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# Study of Fresh and hardened properties of High performance concrete: A Review

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***Abstract*—The main aspiration of this study is to examine the properties of concrete fundamental for generating high performance concrete with locally available cementitious materials that could provide additional shielding during service life. This paper, through a comprehensive review from literature presents the strength and exploits stipulation and addresses rare production aspect of high performance concrete. It also focuses on the importance of durability studies for the structures which are constructed at marine environments which may lead to corrosion of the reinforcement, thereby affecting the service life of the structures. The preventive measures are also discussed in the study below which results in production of durable concrete.**

***Keywords:- HPC-High performance concrete, SCC, GGBS, VEC-Viscosity-enhancing compounds***

## INTRODUCTION

In this era, the implementation of high performance concrete has enlarged and many research and observation were carried out in order to find excessive, competent and adequate mix design. High performance concrete is a sub division of special concrete which require more concern than ordinary concrete so that it may have the capability to spread into place and fill form work as well as wrap the reinforcement area under its own weight, similarly it provide a better working environment and produce the concrete without or with lower shrinkage behavior. Also care must be taken during curing so that it cannot experience shrinkage behaviors which can occur during hydration. This type of concrete gives the engineer a solution for using the concrete in special cases, such as construction around marine environment like jetty, high speed railway sleepers, precast beam for bridge.

However, high performance concrete need more consistency than traditional concrete due to the addition of some materials as well as successful mix design, which can be achieve by different trials and review from the literature.

## LITERATURE REVIEW

**Aslani Farhad (2019)** observed that increasing CR content generally decreased the width of the critical crack and led to a more distrbutted crack pattern. However, higher percentage of CR aggregate in SCC mixes increased the risk of segregation, because coarser CR aggregate required more energy to overcome their internal friction in order to be more flowable. Similarly, the density of SCRC mixes decreased as CR content increased.

Moreover, it was observed that all SCRC mixes showed significant improvement in compressive and tensile strength at 100 degree because of complete hydration of cement paste at that temperature.

It was also found that the degradation of modulus of elasticity was much higher than the degradation in compressive strength with increase in temperature. From the results it can be concluded that elevated temperature caused significant damage to SCRC mix stiffness, which was due to melted CR.

**Wang Dehong et al., (2019)** studied the effect of addition of basalt fiber on compressive strength of high performance concrete. The observed that air entraining effect of the fiber increased the pores in the concrete mix which means the bonding between the polypropylene fiber and cement matrix was less than that of basalt fiber.

Moreover, the two types of fiber had a complementary effect on the elastic modulus, where by the elastic modulus of polypropylene fiber was lower which caused a delay to the formation and propagation of micro cracks in the early stage of hardening and reduced the number of crack sources.Basalt fiber showed improved elastic modulus and they prevented the crack propagation during hardening of concrete. Similarly, these two types of fibers played a major role in order to improve the compressive strength of high performance concrete.

It was also found that, when the volume fraction of a single fiber is less than 7.2%, the flexural strength increased by 1.1% to 24.5% and split tensile strength increased by 21.9% to 44.5%.

**Y sun et al., (2018)** perceived that when volume of water changed, the change in volume of aggregate was more sensitive to the strength than that of paste volume, because it's not easy to control the water consumption amount in concrete mix plant during construction as accurate as laboratory level. It was also found that each group of mixture showed the phenomenon that the concrete strength increased as cement content increased, where by more cement in binder led to higher intense hydration reaction in the early age. Moreover, study showed that use of cement with higher strength increased the strength of the paste which resisted the micro cracks between the boundaries of aggregate and paste. However, it was noticed that in the first 7 days of curing, the shrinkage strain increased and the strain accounted around 80%, while the increment in 28 days shrinkage strain was very small.

**Long Guangcheng et al. (2017)** discovered that the effect of VEC fresh properties of self compacting concrete. They observed that the use of VEC in SCC decreased the slump and flow rate was also lower than without VEC mixes. This showed that addition of VEC increased the viscosity but decreased the flowability of the fresh concrete. Similarly, it was found that, the mix with VEC had a very thinner layer on its top surface than the mix without VEC, which showed the segregation resistance of the fresh concrete. Also it was observed that, addition of calcium sulfoaluminate not only eliminate settlement and even generate a certain expansion deformation within 24h after casting, but can also decrease the drying shrinkage as well as creep of selfcompacting concrete. However the calcium sulfoaluminate increased the brittleness of self compacting concrete.

**Ahmed S. Ouda (2016)** examined that the compressive strength of cement paste treated with 0.5% and 1% anhydrous borax was lower than those of the reference mixture up to 28 days of hydration. Similarly, cement with 0.5% and 1% dehydrate borax showed high compressive strength. Moreover, it was found that high performance heavy density concrete incorporating ilmenite or air cooled slay as course aggregate exhibits the highest level of shielding against gamma-rays. Also it showed that concrete made of carbonate aggregate such as dolomite and those made of iron ores such as hematite and limonite are very useful in shielding the neutron radiation.

**Gedam A. Banti (2015)** studied the effect of supplementary cementations materials on shrinkage and creep. Results showed that the use of finer cementations materials increased the water demand in concrete. Where by higher percentage of superplasticizer was needed to maintain desired workability in fresh stage. Similarly, the demand of superplasticizer was maximum in the mix with replacement of some percentage of silica fume and GGBS. However, it was found that the rate of gain of strength between the 7 to 28 days for concrete mix having only OPC cement was maximum as compared to other mix with some addition of fly Ash and silica fume. It's inferred that self compacting concrete mix with OPC cement when blended with silica fume, GGBS affected the initial rate of hydration and pozzolanic reaction of OPC cement resulted in low strength at early age. Also it showed that the use of GGBS as partial replacement of OPC cement has best results for coefficient of permeability, shrinkage and creep.

**Moradian Masoud (2014)** observed that the principal mechanism responsible for the extensive deterioration of the structure was chloride induced corrosion, where by this mechanism led to an extensive delamination and spalling of the concrete cover, dimensional and electrochemical incompatibility between former repair and substrate concrete, which also led to a reinforcement corrosion in the area. They suggested that the removal of the deteriorated concrete, rebar and replaced with new durable one will be a suitable alternative.

**Vidal et al., (2014)** found that the coefficient of variation of creep for the four HPC mixes during 300 days of loading was less than 5%, similarly 50 degree heating led to an increase in creep rate and approximate doubling of the creep amplitude after 300 days of loading, where by basic creep were found to be between 2.0 to 3.7 times higher loading. However, it was observed that mix with addition of fiber developed higher compressive strength as well as young modulus than the mix without. They also found that if the fiber is too low or too high, it increased its internal defect which decreased in the improvement of strength.

**Huo Sharon X (2006)** observed that, modulus of elasticity of high performance concrete was higher than that of normal concrete. The experimental results showed that use of low steam curing temperature in high performance concrete beam production enhanced the overall performance. Moreover, it was found that the average initial camber of NSC beams was 25mm when measured on the prestressing bed. Where by the average camber of the same beams immediately after the beams placed at a storage location was 30mm, which was 17.6% higher than the initial camber on the prestressing bed. This showed that increase in camber was mainly due to the removal of possible restraints on beams that were imposed by prestressing bed, where by the member was free to deform and more camber was observed at the new location.

## CONCLUSION

Based on the review from the literature, the following conclusion are offered

1. Research results obtained from various experiments showed that high performance concrete with high density aggregates can be used for shielding the neutron radiation.
2. It can be concluded that the use of basalt fiber and polypropylene hybrid fiber can improve the modulus of elasticity, split tensile strength and compressive strength of concrete.
3. Concrete mix made of carbonate aggregate such as dolomite and that made of iron ores such as hematite are very effective for shielding against neutron radiation.
4. From the above literature it can also be concluded that the use of mineral and chemical admixtures can improve the workability, strength and durability of any concrete.

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