EXPERIMENTAL STUDY ON UTILIZATION OF INDUSTRIAL WASTE IN CONCRETE

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ABSTRACT :- Properties of Concrete with glass powder as fine aggregate replacement The feasibility of using waste glass as fine aggregate replacement in concrete was researched, which is an absorbing possibility for providence on waste disposal spots and conservation of natural resources. An experimental work was performed to study the depression, unit weight, compressive strength, unyoking tensile strength, flexural strength, modulus of pliantness, ultrasonic palpitation haste, dry viscosity and chloride ion penetration test at different curing periods of 7, 14 and 28 days. Five concrete composites with 0, 5, 15 and 20 relief by weight of beach with waste glass were prepared. In this exploration, an experimental disquisition was carried out to study the complete stress-strain geste, mechanical strength and continuity parcels of concrete with partial relief of natural swash beach by glass greasepaint. Five different grades of concrete M20, M30, M40, M50 and M60 were designed for the present study. Concrete with different glass powder replacement percentages of 0, and 50 were tested to study their properties and to find the optimum of replacement for sand. All the fresh concrete composites were tested also for the workability properties by conducting depression cone tests. According to the test results, it's observed that the depression value of fresh concrete increase gradationally with of glass powder upto 40 replacements. The Rapid Chloride Penetration Test (RCPT) test results show that the chloride penetration rate is vastly reduced with addition of glass greasepaint and permeability properties of concrete is enhanced upto 50 replacement situations.

Estimation of Effectiveness factor and Exertion Indicator for Rice Husk Ash, Waste Glass Powder, and Sugar cane Bagasse Ash as cement relief in concrete Colorful types of Supplementary Cementitious Accoutrements (SCMs) like Rice Husk Ash (RHA), Waste Glass Powder (GP), and Sugarcane Bagasse Ash (SBA) are delved experimentally and analytically, for a implicit use in concrete. The relative performances of these SCMs are compared with that of the portland cement using the conception of the effectiveness factor (or k value). In the current work, the conception of an effectiveness factor was used as a measure of the relative performance of SCMs compared with Ordinary Portland cement. Compressive strength tests on concrete with colorful chance of relief of cement with these SCMs were performed. With regard to compressive strength, effectiveness factors for these SCMs were calculated. A blend design strategy to fulfill any requirements for concrete strength with SCMs was developed and it enables concrete performance to be directly prognosticated. Experimental results show that when SCMs substitute summations, strengths of the SCM (RHA, GP and SBA) concrete plant to be advanced than that of the control samples. Still, when SCMs (RHA, GP and SBA) replace cement, the strength is reduced at first and at latterly periods, this gap is gradationally reduced and the SCM concrete reaches advanced strength than that of the control concrete blend due to advanced active silica content in comparison with the cement. By introducing the effectiveness factor conception, the Sugarcane bagasse ash of this work can substitute, equally, for Portland cement ($k = 1$). The Rice cocoon ash parade lower effectiveness factors ($k = 0.35$ –0.6) and waste glass greasepaint have little advanced value of effectiveness factors ($k = 0.3$ –0.95) at latterly periods.

Besides that, exercise of plastic waste in construction assiduity results in the environmental and profitable benefits in the product of concrete. Concrete with colorful (0 to 55) of waste plastic summations were tested for their plasticity and strength parcels. In the present work, plastic summations attained as end product of a polymer reclaim assiduity in the form of earnings called as plastic summations are used as fine aggregate reserves. According to the experimental results, the addition of plastic total as fine total reserves results in increase in compressive strength, resolve tensile strength and flexural strength up to 40 reserves for beach and hence they can be used in concrete products for sustainable developments

I. INTRODUCTION

In the present exploration work, we concentrated on the study on pozzolanas like waste glass powder, rice husk ash and sugarcane bagasse and on solid wastes like plastic and polypropylene wastes for their addition in concrete products.

MATERIALS USED:-

Glass Powder:- Glass is an unformed material with high silica content, it can be produced with variety of flyspeck size of lower than700 µm, 425 µm 150 µm and with 75 µm and thus can be considered as a pozzolanic material. Glass powder with silica content further than 72 and particle size 600 µm gives increased strength and enhanced continuity in the concrete.

Rice Husk Ash :- Rice husk is an agrarian waste material, every time, further than 500 million tons of rice is produced worldwide. In the product process of rice, about 20 of the rice husk is left out as the waste material. By burning this rice husk at temperature in the range of 600 to 700oC, under controlled temperature conditions, the rice husk ash with veritably high silica content is produced. Being the rice having silica content, rice husk ash can be used as a pozzolana in concrete products. RHA is a largely reactive pozzolanic material and has the implicit to be used as replacement accoutrements for OPC.

Sugarcane Bagasse Ash (SBA) :- Sugarcane bagasse is the waste produced after juice birth from sugarcane. Brazil and India are the world's major sugarcane producing countries with Brazil having over of 719 million tons in 2010 and recorded one-third of the world's total sugarcane. The Sugarcane Bagasse Ash (SBA) is attained as by product of control burning of sugarcane bagasse. Sugarcane Bagasse is generally burnt as a means of solid waste disposal. The disposal of this ash also pose serious environmental problem the effectiveness factor for the sugar bagasse ash with ordinary Portland cement was plant out in this work.

Polymer Industrial Waste:- The use of waste plastic accoutrements in a number of civil engineering operations has been delved through a large number of research studies. These have been conducted to examine the possibility of using plastics in colorful civil engineering systems, in the construction field. Plastic wastes constitute a major portion of the solid wastes in India. Thus use of waste plastics in concrete will give a sustainable result for its disposal problem and for environmental threats. In the present work, the waste by product of polymer assiduity in Salem was used as the replacement for sand in concrete to study the parcels of concrete with waste plastics as fine summations reserves.

Cement :- Locally available ACC cement 53 grades (Ordinary Portland cement) attesting to (IS269-2015), was used for the present exploration. The Standard thickness of cements was determined in agreement with IS 4031 (Part 4)-1995. Pastes having standard thickness were used to determine the original setting time and final setting time in agreement with (IS 4031 (Part5)-1995).

Sand :-Locally available natural river sand with maximum size of 4.75 mm and confirming to zone II as per IS 383-1987 was used as fine aggregates. The specific gravity of sand is 2.66; its water absorption is 3.0% and unit weight 1690kg/m3.

Coarse Aggregate :-Graded crushed granite coarse aggregates with maximum nominal size of 20 mm and down was confirming to IS:383-2016 was used as coarse aggregate in the concrete mixes. The specific gravity of coarse aggregate is 2.7, its fineness modulus is 6.7, bulk density is 1800 kg/m3 and its water absorption is 0.3%.

Superplasticizer :-Conplast SP 430 received from Elkem India (P) Ltd, Confirming to ASTMC-1240 was used as super plasticizer.

OBJECTIVES OF THE RESEARCH

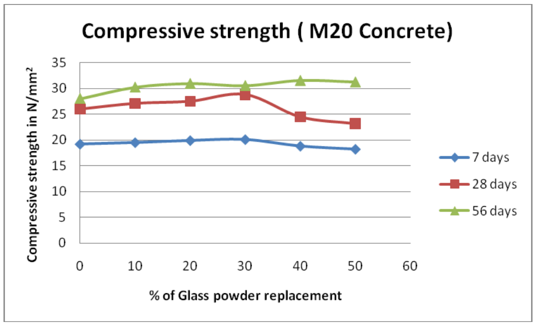
The current research was focused on the following five objectives:

- To carry out experimental investigation on the workability properties of fresh concrete, mechanical and durability properties of the concrete with strength concrete with different glass powder replacement percentages of 0%, 10%,20%,30%,40% and 50% on five different grades of concrete M20, M30, M40,M50 and M60.
- To carryout extensive experimental and analytical investigation on various types of Supplementary Cementitious Materials (SCMs) like Rice Husk Ash (RHA), Waste Glass Powder (GP), and Sugarcane Bagasse Ash (SBA) are investigated experimentally and analytically, for a potential use in concrete. To investigate the relative performance of these SCMs compared with that of the portland cement using the concept of the efficiency factor (or k value) and to study the influence of these three SCMs in strength properties of concrete and to find their optimum quantity of replacements for cement in order to attain the target concrete strength.

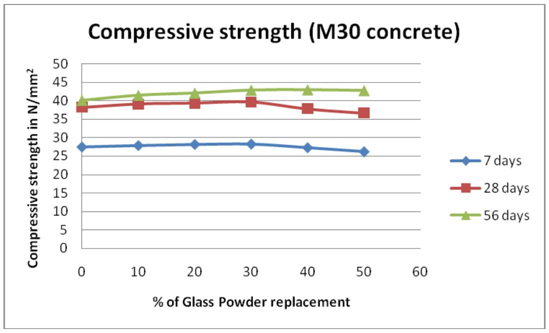
- To investigate the performance of beam with polypropylene rope reinforcements through experiments.
  To perform experimental investigation on the influence of addition of plastic waste on the mechanical strength such as compressive strength, tensile strength and flexural strength of concrete.
- The use of plastic in concrete has become increasingly popular generating significant research interest over the past twenty years. Owing to the increase in number of cars worldwide, the accumulation of huge volume of plastic has become a major waste problem. Looking to the global issue of environmental pollution by plastic waste, research efforts have been focused on consuming this waste on massive scale in efficient and environmental friendly manner.
- To design the mix proportions for five various grades (M20, M30, M40, M50 and M60) of concrete with different glass powder replacements (0%, 10%, 20%, 30% 40% and 50%) for natural sand in concrete.
- To investigate the workability properties of fresh concrete, mechanical properties of hardened concrete and their durability properties by testing the specimens prepared as per standard specifications.
- To investigate the detailed stress strain behavior of concrete with different % of waste glass powder additions.

Mix proportions for concrete

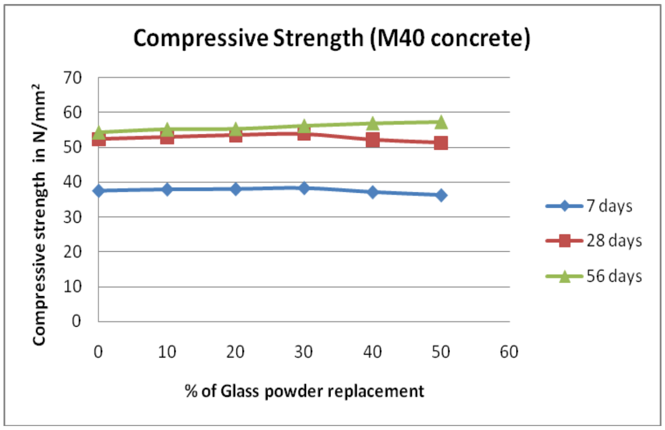
Grade	M20	M30	M40	M50	M60
w/c	0.50	0.45	0.40	0.35	0.30
Cement kg/m³	360	400	420	480	500
Sand kg/m³	750.12	734.16	696.17	678.00	745.8
Coarse aggregate kg/m³	1142.10	1117.8	1256.2	1223.4	1135.6
Water content litres/m³	180	180	140	140	140
Super plasticizer kg/m³	0	0	4.2	4.2	8.4



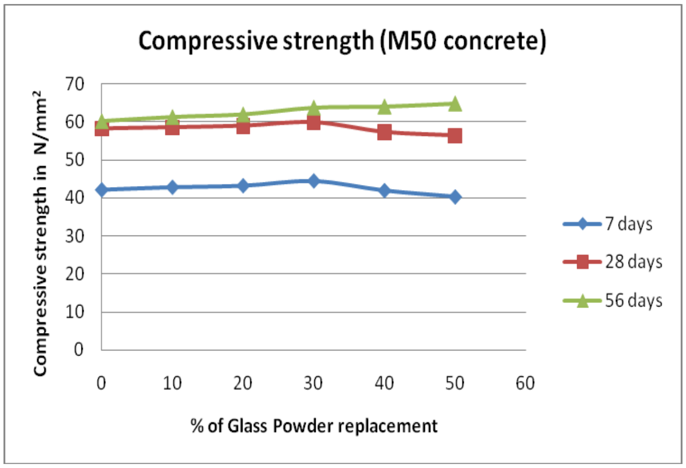
Compressive strength M20 concrete for various % of glass powder



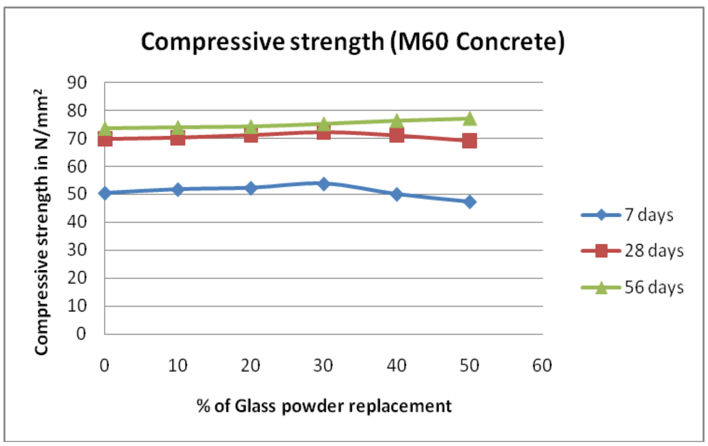
Compressive strength M30 concrete for various % of glass powder



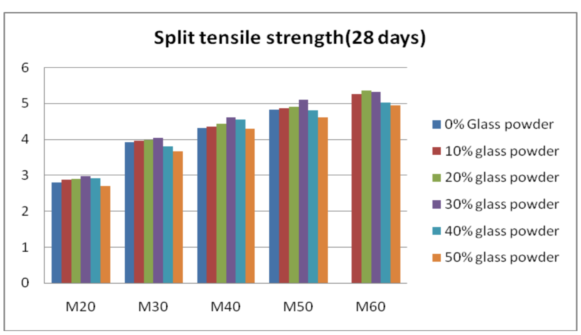
Compressive strength M40 concrete for various % of glass powder



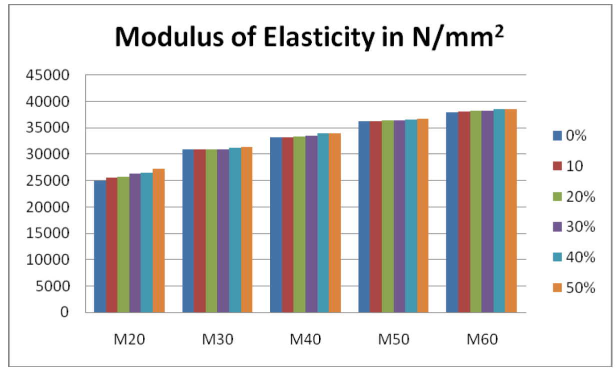
Compressive strength M50 concrete for various % of glass powder



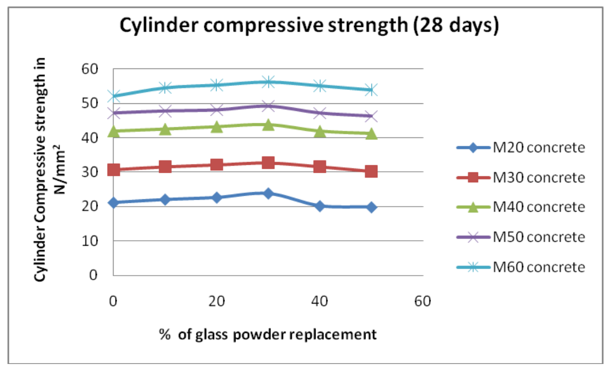
Compressive strength M60 concrete for various % of glass powder



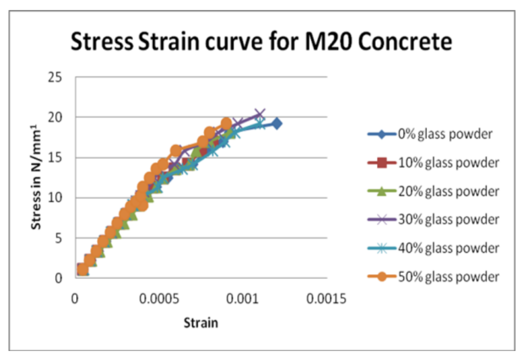
Split tensile strength at 28 days for various % of glass powder and different concrete grades



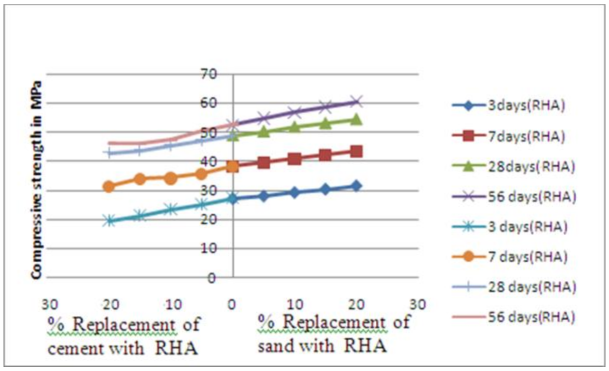
Modulus of elasticity of concrete with various % of glass powder



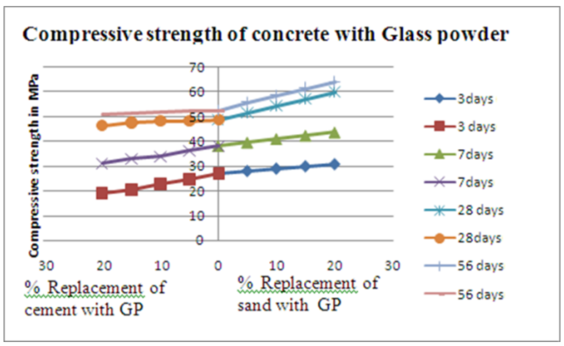
Cylinder compressive strength of concrete with various % of glass powder



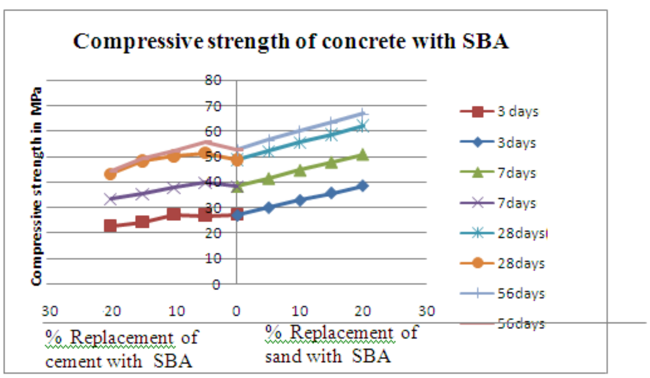
Stress Strain curve for M20 concrete with various % glass powder replacement



Compressive strength of Concrete with Rice Husk Ash

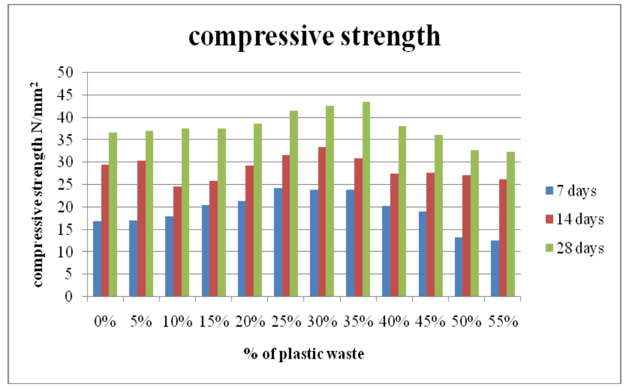


Compressive strength of concrete with Glass Powder

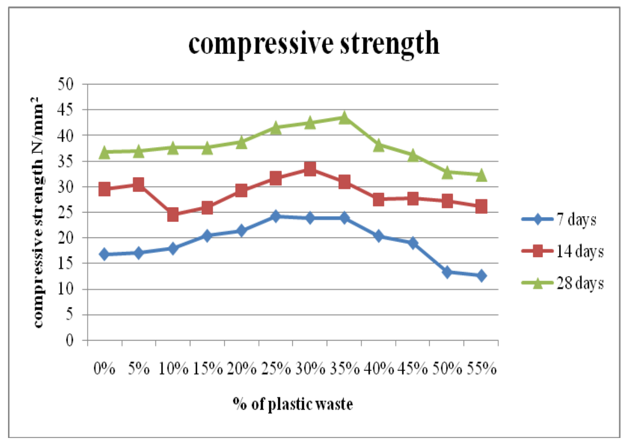


Compressive strength of Concrete with SBA

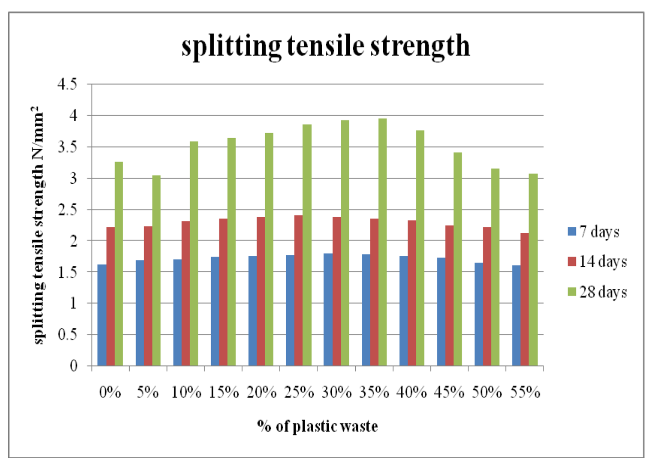
Activity Index:- When SCMs are used as pozzolanic materials in concrete, activity index can be used as a measure of their activity in concrete. Activity Index is defined as the ratio of the compressive strength of a pozzolanic mortar to that of a control mortar. The control mortar was prepared with a water cement ratio of 0.5 and cement to sand ratio of 3 as per the specifications. The pozzolanic (SCM) mortar were prepared with the same water/ cement ratio of 0.5,with sand to aggregate ratio of 3 and with the 80% cement content and 20% of SCMs (RHA, GP and SBA) for respective mortar specimens. The mortar specimens were tested at 28 days and 56 days after proper curing.



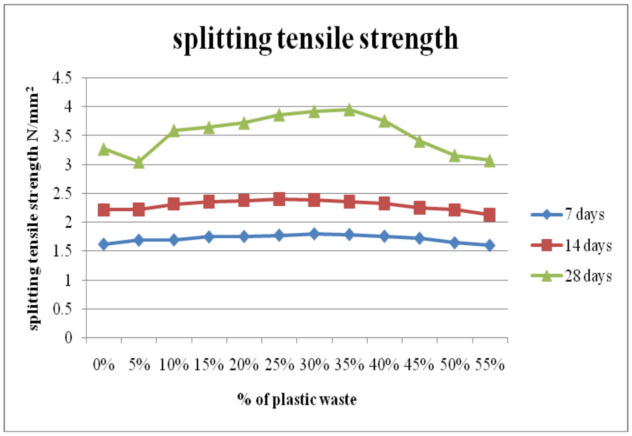
Bar chart for Compressive strength of concrete with plastic waste aggregates



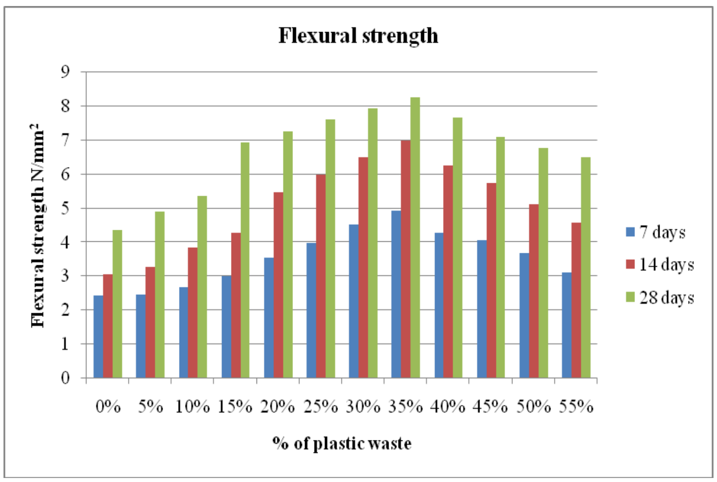
Compressive strength of concrete with plastic waste aggregates at various ages



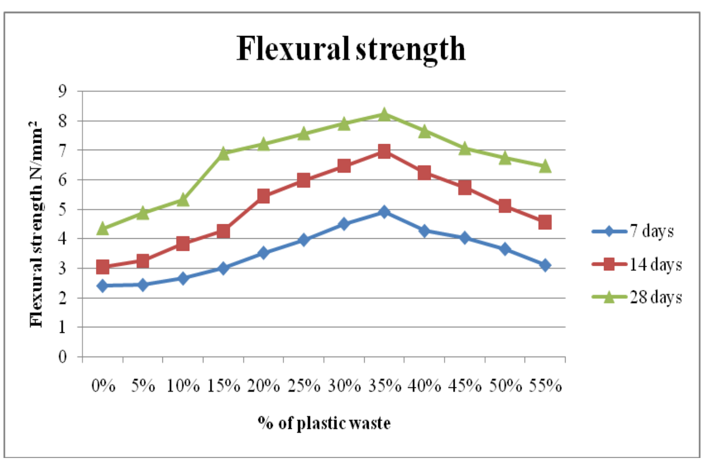
Bar chart for Split tensile strength of concrete with plastic waste aggregates



Split tensile strength of concrete with plastic waste aggregates at various ages



Bar chart for Flexural strength of concrete with plastic waste aggregates



Flexural strength of concrete with plastic waste aggregates at various ages

CONCLUSIONS

- The mix design for concrete with five various grades (M20, M30, M40, M50, M60) was done. Extensive experimental study on strength and durability properties of these five grades of concrete with different % of (0%, 10%, 20%, 30%, 40% and 50%) waste glass powder for cement replacement was carried out. The stress strain behaviour of all the above concrete mixes was investigated and reported in this section. Based on this study the following conclusions are drawn :
- According to the test results, it is observed that the slump value of fresh concrete increase gradually with % of glass powder upto 40% replacements.
- The increase in compressive strength, flexural strength and split tensile strength gradually increase upto 30% addition of waste glass powder and for 40% and 50% replacements the strength values are comparable with that of the control mix.
- The density and modulus of elasticity of concrete also gradually increases from 0% to 50% addition of glass powder in the concrete.
- The RCPT test results show that the chloride penetration rate is highly reduced with addition of glass powder and permeability properties of concrete is enhanced upto 50% replacement levels.
- Therefore 50% of glass powder can be used as the replacement material for fine aggregates without much compromise on the strength and durability properties and to achieve economic and environmental benefits.
- It is observed that the concept of efficiency factor can be applied to find the relative performance of various SCMs (Rice husk Ash, waste Glass powder and Sugarcane bagasse powder) with reference to ordinary Portland cement. From the current research works, the efficiency factors for various SCMs (RHA,GP and SBA) are calculated and reported in Table 3. These values are valid for a certain amount of SCM in concrete (upto 20%) and they are different depending on the various ages of concrete specimens.
- It is observed that when SCMs substitute aggregates, strengths of the SCM (RHA, GP and SBA) concrete found to be higher than that of the control specimens. However, when SCMs (RHA, GP and SBA) replace cement, the strength is reduced at first and , at later ages, this gap is gradually reduced and the SCM concrete reaches higher strength than that of the control concrete mix due to higher active silica content in comparison with the cement.
- By introducing the efficiency factor concept, the Sugarcane bagasse ash of this work can substitute,

equivalently, for Portland cement (k= 1). The Rice husk ash exhibit lower efficiency factors (k= 0.35–0.6) and waste glass powder have little higher value of efficiency factors (k= 0.3–0.95) at later ages.

- At the next phase, plastic aggregates obtained as end product of a polymer recycle industry in the form of gains called as plastic aggregates are used as fine aggregate replacements. According to the experimental results, the addition of plastic aggregate as fine aggregate replacements results in increase in compressive strength, split tensile strength and flexural strength upto 40% replacements for sand and hence they can be used in concrete productions for sustainable developments.

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