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Assessment of properties of concrete due to addition of Rice Husk ,Coconut Fiber and steel wire (obtained from tyre pyrolysis)

Ankit Singhroha
Dronacharya College Of Engineering

I. INTRODUCTION

Concrete is the most widely used construction material all over the world. With innovations in science and technology in construction industry, the scope of concrete as a structural material, has widened. Since concrete is weak in tension and flexure, most commonly, it is reinforced using steel reinforcing bars. However usage of steel reinforcement is expensive. Considerable efforts have been made world-wide to add various types of fibers to concrete so to make it more strong, durable and economical. Fibers such as coconut fiber, steel fibre from pyrolysis of tyre and fly ash has certain physical and mechanical characteristics that can be utilized effectively in the development of reinforced concrete material. In most cases, these coconut fibers are dumped as agricultural waste, so can be easily available in large quantity hence making them cheap.

All the materials required producing such huge quantities of concrete come from the earth's crust. Thus, it depletes its resources every year creating ecological strains. On the other hand, human activities on the Earth produce solid waste in considerable quantities of over 2500/MT per year, including industrial wastes, agricultural wastes and wastes from rural and urban societies. Recent technological development has shown that these materials are valuable as inorganic and organic resources and can produce various useful products. Amongst the solid wastes, the most prominent ones are fly ash, blast furnace slag, rice husk, silica fume and demolished construction materials. From the middle of 20th century, there had been an increase in the consumption of mineral admixtures by the cement and concrete industries. The increasing demand for cement and concrete is met by partial cement replacement. Substantial energy and cost savings can result when industrial by-products are used as a partial replacement for the energy intense Portland cement. The use of by-products is an environmental friendly method of disposal of large quantities of materials that would otherwise pollute land, water and air. Most of the increase in cement demand will be met by the use of supplementary cementing materials. Rice milling generates a by-product known as husk. This surrounds the paddy grain. During the milling of paddy about 78 % of weight is received as rice, broken rice and bran. The rest 22 % of the weight of paddy is received as husk. This husk is used as fuel in the rice mills to generate steam for the parboiling process. This husk contains about 75 % organic volatile matter which burns up and the balance 25 % of the weight of this husk is converted into ash during the firing process, which is known as rice husk ash (RHA). Rice husk was burnt approximately 48 hours under uncontrolled combustion process. The burning temperature was within the range of 600 to 850 degrees. The ash obtained was ground in a ball mill for 30 minutes and its color was seen as grey. This RHA in turn contains around 85%-90% amorphous silica. So for every 1000 kg of paddy milled, about 220 kg (22%) of husk is produced, and when this husk is burnt in the boilers, about 55 kg (25%) of RHA is generated. India is a major rice producing country, and the husk generated.

Fly Ash is one of the residues generated by coal combustion, and is composed of the fine particles that are driven out of the boiler with the flue gases. Ash that falls in the bottom of the boiler is called bottom ash. Fly ash is generally captured by electrostatic precipitators or other particle filtration equipment before the flue gases reach the chimneys of coal-fired power plants, and together with bottom ash removed from the bottom of the boiler is known as **coal ash**. Depending upon the source and makeup of the coal being burned, the components of fly ash vary considerably, but all fly ash includes substantial amounts of silicon dioxide(SiO_2) (both amorphous and crystalline), aluminium oxide (Al_2O_3) and calcium oxide (CaO), the main mineral compounds in coal-bearing rock strata.

Constituents depend upon the specific coal bed makeup, but may include one or more of the following elements or substances found in trace concentrations (up to hundred ppm) arsenic, beryllium, boron, cadmium, chromium, hexavalentchromium, cobalt, lead, manganese, mercu ry, molybdenum, selenium, strontium, thallium, and vanadium, along with very small concentrations of dioxins and PAH compounds.

In the past, fly ash was generally released into the atmosphere, but air pollution control standards now require that it be captured prior to release by fitting pollution control equipment. In the US, fly ash is generally stored at coal power plants or placed in landfills. About 43% is recycled,[3] often used as a pozzolan to produce hydraulic cement or hydraulic plaster and a replacement or partial replacement for Portland cement in concrete production. Pozzolans ensure the setting of concrete and plaster and provide concrete with more protection from wet conditions and chemical attack.

After a long regulatory process, the EPA published a final ruling in December 2014, which establishes that coal fly ash does not have to be classified as a hazardous waste under the Resource Conservation and Recovery Act (RCRA).[4] .

In the case that fly or bottom ash is not produced from coal, for example when solid waste is used to produce electricity in an incinerator (see waste-to-energyfacilities), this kind of ash may contain higher levels of contaminants than coal ash. In that case the ash produced is often classified as hazardous waste.

II. USES OF FLY ASH

- Grout and Flowable fill production
- Waste stabilization and solidification
- Cement clinkers production - (as a substitute material for clay)
- Mine reclamation
- Stabilization of soft soils
- Road subbase construction
- As Aggregate substitute material (e.g. for brick production)
- Mineral filler in asphaltic concrete
- Agricultural uses: soil amendment, fertilizer, cattle feeders, soil stabilization in stock feed yards, and agricultural stakes
- Loose application on rivers to melt ice[15]
- Loose application on roads and parking lots for ice control[16]
- Other applications include cosmetics, toothpaste, kitchen counter tops, floor and ceiling tiles, bowling balls, flotation devices, stucco, utensils, tool handles, picture frames, auto bodies and boat hulls, cellular concrete, geopolymers, roofing tiles, roofing granules, decking, fireplace mantles, cinder block, PVC pipe, Structural Insulated Panels, house siding and trim, running tracks, blasting grit, recycled plastic lumber, utility poles and crossarms, railway sleepers, highway sound barriers, marine pilings, doors, window frames, scaffolding, sign posts, crypts, columns, railroad ties, vinyl flooring, paving stones, shower stalls, garage doors, park benches, landscape timbers, planters, pallet blocks, molding, mail boxes, artificial reef, binding agent, paints and undercoatings, metal castings, and filler in wood and plastic products.

III. STEEL WIRE FROM PYROLYSIS OF TYRE

The pyrolysis method for recycling used tyres is a technique which heats whole or shredded tyres in a reactor vessel containing an oxygen free atmosphere and a heat source. In the reactor the rubber is softened after which the rubber polymers continuously breakdown into smaller molecules. These smaller molecules eventually vaporize and exit from the reactor. These vapors can be burned directly to produce power or condensed into an oily type liquid, generally used as a fuel. Some molecules are too small to condense. They remain as a gas which can be burned as fuel. For instance whole tyres contain fibers and steel. Shredded tyres have most of the steel and sometimes most of the fiber removed. For instance whole tyres contain fibers and steel.

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The steel wire**(15 to 20%)** can be removed from the carbon black with magnets for recycling after pyrolysis process .This steel wire waste which obtained from pyrolysis of tyre can be used in concrete which can increase its flexural strength and tensile strength. Pyrolysis can be used to reprocess the tyres into fuel gas, fuel oil, solid residue (steel wire) and carbon black. A pyrolysis method which produces activated carbon and high-grade carbon black. This wasted steel wire can be used in concrete which can increase its strength.

IV. METHODOLOGY OF INVESTIGATION

The data of 30 trials of mixes are used for the analysis. From the data of 30 trials with adding plasticizer equations are developed 'Multiple Regression and correlation Analysis' was applied to derive the equations. In Multiple Regression Analysis, various formulae were developed, by varying the input parameters to predict the 7, 14, 28 and 90 days strength of concrete cube. Selection of following equations with different inputs, which would help the user to predict the strength of concrete cube with available data / input parameters, is based on the results of analysis and the validation of formula.

II. Experimental Programme Experimental programme comprises of test on cement, RHA, FA, cement concrete with partial replacement of cement with RHA and FA. A. RICE HUSK ASH 1) Normal Consistency = 17% 2) Initial and Final Setting time = 195min. and 265min. 3) Compressive Strength = 11 N/mm2 4) Specific Gravity = 2.09 B. ORDINARY PORTLAND CEMENT OPC 43 grade cement is used for this whole experimental study. The physical test results on OPC are as follows. 1) Normal consistency = 22% 2) Initial Setting time = 30 min. 3) Final Setting Time = 10 hrs. 4) Specific Gravity = 3.15 C. TEST ON CONCRETE An M25 mix is designed as per guidelines in IS 10262, 1982 based on the preliminary studies conducted in the constituent materials. Tests on fresh concrete are obtained as follows. 1) Slump Test=55mm 2) Vee-Bee = 13sec. 3) Compaction factor =0.95 4) Flow Test =78 %. D. Mixture Proportioning The mixture proportioning was done according the Indian Standard Recommended Method IS 10262- 1982.The target mean strength was 32.1 Mpa for the OPC control mixture, the total binder content was 435.45 kg/m ,fine aggregate is taken 476kg/m and coarse aggregate is taken 1242.62kg/m the water to binder ratio was kept constant as 0.44, the Superplasticizer content was varied to maintain a slump of (200-240 mm) for all mixtures. The total mixing time was 5 minutes, the samples were then casted and left for 24 hrs before demoulding They were then placed in the curing tank until the day of testing Cement, sand, Fly ash, Rice husk ash and fine and coarse aggregate were properly mixed together in accordance with British Standard Code of Practice (BS 8110)19 in the ratio 1:1.1:2.85 by weight before water was added and was properly mixed together to achieve homogenous material. Water absorption capacity and moisture content were taken into consideration and appropriately subtracted from the water/cement ratio used for mixing. Muthadhi et al. 9 reported the blending of rice husk ash (RHA) in cement is recommended in most international building codes now. Hence, cement was replaced in percentages of 0, 1,2,3,4, 5 up to 30% with rice husk ash and fly ash and 150 × 150 × 150mm3, Beam and Cylinder moulds were used for casting. Compaction of concrete in three layers with 25 strokes of 16 mm rod was carried out for each layer. The concrete was left in the mould and allowed to set for 24 hours before the cubes were de moulded and placed in curing tank. The concrete cubes were cured in the tank for 7, 14, 28 and 90 days

V. CONCLUSION

Based on the limited study carried out on the strength behavior of Rice Husk ash, the following conclusions are drawn: At all the cement replacement levels of Rice husk ash; there is gradual increase in compressive strength from 3 days to 7 days. However there is significant increase in compressive strength from 7 days to 28 days followed by gradual increase from 28 days to 56 days. At the initial ages, with the increase in the percentage replacement of both Rice husk ash, the flexural strength of Rice husk ash concrete is found to be decrease gradually till 7.5% replacement. However as the age advances, there is a significant decrease in the flexural strength of Rice Husk ash concrete. By using this Rice husk ash in concrete as replacement the emission of green house gases can be decreased to a greater extent. As a result there is greater possibility to gain more number of carbon credits.

Coconut fibre being low in density reduces the overall weight of the fibre reinforced concrete thus it can be used as a structural light weight concrete. 2) By reinforcing the concrete with coconut fibres which are freely available, we can reduce the environmental waste. 3) Flexural strength increases in case of 3% fibre mix. Thus, economy can be achieved in construction. 4) Since, 5% & 7 % fibres do not show favourable results, it can be concluded that fibre content should not be used beyond 3%.

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