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Application of Mersey Silt as Fine Aggregate in Concrete

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ABSTRACT

Cement, sand and aggregate are basic requirements for any construction industry. Sand is a substance used in mortering and concrete preparation that plays a significant role in the design of a blend. There is a shortage of river sand now a day's erosion of rivers and environmental problems. The lack of or scarcity of sand from river would impact the construction industry and the latest substitute material must therefore be sought to replace river sand in order to avoid excess river erosion and environmental damage.Many scientists consider various sand-related materials and Mersey silt is one of the most important materials. The required concrete mixture can be obtained by using different proportions of this silt along with sand. This paper provides a study of the various amounts of Mersey silt in the preparation of concrete as a partial substitute for natural sand. This study emphasize on compression and split tensile strength aspect on concrete with Mersey silt as partial replacement (10%, 15% and 20%) for natural sand using M_{30} grade concrete.

Keywords: Mersey, Silt, Fine Aggregate, Concrete.

1. INTRODUCTION

For any construction industry, cement, sand and aggregates are essential requirements. Sand is an important material used in mortar and concrete preparation, and plays an important role in the production of mixes. In general, because of the high use of concrete and mortar, the use of natural sand is high.The demand for natural sand in developing countries is therefore very high to meet the rapid growth of infrastructure. Developing countries, such as India, are facing a shortage of good quality natural sand, and natural sand deposits, particularly in India, are being used and are causing serious threats to both the environment and society.Researchers and engineers have made use of their own ideas to minimize or eliminate river-sand use, and have made use of new innovations such as Mersey silt, sand (made from sand), robot silica or sand, crushed stone dust, recycled sand, processed and tamed silt, and dams from other waterbodies besides sand.

On the other hand, lack of needed quality in some of the above materials is the great limitation. The sustainable growth of infrastructure today needs the alternative material to meet the technical requirements of fine aggregates and to be locally available in large volumes.The author's studies identified Mersey Silt production and properties, a waste material with the option of being utilized as a fine concrete aggregate which could contribute significantly to the supply of aggregations in principle.This paper describes a series of practical trials of the material in concrete.

1.1 OBJECTIVES

Following are the main objectives of our project.

- To study the properties of Mersey silt

- To investigate the compression and split tensile strength of Mersey silt concrete.
- To find out the optimum percentage of Mersey silt that can partially replace fine aggregate in concrete.

2. METHODOLOGY

Figure 1 shows the methodology of the study.

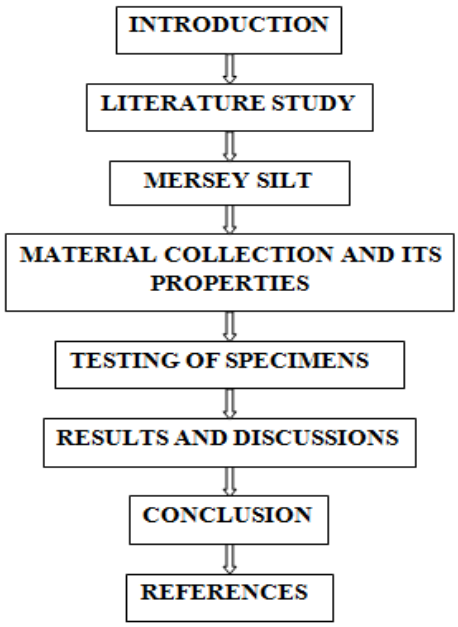

Figure 1 Methodology

3. MERSEY SILT

3.1 Dredging

Dredging as described in the Regulations is a general term referring to the removal from or off bed or the banks of the principal river of any sand, ballast, clay, gravel or other substance. In addition to extracting sediment from a culvert, the exclusion from dredging allows you to remove only silt and sand accumulated on a river bank. Dredging is the removal from the lakes, rivers, harbours, and other bodies of water of sand and debris. Sedimentation, as a natural cycle of sand and slush cleaning, slowly fills the tunnels and harbours on rivers all over the world. It is a daily need.

Dredging is often undertaken to minimize exposure to pollutants by fish, animals and humans and to avoid pollution spreading to other parts of the body of water. This drag is often required because sediments are often polluted with a number of contaminants in and around cities and industrial areas. Such contaminants are pumped into waterways from point sources such as sewage flows, urban and industrial discharges and spills; or from non-point sources such as surface runoff and soil deposition through preserving and restoring aquatic natural resources when environmental harm occurs, the NOAA Response and Restoration Office plays a significant role.Dredged content is disposed of and handled by industry, industry, local government, private sector agencies such as port authorities. The U.S. Army Corps of Engineers issues dredged content authorizations; the U.S. Oversight and approval for disposal of dredged materials is provided by an Environmental Protection Agency.

3.2 Beneficial Uses of Leftover Dredging Material

Dredging is the process of removing sediments from the lakes (both public and private) and waterway reservoirs such as mud and silt. One of the benefits of dredging is that boats can safely cross ports and trade routes without scraping along the bottom. What many people don't know is that this leftover dredging material can be reused to reduce the amount sent to the Confined Disposal Facilities (CDF). While not all materials can be reused (some may be contaminated), the reuse of dredged sediment can help minimize the environmental impact of dredging.

4. MATERIAL COLLECTIONS AND ITS PROPERTIES

4.1 Cement

Cement acts as a binding agent for materials in this report Ordinary Portland cement is used for casting cubes, cylinders and beams. The properties of cement that were studied are normal consistency, fineness of cement and specific gravity and the test was done. The Reports are in table 1.

Table 1: Properties of cement

S.No	Property	Result
1	Fineness	8.2%
2	Specific gravity	3.0
3	Normal consistency	33%

Figure 2 shows the cement.

Figure 2 Cement

4.2 Fine Aggregates

Fine aggregate used in this study is locally available and confirmed to grading zone III as per IS 383-1970. The aggregates whose size is less than 4.75mm. Sand is generally considered to have a lower size limit of about 0.07mm. The specific gravity of fine aggregate was found out using pycnometer and sieve analysis. Table 2 shows the properties of fine aggregate.

Table 2: Properties of fine aggregate

S.No	Property	Result
1	Specific gravity	2.65
2	Fineness modulus	2.8

Figure 3 shows the Fine Aggregate.

Figure 3 Fine aggregate

4.3 Coarse Aggregate

The material whose particles are of size as retained on 4.75mm is sieve is termed as coarse aggregate. Locally available coarse aggregate with maximum size of 20 mm and minimum size of 12.5 mm were used in this project report conforming to IS 383-1970. Figure 4 shows the coarse Aggregate.

Figure 4 Coarse aggregate

Table 3 shows the properties of coarse aggregates.

Table 3: Properties of coarse aggregate

S.No	Property	Result
1	Specific gravity	2.74
2	Water absorption	0.8%

4.4 Water

The following properties should be used in concrete work: the water should be free from harmful soils, acids, alkaline or other organic or inorganic impurities. It should be free of iron, vegetables or any other contaminants that may adversely impact concrete or reinforcement. Drinking water for the premises should be used for mixing and preparing concrete. drinking water should be available. Figure 5 shows the water.

Figure 5 Water

4.5 Mersey Silt

Figure 6 shows the mersey silt.

Figure 6 Mersey silt

Our project deals with the partial replacement of natural sand by Mersey silt. The geology and sedimentology of the Mersey estuary silt are given below.

The particle size ranges vary with location but the bed is predominantly sand with less than 25 % finer than 63 μm. The sand fraction is predominantly quartz with small quantities of a wide range of heavy minerals. The finer silt and mud fractions contain quartz, and several clay minerals including illite and chlorite.

5. TESTING OF SPECIMENS

5.1 Compression Strength Test

Compressive strength is the material or structure's ability to withstand or resist under stress. The strength of a material is measured by the material's ability to withstand failure in the form of cracks. The push force applied to the two sides of the concrete specimen is determined during the test and the full strain shown without fail. Figure 7 shows the compression strength test.

Figure 7 Compression test on cube

5.2 Split Tensile Strength Test

One of the fundamental and important properties that greatly affects the size and the magnitude of the cracking structures is the tensile strength of concrete. Moreover, because of its fragile nature, the concrete is very weak in tension. That's why. The direct tension is not expected to resist.As to the tensile strength, concrete develops cracks. The tensile strength of concrete must also be measured in order to assess how easily the concrete components will break. In addition, a tensile strength test is a tool for evaluating the tensile strength of the concrete cylindrical structure. The method on the basis of the Standard Cylinder Concrete Specimen Test Method (ASTM), close to other codes such as the IS 5816 1999. Figure 8 shows the split tensile strength test.

Figure 8 Split tensile strength on cylinder

6. TEST RESULTS

6.1 Compression Strength Test

Table 4 shows the compression strength test results.

Table 4: Compression strength test results

S. No	Percentage of replacement (%)	Compression strength (N/mm²)								
		7 days			14 days			28 days		
		S-1	S-2	S-3	S-1	S-2	S-3	S-1	S-2	S-3
1	0	18.6	18.2	18.8	26.3	25.8	26.2	30.5	31.2	30.8
2	10	19.2	19.5	19.1	26.3	26.8	26.5	30.9	31.6	31.8
3	15	19.3	19.0	19.5	26.5	26.1	26.3	31.2	30.9	31.4
4	20	19.8	19.4	19.9	26.9	27.1	26.8	31.5	31.3	**31.9**

The above table shows that the compression strength of concrete cubes with partial replacement of natural sand by Mersey silt gives better results when compared to normal concrete.

6.2 Split Tensile Strength

Table 5 shows the split tensile strength results.

Table 5: Split tensile strength results

S. No	Percentage of replacement (%)	Split tensile strength (N/mm²)								
		7 days			14 days			28 days		
		S-1	S-2	S-3	S-1	S-2	S-3	S-1	S-2	S-3
1	0	1.62	1.85	1.88	2.54	2.59	2.58	3.10	3.13	3.09
2	10	1.81	1.92	1.93	2.61	2.65	2.64	3.12	3.15	3.18
3	15	1.92	1.90	1.94	2.63	2.61	2.65	3.15	3.18	3.16
4	20	1.93	1.94	1.99	2.69	2.73	2.68	3.13	3.16	**3.19**

The split tensile strength of Mersey silt concrete shows considerable results when compared to conventional concrete.

7. CONCLUSION

Mersey Silt potentially offers a significant contribution in partial replacement of natural river sand in concrete. The strength point of view varies considerably, which is critical for controlling all aggregate production processes.
From the experimental results, the following conclusions were made.

- The compression strength of conventional concrete at 28 days is less when compared to Mersey silt concrete mix.
- The Mersey silt concrete achieved higher split tensile strength up to 20 % replacement.
- Hence, Mersey silt can be partially replaced instead of natural sand in concrete up to 20%, in order to obtain higher strength than the conventional mix.

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