

# **An Effect on Oyster Shell Powder's Mechanical Properties in Self Compacting Concrete**

S.Abinaya<sup>1</sup>, S.Prasanna venkatesh<sup>2</sup>

PG Student, Department of Civil Engineering, Starlion College of Engg and Tech, Thanjavur, Tamilnadu, India<sup>1</sup>

Assistant Professor, Department of Civil Engineering, Starlion College of Engg and Tech., Thanjavur, Tamilnadu, India<sup>2</sup>

**ABSTRACT:** Self – compacting concrete (SCC) is a high – performance concrete that can flow under its own weight to completely fill the form work and self-consolidate without any mechanical vibration. Such concrete an accelerate the placement, reduce the labor requirements needed for consolidation, finishing and eliminate environmental pollution. Oyster shell were collected from river and sea & it produced to powder from In this study, pozzolonic replaced with various percentages by oyster shell powder and the fresh and hardened properties of cement concrete were studied. In this study, cement content in the SCC mix is replaced with various percentage of 0%, 2.5%, 5%, 7.5%, 10% and 20% of oyster (River and Sea) shell powder is used and the fresh and hardened properties of cement concrete were studied. It is observed that can be effectively used as a mineral additive in SCC. The Mix Design for concrete M25 grade is being done as per the Indian Standard Code IS: 10262-2009. Specimens (cube & cylinders) were cast to study the strength properties such as compressive strength (3, 7, 14 and 28 days), split tensile strength (28 days), Flexural Strength (28 days) and durability aspects such as water absorption (28 days). Water Binder ratio was maintained at 0.40. Test results was indicate that concrete containing oyster shell power to an extent of 5% shows better strength characteristics when compared to the concrete with 0% of oyster shell power, whereas concrete with oyster shell power of 5% replacement shows optimum results better durability characteristics than the other percentage replacements of oyster shell power.

**KEYWORDS:** self-compacting concrete, high performance, shell powder.

## **I. INTRODUCTION**

Self – compacting concrete (SCC) is a fluid mixture, which is suitable for placing difficult conditions and also in congested reinforcement, without vibration. In principle, a self – compacting or self – consolidating concrete must:

- Have a fluidity that allows self – compaction without external energy
- Remain homogeneous in a form during and after the placing process and
- Flow easily through reinforcement

Self – consolidating concrete has recently been used in the pre – cast industry and in some commercial applications, however the relatively high material cost still hinders the wide spread use of such specialty concrete in various segments of the construction industry, including commercial and residential construction<sup>1</sup>. The incorporation of high volumes of finely ground powder materials is necessary to enhance cohesiveness and increase the paste volume required for successful casting of SCC. Proper selection of finely ground materials can enhance the packing density of solid particles and enable the reduction of water or HRWRA demand required to achieve high deformability. It can also reduce viscosity for a given consistency; especially in the case of SCC made with relatively low Water – Binder ratio. Reducing the free water can decrease the VEA dosage necessary for stability. High binder content typically includes substitutions of cement with 40% fly ash and 2.5% to 20% oyster shell powder. The cost of SCC can be reduced through the selection of adequate concrete - making materials and admixture constituents, including partial substitutions of cement and supplementary Cementations materials by readily available fillers. Regardless of its binder composition, SCC is characterized by its low yield value to secure high deformability, and moderate viscosity to provide uniform suspension of solid particles, both during casting and thereafter until setting. The mixture

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

proportioning of SCC to simultaneously meet the various performance requirements at minimum cost involves the optimization of several mixture constituents that have a marked influence on performance. This includes deformability, passing ability, filling capacity and segregation resistance. As with any new technology, there was clearly a learning curve to overcome, and refinement of the materials and mix proportions used took care to finally achieve optimum performance. In Japan, self – compacting concretes are divided into three different types according to the composition of the mortar: Powder type, Viscosity – modifying agent (stabilizer) type, Combination type For the powder type, a high proportion of fines produce the necessary mortar volume, while in the stabilizer type, fines content can be in the range admissible for vibrated concrete<sup>2</sup>. The viscosity required to inhibit segregation will then be adjusted by using a stabilizer .The combination type is created by adding a small amount of stabilizer to the powder type to balance the moisture fluctuations in the manufacturing process. The SCC essentially eliminates the need for vibration to consolidate the concrete. This results in an increase in productivity, a reduction in noise exposure and a finished product with few if any external blemishes such as “bug holes”. However, after completion of proper proportioning, mixing, placing, curing and consolidation, hardened concrete becomes a strong, durable, and practically impermeable building material that requires no maintenance.

## II. MATERIALS AND METHODOLOGY

Oyster shell powder: Mari culture centred on the blue belt zone along the southern coast of Korea appears to be high-profit fishery. Especially, the oyster as a dominant of shellfish farms is remarkable in the economics view. However, such industry has a potential of serious problem about disposal of oyster shell waste although it is considered to be greatly advantageous to the development of technology and economics. Chemical analysis, X-ray diffraction analysis (XRD), measurement of specific surface by BET, and microstructure analysis by electron microscope (SEM) were carried out to investigate the properties of oyster-shell as raw materials.. It is noted that oyster-shell is entirely composed of CaCO<sub>3</sub> (approximately 96%) and other minerals of trivial amount.

**Table 1**Chemical composition of oyster-shell

Composition	river oyster	sea oyster
CaCO <sub>3</sub>	95.994	89.56
SiO <sub>2</sub>	1.283	4.04
MgO	0.68	0.649
Al <sub>2</sub> O <sub>3</sub>	0.40	0.419
SrO	0.35	0.33
P <sub>2</sub> O <sub>5</sub>	0.206	0.204
Na <sub>2</sub> O	0.98	0.98
SO <sub>3</sub>	0.724	0.724

**Table 2** Physical properties of oyster shell

Color	Creamish White
Specific gravity	2.7
Moisture	3.9%
CaCO <sub>3</sub>	87.56%
SiO <sub>2</sub>	4.04%

**Cement:** Cement is made by heating limestone (calcium carbonate) with small quantities of other materials (such as clay) to 1450°C in a kiln, in a process known as calcinations, where by a molecule of carbondioxide is liberated fromthe calcium carbonate to form calcium oxide, or quicklime, which is then blended with the other materials that have been included in the mix. The resulting hard substance, called 'clinker', is then ground with a small amount of gypsum into a powder to make 'ordinary Portland cement', the most commonly used type of cement (often referred to as OPC)<sup>7</sup>. Portland cement is a basic ingredient of concrete, mortar and most non-specialty grout. The most

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

common use for portland cement is in the production of concrete. Concrete is a composite material consisting of aggregate (gravel and sand), cement, and water. As a construction material, concrete can be cast in almost any shape desired, and once hardened, can become a structural (load bearing) element.

**Coarse aggregate:** The coarse aggregate chosen for SCC is typically shape in angular, is well graded, and smaller in maximum size than that used for conventional concrete typical conventional concrete could have a maximum aggregate size of 40 mm or more. In general, a rounded aggregate and smaller aggregate particles aid in the flow ability and deformability of the concrete as well as aiding in the prevention of segregation and deformability of the concrete as well as aiding in the prevention of segregation.

**Fine aggregate:** In the present investigation fine aggregate is natural sand from local market is used. The physical properties of fine aggregate like specific gravity, bulk density, gradation and fineness modulus are tested in accordance with IS :2386. All along in India, we have been using natural sand. The volume of concrete manufactured in India has not been much, when compared to some advanced countries.

**Super plasticizer:** Super plasticizer is essential for the creation of SCC. The job of SP is to impart a high degree of flow ability and deformability, however the high dosages generally associate with SCC can lead to a high degree of segregation. Conplast SP 430 is utilized in this project, which is a product of FOSROC Company having a specific gravity of 1.222. Super plasticizer is a chemical compound used to increase the workability without adding more water i.e. spreads the given water in the concrete throughout the concrete mix resulting to form a uniform mix.

Water-reducing admixtures are negatively charge organic molecules that adsorb primarily at the solid-water interface, whereas solid particles carry residual charges on their surfaces, which may be positive, negative, or both. In cement paste, opposing charges on adjacent particles of cement can exert considerable electrostatic attractions, causing the particles to flocculate super plasticizers have air-determining properties, an air-entraining agent must be added to the concrete to get a stable air void system before a super plasticizer is added (Gagne et al., 1996).

The concrete is casted in to cube moulds of size 100mm×100mm, beam moulds of size 100×100×500mm and cylindrical moulds of 200 mm height×150 mm dia. The moulds used for the purpose are fabricated with steel seat. It is easy for assembling and removal of the mould specimen without damage. Moulds are provided with base plates, having smooth to support. The mould is filled without leakage .In assembling the moulds for use joints between the section of the mould are applied with a thin coat mould oil and similar coating of mould oil is applied between the contact faces of mould and the base plate to ensure that no water escape during filling .The interior surfaces of the assembled mould shall be thinly coated with mould oil to prevent adhesion of concrete.

### III. TEST RESULTS AND DISCUSSIONS

Results of fresh and hardened concrete with partial replacement of silica fume are discussed in comparison with those of normal concrete.

**Table 3: Results of Compressive, Split Tensile and Flexural Strength**

Mix	% oyster shell power added	Compressive Strength(N/mm <sup>2</sup> )		Split tensile Strength(N/mm <sup>2</sup> )		Flexural Strength(N/mm <sup>2</sup> )	
		7 days	28 days	7 days	28 days	7 days	28 days
M1	0%	21	38	19	39.5	5.20	5.84
M2	2.50%	22	40	20	41	6.5	7.12
M3	5%	23	42	18.5	40	7.25	8.65
M4	7.50%	21.5	40	18.5	39	7.45	8.92
M5	10%	21.5	39.5	18	38	6.14	7.33

The results of compressive strength were presented in Table 1. The test was carried out conforming to IS 516-1959 to obtain compressive strength of concrete at the age of 7 and 28 days. The cubes were tested using Universal

## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

Testing Machine (UTM) of capacity 2000Kn. From Fig 3 the compressive strength is up to 21.5 N/mm<sup>2</sup> and 39.5 N/mm<sup>2</sup> at 7 and 28 days. The maximum compressive strength is observed at 10% replacement of silica fume. There is a significant improvement in the compressive strength of concrete because of the high pozzolanic nature of the silica fume and its void filling ability<sup>11</sup>.

The results of Split Tensile strength were presented in Table 1. The test was carried out conforming to IS 516-1959 to obtain Split tensile strength of concrete at the age of 7 and 28 days. The cylinders were tested using Compression Testing Machine (CTM) of capacity 2000Kn. From Fig 4 the increase in strength is 4.10N/mm<sup>2</sup> and 4.65N/mm<sup>2</sup> at 7 and 28 days. The maximum increase in split tensile strength is observed at 10% replacement of silica fume. The optimum silica fume replacement percentages for tensile strengths have been found to be a function of water cement ratio of the mix. The optimum 28-day split tensile strength has been obtained in the range of 5–10% silica fume replacement level, whereas the value for flexural strength ranged from 15% to 25%.

The results of flexural strength of normal concrete and silica fume replaced concrete were presented in Table 1. The test was carried out conforming to IS 516-1959 to obtain Flexural strength of concrete at the age of 7 and 28 days. The cubes were tested using Universal Testing Machine (UTM) of capacity 1000 tones. From Fig 5 the maximum increase in flexural strength is observed as 7.75N/mm<sup>2</sup> and 9.38 N/mm<sup>2</sup> at 7 and 28 days when silica fume is replaced by 15% to that of cement. The flexure strength at the age of 28 days of silica fume concrete continuously increased with respect to conventional concrete and reached a maximum value of 15% replacement level for M40 grades of concrete.

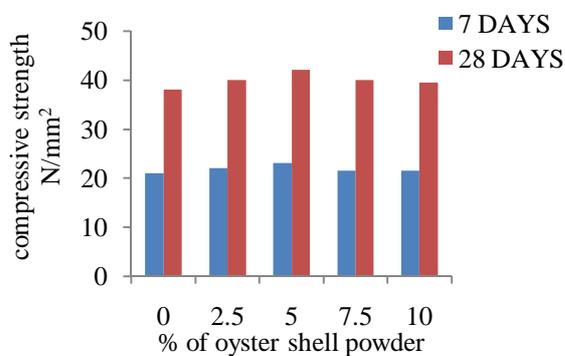


Fig.1: Effect of oyster powder on compressive strength of concrete

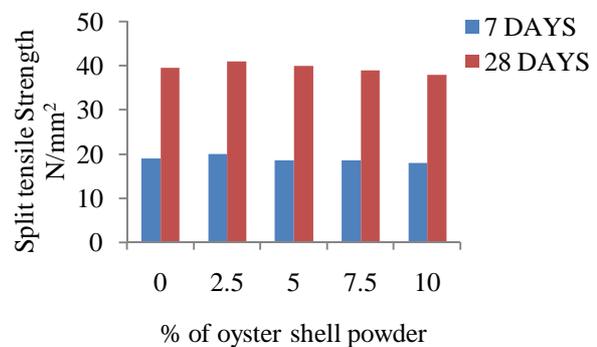
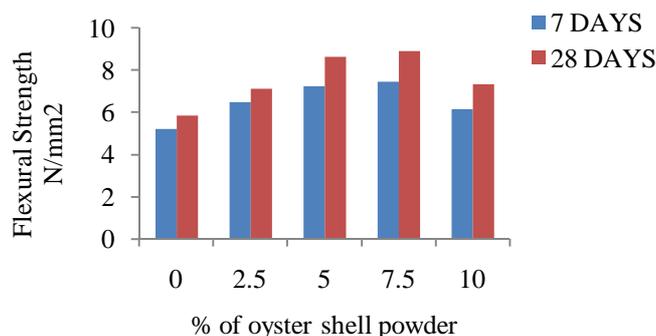


Fig.2: Effect of oyster powder on split tensile strength of concrete



# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

## IV. CONCLUSION

In this study ,it has been found that with the increase in various percentage of replacement river and oyster shell powder, hence if we increase the sea and river oyster shell powder replace of pozzolanic properties fly ash .so optimum percentage increase the river and sea oyster shell powder we have a better workable concrete is 5%.The result of the mechanical properties (compressive, split and flexure strength) have shown significant performance difference and the higher compressive strength has been obtained for oyster shell powder replacement level could be of optimum consideration for flow ability, mechanical properties study.

## REFERENCES

- [1] RAMACHANDRAN, V.S. and CHUN-MEI, Z., "Dependence of Fineness of Calcium Carbonate on the Hydration behaviour of Tricalcium Silicate," Durability of Building Materials, Vol. 4, 1986, pp. 45-66.
- [2] Husson, S., Gullhot, B., and Pera, J. "Influence of Different Filler on the Hydration of C3S," Proceedings, 9th International Congress on the Chemistry of Cement. India 1992, vol. IV. pp. 83-89.
- [3] Walter.A.Gutteridge and Dalziel, J.A., "Filler Cement: the effect of the Secondary Component on the Hydration of Portland Cement," Cement and Concrete Research, Vol. 20, 1990, pp. 778-782.
- [4] Bonavetti, V.L., Rahhal, V.F., and Irassar, E.F., "Studies on the Carboaluminate formation in Limestone Filler-Blended Cements," Cement and Concrete Research, Vol. 31, 2001, pp. 853-859.
- [5] Bonavetti, V.L., et al., "Limestone Filler Cement in Low W/C Concrete: A rational use of energy," Cement and Concrete Research, Vol. 33, 2003, pp. 865-871.
- [6] Soroka, I. and Stern, N., "Calcareous Fillers and the Compressive Strength of Portland Cement," Cement and Concrete Research, Vol. 6, 1976, pp. 367-376.
- [7] Hornain, H., et al., "Diffusion of Chloride Ions in Limestone Filler Blended Cement Paste and Mortars," Cement and Concrete Research, Vol. 25, 1995, pp. 1667-1678.
- [8] Cochet, G. and Jesus, B., "Diffusion of Chloride Ions in Portland Cement-Filler Mortars," Proceedings, Blended Cements in Construction, Sheffield, UK 1991, pp. 365-375.
- [9] Moukwa, M., "Penetration of Chloride Ions from Sea Water into Mortar under Different Exposure Conditions," Cement and Concrete Research, Vol. 19, 1989, pp. 894-904. 48
- [10] EN206-1, Concrete-Part 1: Specification, performance, production and conformity. European standard, 2000.
- [11] Lundgren, M., "Limestone Filler as Addition in Cement Mortars: Influence on Early-Age Strength Development at Low Temperature." Nordic Concrete Research, no.31, 2004, pp 50-63.
- [12] EN 196-1, Methods for testing cement-Part 1: Determination of strength, European standard, 1994.
- [13] EN 197-1, Cement-Part 1: Composition, specification and conformity criteria for common cements. European standard, 2000.
- [14] EN 1015-3, Methods of test for mortar for masonry- Part 3: Determination of consistency of fresh mortar (by flow table).
- [15] SS 13 71 24, Concrete testing-Fresh concrete-Air content (pressure method), Swedish standard, 1989.
- [16] Luping, T., "Evaluation of the rapid test method for measuring the chloride diffusion coefficients of concrete." SP Report 1998:42, SP Swedish National Testing and Research Institute, 1998.