.132x10^{-3}cm/s$
	River sand	$1.468x10^{-3}cm/s$

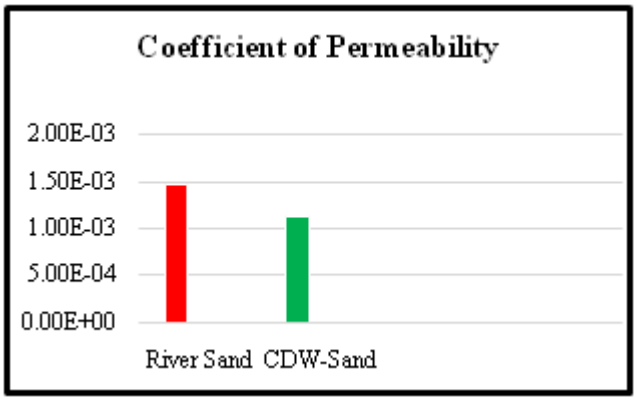

Fig.4.5: Graphical Representation of Samples

EFFECT OF PARAFFIN WAX IN CDW - SAND

CDW sand is added with various percentage of wax(0.1%,0.2%,0.3%,0.4%) and tested their permeability and shear characteristics. The graph shows various changes in permeability and shear strength behaviour of CDW sand.

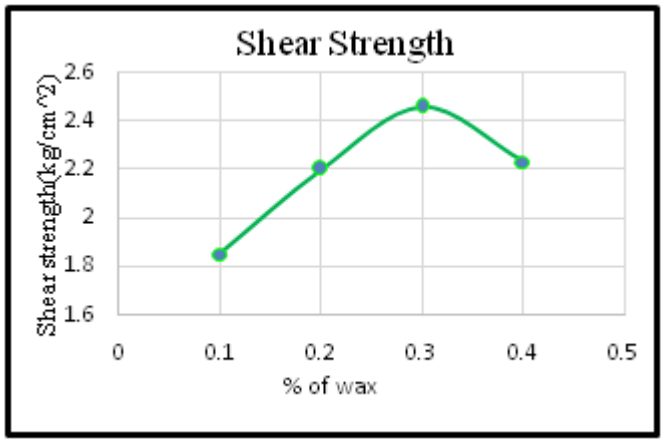

Fig.4.6: variation of shear strength with % wax

The fig.4.6 shows the variations in shear strength by adding different percentage of paraffin wax. considerable increase in shear strength upto 0.3% and cause a reduction on further addition of wax into CDW sand.On addition 0.4% makes the sand particle to slip one over the other thus loosing its shear strength.

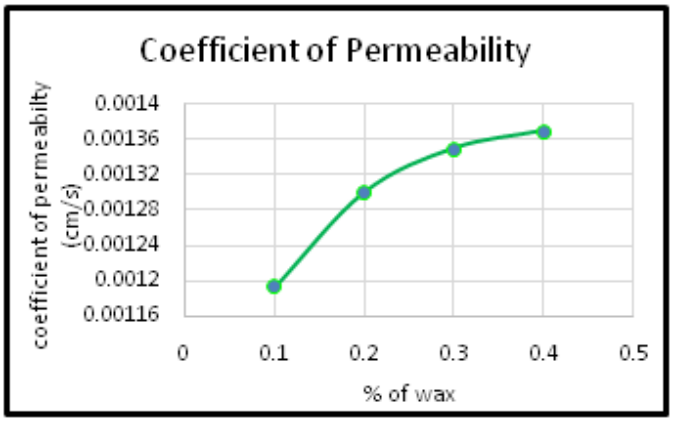

Fig.4.7: variation of seepage with % wax

The fig.4.7 shows the variations in shear strength by adding different percentage of paraffin wax. Sub-sequential addition of wax into the CDW sand shows an increase in their permeability characteristics.For 0.4% it shows higher permeability coefficient because the sand particles more getting more attached with each other making its pore size higher

Table.4.5: Effect of wax on Samples

% of wax	Coefficient of permeability	Shear Strength
0.1	0.001192	1.852
0.2	0.0013	2.0
0.3	0.00135	2.45
0.4	0.00137	2.23

The table 4.5 also shows the values of permeability and shear strength of CDW sand with effect of various percentage of wax.

Better result get by adding o.3% of wax in CDW sand.

V. CONCLUSION

Due to shortage of good quality natural sand and heavy dependency on this, for concrete manufacturing, there has been seen usage of poor quality natural sands for construction. Thus it becomes almost obligatory to find alternatives to natural sand and evaluate these alternatives for use in concrete production.From various test conducted on CDW sand mixed with wax the results shows that it is having better properties than natural sand which is usable for construction purpose.Addition of wax into CDW sand helps in increasing its permeability and shear strength characteristics.0.3% addition of wax makes the CDW sand more suitable for various applications.

REFERENCES

[1] Bcsj Committee “Study on Recycled Aggregate and Recycled Aggregate Concrete”. Building Contractors Society of Japan, Committee on Disposal and Reuse of Concrete Construction Waste. Sum- Mary in Journal, Japan, Vol. 16, No. 7: pp. 18-31, 1978

[2] Etxeberria M, et al. “Influence of amount of recycled coarse aggregates and production process on properties of recycled aggregate concrete”, Cement and Concrete Research 37(5):735-742, 2007

[3] Topcu I.B.“Physical and mechanical properties of concretes produced with waste concrete”, Cement and Concrete Research 27(12):1817-1823, 1997

[4] Rao Akash, Jha Kumar N.& Misra Sudhir, “Use of aggregates from recycled construction anddemolition waste in concrete”. Resources Conservation and Recycling Vol. 50, No. 1:pp. 71-81, 2007.

[5] Mulheron Mm. & M. O'mahony, “The durability of recycled aggregates and recycled aggregate concrete”, 2nd International symposium on Demolition and Reuse of Concrete and Masonry, pp 633-642, 1988.

[6] Montgomery Dg., “Workability and compressive strength properties of concrete containing recycled concrete aggregate”, Proceedings of international symposium:

[7] Poon, C.S., Yu, Ann T.W., and Ng, L.H., "On-site sorting of construction and demolition waste in Hong-Kong.” Resources, Conservation and Recycling, 32, 157-172, 2001