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Concrete Using Agricultural Waste and Egg Shell Powder Waste: A Review

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Abstract - *Reuse of recycled or waste materials for the construction of civil structures is an issue of great importance in this century. Addition of waste products in concrete is also very common now days. It is worldwide recognized that the reuse and recycle of industrial and agricultural by adding in a proportion instead of conventional material for concrete production has many beneficial feature rather than dumping it or burying it in a landfill. In this study, literature review has been conducted to investigate the effect of agriculture waste such as fly ash, groundnut shell, oyster shell, tobacco waste, and egg shell powder waste on characteristics strength properties of concrete. Review of work done by various researchers are studied and compiled here. Incorporation of agriculture waste and ESP waste affects workability, strength and durability properties significantly*

Key Words: agricultural waste, egg shell powder waste, compressive strength, flexural strength concrete, mortar.

1. INTRODUCTION

High demand of natural resources due to rapid urbanization and the disposal problem of agriculture wastes in developed countries have created opportunity for used of agro waste in the construction industry [1].Development of a nation not only depends upon the technology but also depends upon the infrastructure. Generally, agriculture waste refers to sugarcane baggash ash, rice husk, wild giant reed, , sawdust, groundnut shell, oyster shell, tobacco waste, palm oil fuel ash, coconut shell and so on [2].Researchers have shown the importance of agro- waste ash, by partially replacing 10-30%of cement with agro wastes in order to achieve high-strength concrete [3]. Furthermore, despite such replacement, cement incorporating agro waste ash has exhibited a great performance in mortar and concrete, even under exposure to a hydrochloric acid solution [4].Recently with the development of socio- economics aspects and the progress of science and technology, resource utilization agro waste as booming because of their viability and low cost nature. Moreover, agro wastes contain fiber that shows a good stiffness-toughness balance, high efficiency with thermal insulation properties, tensile property, and the characteristic of biomass ash [5]. In agriculture, it is a waste, but for the construction industry and scientific research, it presents great potential as an additive, which enables it to reduce energy demand during both construction and service life. Furthermore, agro-cement has a good thermal insulation function, which properly handles both the problem of agriculture waste disposal and the thermal effect of urban construction [6].

Eggshell powder as cement replacement is a viable option to produce green concrete. At the same time, it improves the disposal of egg shell, which is thrown away as household waste and mostly ends up in the landfill. The advantages are associated with the high calcium content and good filling effect of egg shell powder. This includes improved hardened properties, reduced setting time and increased resistance to water penetration and carbonation [17].

2. NOTEWORTHY CONTRIBUTIONS IN THE FIELD OF CONCRETE INCORPORATING AGRICULTURE WASTE

Application of agriculture waste to mortar and concrete is recent trend and many studies have been conducted in this particular area [7 to 11]. The brief literature reviews of the latest studies are as follows.

Bui Le Anh Tuan [7] conducted experimental study on high strength concretes containing manufactured sand as fine aggregate in the concrete with fly ash, silica fume. The HSC mixes were designed to achieve 28-day compressive strength beyond 55 MPa. Compressive strength, drying shrinkage and sulfate attack tests were conducted to evaluate the feasibility on the production of HSC having crushed sand, FA and SF. The test results indicated that the compressive strength of all HSC mixes exceeded 55MPa at 28 days.

Marthong and Agrawal [8] carried out a comparative study on effects of concrete properties by partially replacing ordinary Portland cement of varying grades by fly ash. It was also observed that at the age of 90 days the rate of strength gain for 33, 43 and 53 grades concrete was increased and had been maximum up to 20% fly ash replacement. Author found that normal consistency increases with increase in fly ash content, setting time and soundness decreases with the increase in grade of cement. It was also found that influence of fly ash on shrinkage was negligible.

Dharani and Selvan [10] investigated durability properties of M25 grade concrete using groundnut shell ash as a mineral admixture for partial replacement of cement. Replacement percentage were 10 %, 15%, 20%, 25% and 30% and compressive strength were determined at the age of 7 days and 28 days of curing. Author found that incorporation of ground nutshell in concrete results in increased compressive strength at 10 % replacement, after that it decreases due to presence of potassium oxide in ash content. GSA concrete shows better resistance to acid attack, chloride attack and water absorption test.

Khekiye et. al. [11] Conducted experimental study to enhance the properties of concrete using oyster shell for partial replacement of river sand for M30 grade. Replacement percentage for oyster shell aggregate were 0 %, 10%, 20%, 30% and 40%. Author used 10 % metakaolin and 10 % marble powder to add strength and better workability to the concrete. Maximum strength performance found at 20 % oyster shell aggregate. Overall increase in compressive strength and split tensile strength were found to be 4-19 % and 2-11 % with respect to control mix.

3. NOTEWORTHY CONTRIBUTIONS IN THE FIELD OFCONCERETE INCORPORATING EGG SHELL POWDER

The brief literature reviews of the concrete using egg shell powder [15 to 19] are as follows.

Amarnath Yerramala [12] investigated concrete incorporating eggshell powder (ESP) for M-30 grade by varying the percentage of ESP and fly ash as partial replacement of cement were used. Replacement percentage were 0 %, 15 %, 30 %, 45 % for ESP by weight of cement. Strength properties were find at 7 and 28 days of curing. ESP replacement at 5 % shows higher compressive strength than control mix whereas at 10 % it shows lower strength. ESP replacement at 15 % shows lower split ensile strength than control mix. Incorporation of fly improves the strength performance of concrete but found similar to that of lime stone filler in concrete.

Dhanlaxmi et al [13] used two types of waste egg shell powder and fly ash for partial replacement of cement. Various properties such as workability, compressive strength and density were determined. Replacement percentage were 0%, 2.5 %, 5%, 7.5%, 10 % and 12.% % for ESP and 0 %, 5 %, 10 %, 15 %, 20 %, 25 %and 30 % for fly ash respectively. Study revealed that the 10 % partly replacement of ESP and 10 % FA with cement makes the concrete economical without affecting the strength and workability properties of concrete. Investigation shows addition of ESP reduces workability, density and compressive strength but when fly ash added to the concrete workability improves and compressive strength shows less reduction as compared to the control mix and egg shell concrete.

Jayasankar et al. [14] conducted an experimental study for M20, M25 and M30 grade by substituting rice husk ash, fly ash and egg shell powder to cement in concrete. Author used various combination of egg shell powder, rice husk ash and fly ash to investigate the properties of concrete. Replacement percentage were 5%, 10%, 15% and 20% for ESP, RHA and FA. It was observed that M20 and M25 concrete shows same level of strength performance as compared to conventional concrete whereas M30shows less strength. Author concluded that use of ESP, RHA and FA above M25 grade may results in decreased strength level.

Sathanantham et al [15] conducted an experimental study by replacing fine aggregate partially by rice husk ash and egg shell powder for M25 grade of concrete. The maximum compressive, split tensile and flexural strength was observed at 20% replacement.Author use Eggshell powder (ESP), Fly ash and (CWP) Ceramic waste powder as alternative material. ESP and CWP were used as a partial replacement of cement and various properties were determined. Replacement percentage for Egg shell powder and ceramic waste powder was 0%, 5%, 10% and 15% while for fly ash 0 % to 40%. Results shows incorporation of rice husk ash and egg shell power for partial replacement of fine aggregate affect the concrete properties significantly.

Yashwanath et al [16] used egg shell powder and fly ash for cement replacement for M30 grade of concrete to find various properties such as workability, compressive strength and split tensile strength. Replacement percentage were 10 % for ESP and 10-30 % for fly ash. Study revealed that the 10 % partly replacement of ESP and 10 % FA with cement makes the concrete economical without affecting the strength and workability properties of concrete.

4. CONCLUSIONS

On the basis of study reviewed here it can be said that recycle and reuse of various waste for concrete production enhances strength of concrete whether it is physical or mechanical properties. Utilisation of such waste material not only reduced environmental pollution but also results in reduced construction cost, possibility of achieving green construction, suitable application of wastes rather than dumping, optimum use of conventional material etc. Hence it can be concluded that concrete produced by waste material if used in correct proportion and manner it is likely a viable option for structural use as it has advantages that construction is greener and environment friendly.

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