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Research on Concrete Use of Recycled Waste Cloth

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Abstract - **Waste cut textiles obtained from tailoring shops are one of the biomasses that are plentiful and not yet being used. Following initial processing, these waste cloths are chopped into tiny pieces, roughly 20mm x 20mm in size, and used in concrete in varying percentages. The addition of these waste materials improves the energy absorption as well as the flexural and tensile characteristics. Physical and engineering requirements are thoroughly investigated, and results are compared to the control concrete. This new material's prospective applications and significance have been thoroughly examined.**

1. INTRODUCTION:

Solid waste disposal is a significant issue everywhere in the world. The utilisation and recycling of these waste products is expanding globally, particularly in the building sector. Due to the scarcity of natural mineral resources and rising costs of waste management, the use of these recycled materials and wastes in construction is becoming more widespread. Yet, there is a growing demand for more knowledge of the engineering behaviour of composite materials due to the expanding usage of wastes in engineering applications[1]. Textile cutting trash from businesses and tailoring studios is disposed of as waste in piles, creating a disposal issue and polluting the environment[2]. Many types of fibres can be recovered from various waste streams and are acceptable for use as reinforcement in concrete, according to studies[2]. According to reports[3-5], polymer concretes can also be reinforced using synthetic and natural fibres. When textile waste cuttings are combined with a thermosetting polymer as a binder, a special type of composite material is created that can be used for inexpensive, light-weight construction[6] as well as better chemical resistance and mechanical strengths[6,7]. According to a report[8], polymer concrete made with waste cloth has brittle qualities that limit its applicability for load-bearing applications.

In order to examine the physical-mechanical properties and explore potential applications in the construction industry, these textile cut cloths from tailoring shops are chopped into small pieces and mixed with regular concrete.

2. EXPERIMENTAL PART:

Materials Used:

Ordinary Portland cement (OPC) 43 grade of Dalmia brand conforming to IS 8112 was used. The river sand used had a fineness modulus of 2.01. The coarse aggregate used was 10mm and down size had fineness modulus of 3.63 mm. The textile cut cloths were collected from the local tailoring shops and was mixture of synthetic and semi synthetic cloth pieces and cut into small sizes approximately 20mm x 20mm as shown in Fig 1. Thesecloths were soaked in soap solution then rinsed enough in flowing water to remove soap and dirt and subsequently these cut cloths were subjected to drying for complete removal of moisture in the electric oven.This textile cutting may not be conceived as either an aggregate or reinforcement. It does however contribute to increase in volume of the mixture (which is the major function of an aggregate), less the weight and intent to contribute to the increase in the flexural and compressive resistance (which is the major function of the steel reinforcement) due to its fibrous nature.

Casting And Moulding Of Specimens:

From various trial mix studies carried out earlier on conventional concrete, one mix proportion was selected and various percentages of cut cloths based on weight of cement. This

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unique kind of concrete was used to cast following test specimens for physico-mechanical strength analysis. For cube compressive strength test 150mm x 150mm x 150mm size cubes were cast, For cylinder compressive strength test 80mm diameter and 150mm long cylinders were cast , for the determination of dry and saturated densities 80mm diameter and 50mm thick disk specimens were prepared. For the determination of split tensile strength tests 80mm diameter and 250mm long cylinders were used. The flexural strength was obtained from the beam specimen of size 50mm x 50mm x 300mm. For shear strength determination small cylinders of size 50mm diameter and 100mm long specimens were cast. For finding the efficiency of the coating systems on water absorption, square tiles specimens of size 100mm x 100mm x 25mm were cast. For arriving impact resistance of this new material tile of size 250mm x 300mm x 10mm thick were prepared and after first day, the moulds were demoulded and the specimens were allowed for 28- days curing and then subjected for experimental studies. The Table 1 shows the designation and mix ratios.

Fig 1: Waste cloth used in concrete

Table 1: Mix Proportions of Waste Cloth Concrete

Mix designation	OPC	Sand	Coarse aggregate	Percentage of waste cloth By the mass of OPC	w/c
C	1.00	1. 5	2.00	-	0.40
T1	1.00	1. 5	2.00	1	0.40
T2	1.00	1.5	2.00	2	0.40
T3	1.00	1.5	2.00	3	0.40
T4	1.00	1.5	2.00	4	0.45
T5	1.00	1.5	2.00	5	0.45

3. RESULTS AND DISCUSSION:

The Table 2 shows the cube compressive strength of cloth concrete after 28 days of curing. The control concrete has high cube compressive and cylinder strength and gradual reduction in cube compressive and cylinder compressive strength as the percentage of addition of wastecloth increases.

It can be seen from Fig 2 that the reduction in cube compressive strength (f_{cu}) follows the equation

$Y = 0.2336x^2 – 4.6204x + 49.368, (R^2 = 0.9543)$

Table 2: Characteristics Strength of Waste Cloth Concretes

Designation	Cube Compressive Strength , fcu (MPa)	Cylinder Compressive Strength,fcy (MPa)	Splitting Tensile Strength,fsp (MPa)	Flexural Strength , fr (MPa)	Impact resistance energy absorbed (kN-m m)
Control	63.01	34.08	2.89	6.81	1.12
T1	44.24	26.53	4.48	7.46	1.4
T2	42.63	22.53	3.73	8.26	1.68
T3	37.35	20.38	2.96	9.26	1.90
T4	33.40	18.22	2.91	9.92	2.24
T5	32.76	14.86	2.71	10.55	2.46

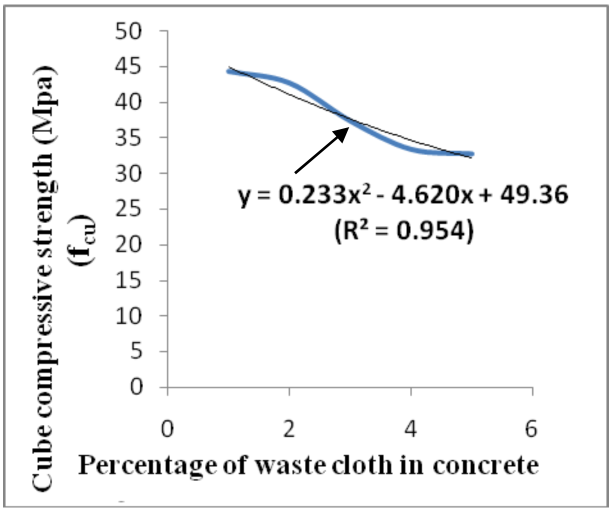
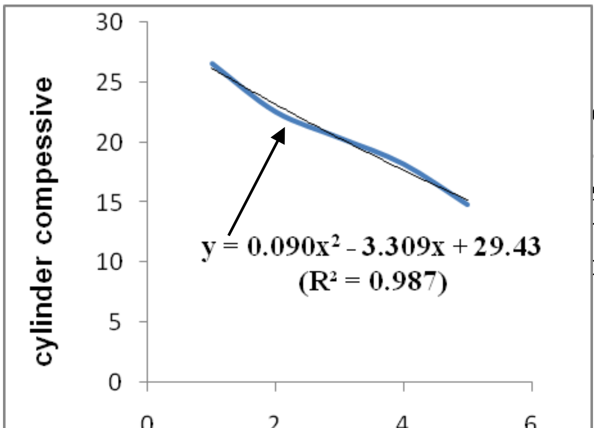


Fig2: Cube Compressive Strength of waste cloth concrete after 28 days

Similar trend was observed in cylinder compressive strength test also (fcy). It can be clearly seen from the Fig 3. The reduction in strength is very steep compared to fcu values and follows the equation

$Y = 0.0907x^2 – 3.3093x + 29.434, (R^2 = 0.9879)$



est, the control concrete had a value of splitting tensile of cube compressive strength. Addition of cloths in d to control mixturefor the percentage of additions 1% mixture T5, ie 5% addition of cloth in concrete reduced control mixture of concrete. this variation in strength follows the equation

$$\mathbf{Y = 0.13x^2 - 1.216x + 5.576, (R^2 = 0.9822)}$$

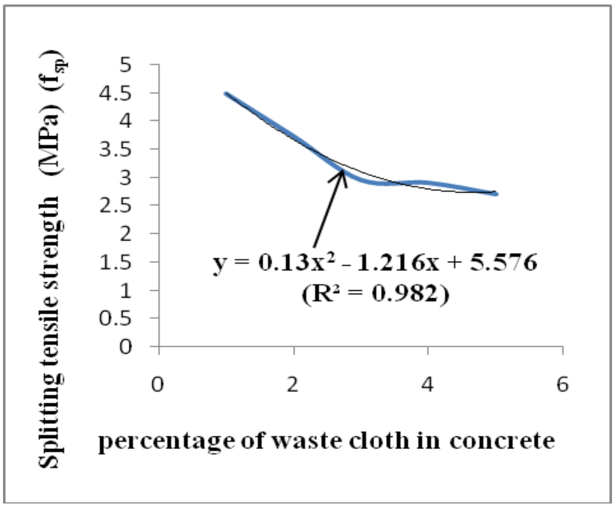


Fig 4: splitting tensile Strength of waste cloth concrete after 28 days

The Fig 5 shows the split view of the cylinder after splitting tensile strength test. An addition of waste cloths interacts in the split plane and resists the tensile or split force and hence the resistance against splitting is increased. However in T5 (5% waste cloth), the quantity of waste cloth addition seems to be high and hence reduction in fcu, fcy and fsp. The flexural resistance or modulus of rupture or bending stress value compared to control concrete and these values follows the equation as seen fromFig **6**

Fig 3: Cylinder Compressive Strength of waste cloth concrete after 28 days

The reduction in compressive strengths can be attributed to the fact that the cohesiveness in the concrete matrix is reduced drastically due to incorporation of waste cloths in concrete. This is true because, as the percentage of cloth is increased in concrete, the compressive strength are reduced. Another reason for reduction in strength is, the calcium silicate hydrate formation is not fully around the fine or coarse aggregate and partially formed on the waste cloth. This is a composite action that reduces the strength.

$$Y = 0.0486x^2 - 1.0754x + 6.398, (R^2 = 0.9975)$$

Fig 5: Split section of waste cloth concrete

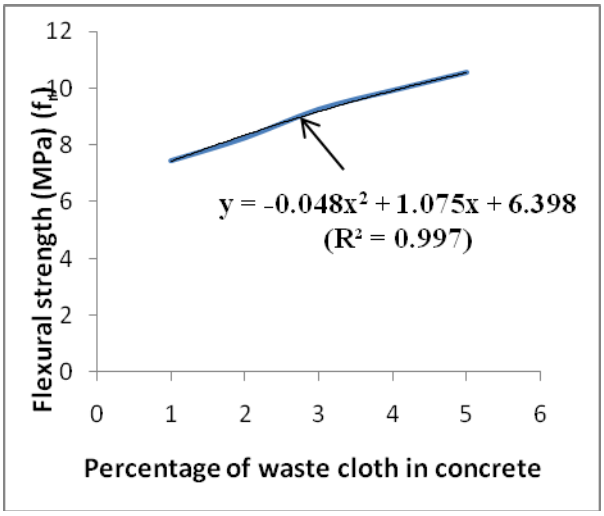


Fig 6: Flexural Strength of waste cloth concrete after 28 days

The reason for increase in bending stress being that the cloths in the concrete mix provide a high tensile strength and acts as reinforcement against bending.

Tile specimens were used for measuring impact resistance. Fig 7 shows the trend of increase in impact energy absorption as the percentage of waste cloth addition is increased. The Table 3 illustrates the height of fall of steel ball which is weighing 560gm and corresponding strain energy absorbed also computed and presented. As it has been discussed, the cloths acts as reinforcing material which enable the tiles to absorb more energy before it fail by impact load. The cracked tiles are shown in Fig 8.

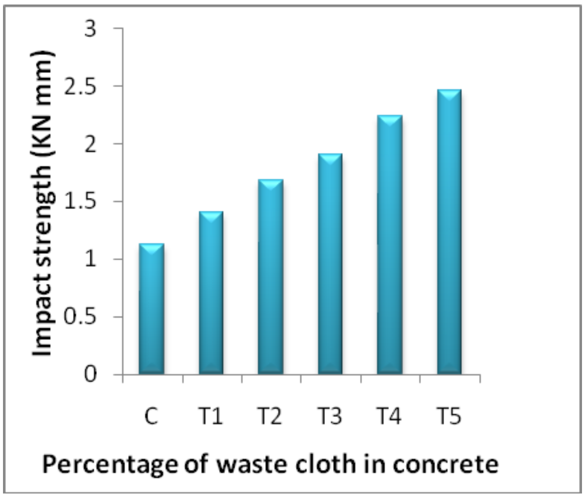


Fig 7: Impact Strength of waste cloth concrete

Fig 8: Tile specimens after impact test

Table 3: Impact Resistance test results of waste cloth concrete

Specimen Designation	Weight of Steel ball (gm)	Height of fall (mm)	Energy Absorbed (kN mm)
C	560	200	1.12
T1	560	250	1.4
T2	560	300	1.68
T3	560	340	1.90
T4	560	400	2.24
T5	560	440	2.46

The Table 4 shows the physical properties of the waste cloth concrete. From this table it can be inferred that the dry density is decreased as the percentage of waste cloth is increased in concrete and the saturated density is increased as the content of cloth is increased. This is due to high amount of water absorption by the incorporated cloths in the concrete.

Table 4: Physical Properties of waste cloth concrete

Designation specimen	% of waste cloth	Dry Density (kg/m^3)	Saturated density (kg/m^3)	Water Absorption (%)	Coefficient of Water absorption Ka x 10^{-10} (m^2/s)
C	-	2396	2460	2.67	0.98
T1	1	2320	2492	7.41	1.16
T2	2	2220	2532	14.05	1.39
T3	3	2160	2584	19.63	2.16
T4	4	2100	2628	25.14	2.27

T 5	5	2060	265 2	28.74	2.45

4. CONCLUSION:

- • When waste cloths are added to concrete, the concrete's compressive strength for both cubes and cylinders is decreased. as a result of cohesiveness loss.
- • The reinforcement effect of cloth fibres in concrete boosts the tensile characteristics of concrete, increasing splitting tensile strength and flexural tensile strength.
- • This particular concrete has a high impact energy absorption rate, and this energy absorption rises with increasing fabric percentage.
- • When the percentage of fabric grows, this material absorbs a significant amount of water. This is a result of clothes themselves absorbing water.
- This unique concrete can be used for ceiling and wall panels since it naturally insulates against sound and heat.This material is suitable for structural applications and particularly for structural beams subjected to high bending stress and impact loads.
- Since this concrete has high affinity to water, a special water proof coating is necessary.

5.

6. REFERENCES:

1. J.M.L. Reis, "Effect of textile waste on the mechanical properties of polymer concrete", *Materials Research* 21,pp 63-69.,2009.
2. R.M. Rowell, J.S. Rowell, "Characterization and factors effecting fiber properties",*Natural polymers and agro fibers based composites*.".,2000.
3. JML Reis, AJM Ferreira, "Fracture behavior of glass fiber reinforced polymer concrete", *polymer testing.*,Vol 22.,pp149-153.,2003.
4. JML Reis, AJM Ferreira, "Assessment of fracture properties of epoxy polymer concrete reinforced with short carbon and glass fibers", *Construction and building* materials.,Vol 18 .,pp 523-528.,2004.
5. JML Reis, "Fracture and flexural characterization of natural fiber reinforced polymer concrete", *Construction and building materials*.,Vol 20.,pp 673-678.,2006.
6. F.F. Aspiras, JRL Manalo, "Utilization of textile waste cuttings as building material", *Journal of material processing technology*Vol 48.,pp 379-384.,1995.
7. DW. Fowler, Polymers in concrete, a vision for the 21^{st} century, *Cement and concrete composites.*,Vol21.,pp 449-452.,1999.
8. R.Letsh, "Polymer concrete properties and structural applications "In : *Proceedings of International conference on polymer concrete, mortars and asphalts,* Oporto, Portugal.,pp 31-43.,2002.