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AN EXPERIMENTAL INVESTIGATION ON FLOATING CONCRETE USING LIGHT WEIGHT AGGREGATE

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***ABSTRACT*:**

Floating concrete is a special type of innovative concrete whose density is less than 1000 kg/m³. This study deals with the development of Floating concrete by using lightweight aggregate (Pumice stone) and Aluminum powder as an air entraining agent. Floating concrete is made by introducing air or gas into concrete slurry, so that when the mix sets and hardens, uniform cellular structure is formed. An attempt has been made in this study to develop a Floating concrete based on trials with an emphasis on overall density. Also, attempt has been made to obtain Floating concrete with considerable compressive strength. In this study, floating concrete was successfully developed using the ingredients whose specific gravity is less than that in the conventional concrete. Study reveals pumice could be successfully used as an alternative to coarse aggregate which in turn results in lower density when compared to conventional material used in concrete. Two-thirds of the world's surface is covered with water. It is, therefore, not surprising that there has been much activity with concrete in the sea in recent decades. Numerous ideas and schemes have been promoted and many have been executed. Following the acceptance of concrete by the oil companies and the success of very large structures in the North Sea, the use of floating concrete structures, i.e. mainly temporarily floating structures, is continually growing.The advantages of floating concrete structures lie in the economy of the materials used (concrete is very well suited to a marine environment), in the fact that it is easy to make concrete structures buoyant in the construction stage as well as permanently and for towing, whereas they are or can be made heavy enough for a safe permanent installation, and in the fact that they can also provide storage space.Although concrete has been extensively used since 1900 for marine and coastal structures, post-tensioning has had a major, if not decisive, role in extending its full exploitation in marine structures. Posttensioning creates a favourable state of stress

Key Words: Cement, Pumice Stones, Aluminium powder.

1.INTRODUCION

The Present world is witnessing construction of very challenges and difficult civil engineering structures. Researchers all over the world are attempting to develop low density or light weight concrete or floating concrete by using different admixtures in concrete up to certain properties. Floating concrete is a composite material composed of cement, water, aggregates and admixtures (both physical and chemical). Unlike traditional Portland cement concrete (whose density is about 2400kg/m$^{3)}$. Floating concrete contains light aggregates and certain admixtures which makes the composite lighter. The density of the floating concrete ranges from 600kg/m^3 to 1000kg/m^3. Since its density is less than that of water (1000kg/m^3), the concrete in its hardened state can float in water. Thus, floating concrete is a special type of concrete whose density is 1/3rd compared to the conventional concrete.

The history of concrete sea structures goes back to the Romans, who used pozzolanic cement concrete for the underwater piers of their river bridges. Some of these are still standing. In 1848 Lambot first used reinforced concrete for small boats; one of his later boats is still afloat. As mentioned in the preface, many marine structures have been built of concrete throughout the world since the early 1900's. In World Wars I and II, many hundreds of reinforced concrete ships were built, but their designs proved to be uneconomical. In the late 1950's, a number of prestressed concrete oceangoing barges were constructed in the Philippines. Concrete lighthouses were constructed as caissons in the 1960's; some of them were fixed in the sea bed by ground anchors. In the 1970's construction of offshore platforms for the exploration of oil started and by the end of 1986 eighteen concrete platforms have been installed in the North Sea. Floating concrete structures are economical to build and maintain. To keep maintenance costs low, quality assurance during construction is very important. A quality assurance programme is, therefore, normally set up. Furthermore, tolerances must be kept small; it is important to limit closely the variation of the unit weights of the materials used and to observe rigorously the specified dimensions. A combination of maximum weight of components and maximum thickness tolerance must be avoided at all costs. For cast-in-place structures, concrete with a minimum 28-day cube strength of 40 N/mm^2 is used, whilst in precast structures a strength of 50 to 60 N/mm^2 is the usual objective. The water/cement ratio should be low and good curing is of importance. The ratio can be minimized by using super Post-tensioned concrete is resistant to corrosion since the prestressing keeps the concrete in compression, thus limiting crack width. The material is highly resistant to fire, and post-tensioning improves watertightness and makes the structures well-suited forwithstanding the heavy wave and ice loadings encountered (for example in the North Sea and the Arctic). Finally, it does not suffer from the low-temperature fracture problems inherent in steel struc-tures.

Large structures can be built of cast-in-place concrete or may be assembled from precast components integrated by cast-in-place joints or by match-cast joints and by posttensioning. A combined application of precast and cast-in-place elements is, of course, also possible. Precasting allows thin sections of high-strength concrete to be obtained. Post-tensioning can be provided in any desired direction to resist stresses from heavy and complex loads. Cyclic loading does not lead to fatigue failure. Cracks from overloading, for example possibly occurring during the delivery voyage, will close again after the loads are removed as a result of the post-tensioning.

The present report has been prepared with the objective of promoting floating concrete structures by illustrating their advantages, by providing a summary of the various possible applications and by explaining which VSL Special Construction Systems can be employed. Explanations of when, where and how these systems may be used are also given. The design of floating concrete structures will, however, not be treated here; design criteria for the determination of loads and forces can be found in the Literature.

1.1 Objectives

The objectives of this project are:

1. To reduce the self weight of the concrete.
2. To characterize the materials required for developing floating concrete.
3. To develop a floating concrete based on trials.
4. To compare compressive strength and tensile strength of developed mixes.

2. METHODOLOGY

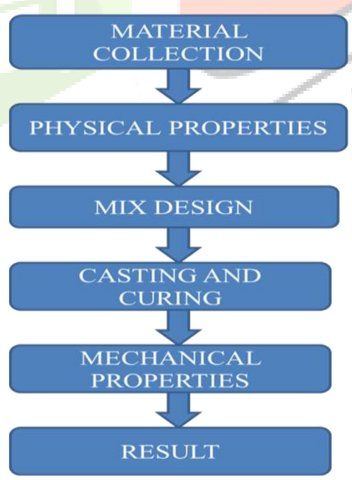

Figure:1 Flow chart

3. MATERIAL COLLECTION

3.1 Cement: Cement is the binding material of the concrete. This is the main proof as to why cement and water mix is used as a bonding agent. Cement is a water-based binder used to bind other building materials (i.e. sand, aggregate) together. It is used in the production of mortar and concrete during the construction process.

3.2 Fine aggregate: Fine aggregates play a very important role in concrete. The aggregate whose size is lesser than IS 4.75 mm and retained on lS 150µ is considered as fine aggregate. It manages to fill the voids between the coarse aggregates. It must be well graded from the particle point of view in order to guarantee filling of the voids. The fineness helps in increasing cohesion there by resisting segregation. In Floating concrete, pumice powder has been used as fine aggregates. The size, shape and texture of aggregates control the workability cement content and drying shrinkage parameters. Generally smooth and rounded aggregates are preferred for concrete. Pumice stone of igneous origin is disintegrated into size less than 4.75 mm and is used as fine aggregate.

Here in this investigation study pumice powder is used as fine aggregates

3.3 Coarse Aggregates: The coarse aggregate constitutes the bulk of concrete mixture and gives the dimensional stability to concrete. Size of aggregates greater than 4.75 mm is considered as coarse aggregate. Generally, aggregates of size between 4.75 mm to 20 mm are used in concrete. The size, shape and texture of aggregates control the workability; cement content and drying shrinkage parameters. Generally smooth and rounded aggregates are preferred for concrete.
In this experimental study Pumice stones has been used to reduce the density of concrete.

3.4 PUMICE STONES

Pumice is composed of highly micro vesicular glass pyroclastic with very thin, translucent bubble walls of extrusive igneous rock. Pumice is a common product of explosive eruptions and commonly forms zones in upper parts of silicic lavas. Pumice has an average porosity of 90%, and floats on water. It has 24% water absorption capacity and aggregate strength ranges from very weak and porous to stronger and less porous.

Figure:2 Pumice stone

3.5 ALUMINIUM POWDER

Aluminium fine powder is utilized as gas shaping admixture. It produces softness in the solid same as preparing pop does in a cake. This admixture when added to mortar or solid blend respond synthetically with hydroxides show in the bond and frame minute rises of hydrogen gas of size extending from 0.1 to 1 mm all through the concrete water.

3.6 HYDROGEN PEROXIDE

The results show that these foam concretes are new and innovative building materials with interesting properties: low mass density and high strength when the addition amount of hydrogen peroxide is in 5% - 6% range. The main uses of hydrogen peroxide are in the preparation of other peroxides and as an oxidizing agent.

$H2 + O2 \rightarrow H2O2$
$2H2O2 \rightarrow 2H2O+O2$

4. LITERATURE SURVEY

Malik Mehran Manzoor et al. (2018) used pumice and aluminium powder as air entraining agents to investigate this development in floating concrete. They had been working on combining the types previously mentioned in the survey. Comparison this study was carried out between simple cement concrete and lightweight concrete with different proportions of aggregates and a fixed amount of aluminium content (2% by weight) of cement. It was made with satisfactory strength using five Light concrete mixes and different proportions of pumice stone. The result of the survey showed that the size of the aggregate and the proportion affects the compressive strength and unit weight of concrete. In addition, the result showed that when using pumice as in addition, it is possible to generate a float with a satisfactory force. This concrete does not correspond to the supporting structure Component strength requirement.

Rayees Ahmad Ganie (2017) studied the production of floating concrete with pumice, foaming agent and thermocol. He It also examined the influence of aggregate types and amounts on the compressive strength of concrete. It was also produced strength which was determined by using five lightweight concrete mixes and different proportions of pumice stones. The result of the investigation was showed. This proportion and the size of the aggregate influenced the compressive strength of the concrete and the unit weight. It also showed the result that you can make satisfied foam concrete using foam and pumice aggregates. Strength requirements for the structural components that carry the load do not match this concrete for the construction of structures such as barges, slabs, buildings, etc. Floating concrete can be used effectively as the highest part of the country is covered in water; the land is used for construction work.

Nikhil S. Chavan et al. (2018) studied the mechanical properties of floating concrete using exhausted polystyrene such as Aggregate exchange. The pressure test, the split tensile test and the density test were performed on concrete and completed. It was possible to float the concrete into the concrete using EPS beads to replace the aggregate. Use EPS Floating concrete provides pearls with standard workability and can be easily compacted and finished. Compressive strength of Floating concrete was inferior to conventional concrete. The density of the floating concrete for each mixing project was less than 1000 kg /m2. There is leakage and honeycomb problems, the leakage problem can be controlled using a sealing solution. It was also possible to build a boat out of concrete, e.g. H. With floating concrete, which offers more advantages, such as cost savings, reduces the use of wood for the rescue operation.

Roshan Peter et al. (2016) conducted various experimental studies on lightweight aggregates for floating concrete structures. In this experiment, they attempted to investigate the mechanical properties of an M20 lightweight concrete using pumice stone as a partial replacement for coarse aggregates and mineral additives such as silica fume with as a control mixture, the compression strength study was prepared for six series. Each set consists of 3 cubes. The optimal 7 days Compressive strength was obtained in the range of 5%silica powder for different replacement of coarse aggregate with pumice Stone for 10%, 20%, 30%, 40% and 50%. A comparison of the compressive strength can lead to the conclusion that any structure can be built with50% pumice coarse aggregate replacement with the addition of 5% silica vapour

Hemant k. Sarje et al. (2014) studied the technique of growing lightweight concrete. His study focuses on demonstration on compression, water absorption. Low thermal conductivity and low density are the main advantages of lightness. Concrete, which minimizes the permanent load and the construction costs by mixing fly ash and air entraining agents such Protein-based Kemelit foaming agent.

5. MIX PROPORTION

Table no 1: The ratio of concrete components (Mix ratio) is carried out from the IS 10262:2009 and the provisions of IS 456:2000.

S.NO	CEMENT	F.A	C.A	W/C RATIO
1	416	235.05	345.85	208
2	1	0.608	0.837	0.5

6. MECHANICAL PROPERTIES

6.1 Compressive Strength Test

Compressive strength is the limit of a material or structure to resist the loads having a tendency to decrease the size. It is tested by using the Universal Testing machine. Here the compressive strength of concrete cubes for the plain concrete and this waste materials concrete are found out using Compression testing machine. Three cubes were cast for each percentage of waste materials and the average of the three compressive strength values were taken. **Table no 2: Compressive strength**

SPECIMEN	**7 DAYS N/mm^2**	**14 DAYS N/mm^2**	**28 DAYS N/mm^2**
SAMPLE 1	11.20	7.43	5.45
SAMPLE 2	10.96	7.38	5.23
SAMPLE 3	11.18	6.98	4.84
AVERAGE	11.11	7.26	5.17

Figure:3 compressive strength

6.2 Tensile Strength Test

Tensile strength is the resistance of a material or structure to breaking under the load in tension. It is evaluated on concrete cylinders of standard dimensions using a Universal Testing machine. Both conventional and waste materials concrete specimens were tested at varying percentages of waste materials and the average values was obtained.

Table no 2: Tensile strength

SPECIMEN	7 DAYS N/mm^2	14 DAYS N/mm^2	28 DAYS N/mm^2
SAMPLE 1	5.80	4.92	4.13
SAMPLE 2	5.53	4.67	3.97
SAMPLE 3	5.44	4.78	4.15
AVERAGE	5.59	4.79	4.08

Figure:4 Tensile strength

7.RESULTS AND DISCUSSION

Following tables and graphs shows the compressive strength of cube specimens and tensile strength of cylinder specimens for 7days, 14days and 28days curing respectively.

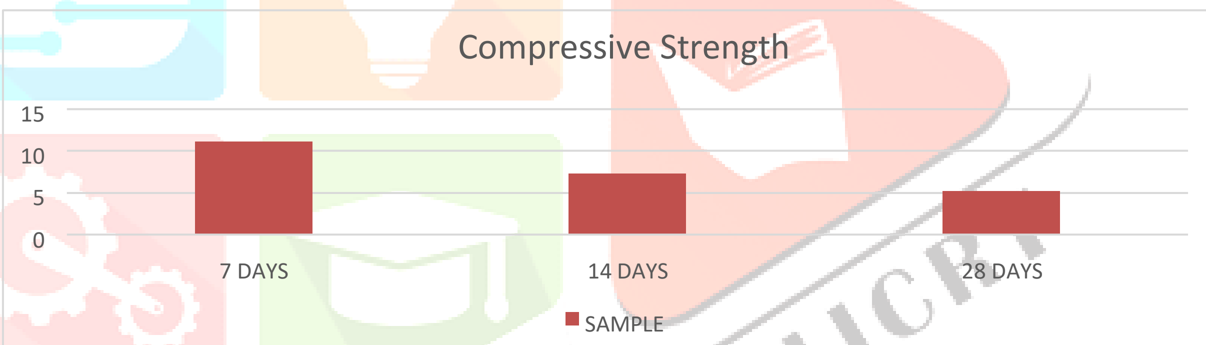

Figure:5 Graph Compressive Strength

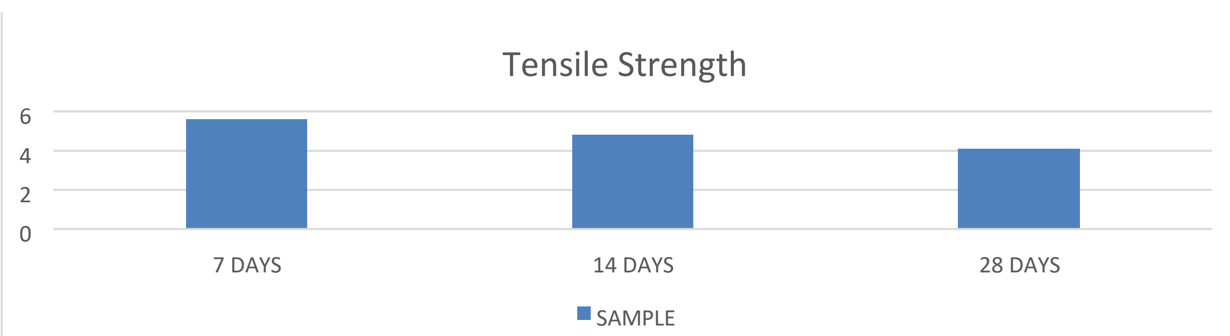

Figure:5 Graph Tensile Strength

CONCLUSION

In this study, the influences of aggregate types and the amount on the compressive strength of concrete were investigated. Using different aggregates Pumice stone In concrete, mixtures were produced with a satisfied strength. The result of the investigation showed that aggregate properties and proportion influenced the unit weight and compressive strength of concrete. It was also seen that, using light weight aggregate in the concrete mixture can reduce the dead load but decreases the concrete strength.

- The mix proportioning based on absolute volume concept used in normal concrete can be successfully employed for achieving a floating concrete keeping the density of the mix less than 1000 kg/m^3
- Pumice stone & powder to be used as an alternative for coarse and fine aggregates. Use of light weight aggregates like pumice and admixtures (aluminium powder) results in reduction of density and thus floating concrete could be easily developed.
- The ingredients used in floating concrete should be selected in such a way that the specific gravity of the materials chosen should be less than that used in conventional concrete

SCOPE FOR FUTURE STUDIES

- Attempts can be made to develop floating concrete with higher compressive strength.
- Attempts can be made to develop floating concrete with other cementitious materials having lower specific gravity.
- Attempts can be made to develop floating concrete.
- Attempts can be made to develop floating concrete of larger dimension.

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