Correlation models to determine the characteristics of concrete with plastic granules

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***Abstract*: To test the viability, mathematical models have been constructed, compressive strength and split tensile strength of the concrete samples produced using plastic granules as replacement of coarse aggregates. In this study, discarded Low Density Polyethylene granules were used as a partial replacement for coarse aggregate Its influence on the properties of concrete has been studied. Waste LDPE is utilised as a partial substitute for coarse aggregates in various quantities such as 0%, 20%, 30%, and 40%.**

***Keywords*: concrete; aggregates; plastic; characteristics; strength**

1. Introduction:

Plastics and polythene do not disintegrate naturally and are therefore ecologically unsuitable, As a result, other ways for recycling these materials must be implemented. There are several modifiers that may be used to modify the properties of road surfaces; However, the vast bulk of the components are raw or natural. When used as a modifier to the components, natural materials are difficult to find and prohibitively expensive. As a result, using discarded plastic bottles as a modifier in road building may drastically reduce material waste while also improving road characteristics.

Recycling waste materials can give a much-needed justification for reducing a costly and ecologically unfavourable solid waste dumping problem for the aforementioned items. Currently, allowing for the hazards associated with waste resource land filling and disposal problems, Researchers are developing new methods of incorporating recycled materials into asphalt pavements, which has resulted in global action. The main reasons for the utilisation of waste materials in the creation of fresh concrete are a lack of adequate deposition area and a scarcity of natural items (Zega et al., 2010). As a result, reusing these old plastic-related wastes to create new materials such as concrete appears to be the greatest option for disposing of plastic trash (Saikia and Brito, 2012). However, the use of other materials may have an impact on the properties of concrete (Westerholm et al., 2008).

2. Experimental Investigations and correlation models

Experiments were carried out on concrete mixes with a target strength of 20 MPa that were cast using 53 grade cement, River sand is used as a fine aggregate with a fineness modulus of 2.27 and a water-to-cement ratio ranging from 0.45 to 0.55. Table 1 displays the results of studies conducted to determine the fundamental properties of the manufactured concrete, The observations are as follows: -

A higher percentage of plastic granules reduces the strength and workability of concrete, whereas a higher amount of glass powder raises the strength. The workability of a Plastic Granules proportion decreases as the amount of glass powder increases.

Table 1 – Results of Experimental Program

S. No.	Mixes with variation in Glass powder	Split Tensile strength in MPa	Slump in mm	Compressive strength in MPa	Cement	Glass Powder	% Plastic Granules
1	M11	5.10	97	19.1	0.95	0.05	0
2	M12	4.60	95	19. 3	0.9	0.1	0
3	M13	4.30	94	19.8	0.85	0.15	0
4	M21	4.59	93	18.6	0.95	0.05	12
5	M22	4.14	91	18.9	0.9	0.1	12
6	M23	3.87	88	19.4	0.85	0.15	12
7	M31	4.13	89	18.4	0.95	0.5	18
8	M32	3.73	87	18.7	0.9	0.1	18
9	M33	3.48	84	19.3	0.85	0.15	18
10	M41	3.72	86	18.1	0.95	0.5	24
11	M42	3.35	83	18.7	0.9	0.1	24

12	M43	3.13	82	19.1	0.85	0.15	24
13	M51	3.35	82	17.9	0.95	0.5	30
14	M52	3.02	80	18.3	0.9	0.1	30
15	M53	2.82	77	18.6	0.85	0.15	30
16	M61	3.01	79	17.6	0.95	0.5	36
17	M62	2.72	77	18.2	0.9	0.1	36
18	M63	2.54	74	18.5	0.85	0.15	36
19	M71	2.71	76	17.1	0.95	0.5	42
20	M72	2.44	73	17.8	0.9	0.1	42
21	M73	2.29	72	18	0.85	0.15	42
22	M81	2.44	73	17	0.95	0.5	48
23	M82	2.20	70	17.4	0.9	0.1	48
24	M83	2.06	67	17.9	0.85	0.15	48
25	M91	2.20	68	16.8	0.95	0.5	54
26	M92	1.98	65	17.4	0.9	0.1	54
27	M93	1.85	63	17.7	0.85	0.15	54
28	M101	1.98	64	16.2	0.95	0.5	60
29	M102	1.78	62	16.9	0.9	0.1	60
30	M103	1.67	60	17.3	0.85	0.15	60

Using the above data, correlation curves were created to calculate the values of compressive strength, Split tensile strength and workability, Here are the specifics: -
Compressive Strength = S in MPa,
Split Tensile Strength = T in MPa,
Workability = W in mm (Slump Value), and **Percentage of Plastic Granules = P** %

The following relationships for measuring compressive strength using the percentage of plastic Granules are determined through data regression analysis. Fig. 1 depicts the graph of the relationship between compressive strength (S) and Plastic Granules (P).

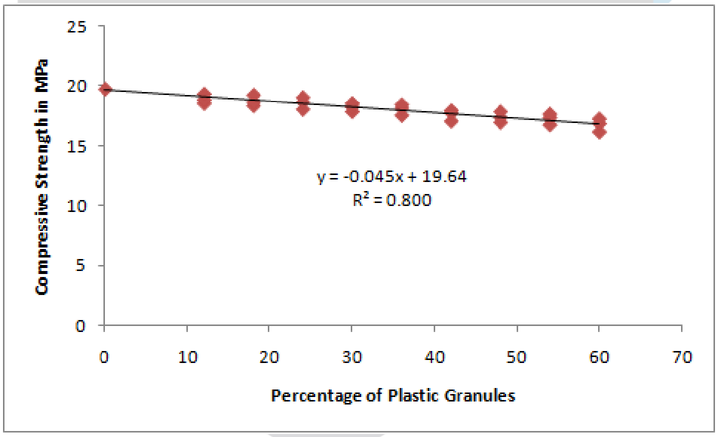

Figure 1 – Relation between S and P

As a result, the obtained relationship:-

$S = -0.045\ P + 19.64$ …eqn. (1)

$R^2 = 0.800$

This equation 1 is useful for estimating the compressive strength of a concrete by entering the percentage of Plastic Granules. In fig. 2 Tensile strength readings was plotted against Plastic Granules to determine a relationship between T and P.

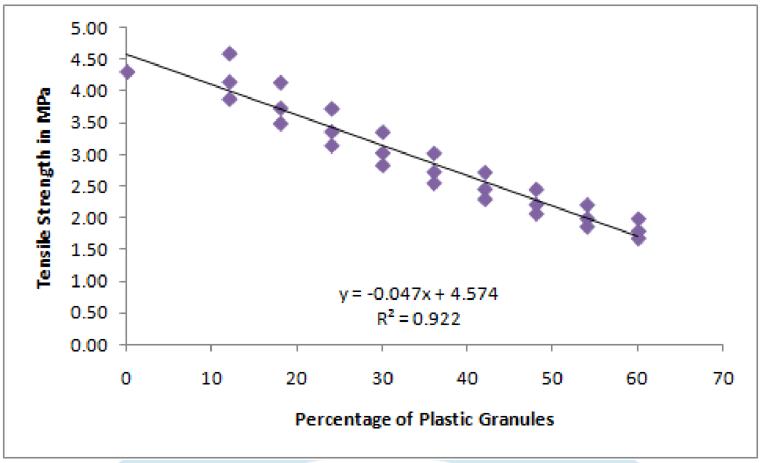

Figure 2 – Relation between T and P

As a result, the relationship between tensile strength and plastic granules has been established as:-

T = -0.047 P + 4.574 ….eqn. (2)

R^2 = 0.922

Now, eqn. 2 may be used to calculate the tensile strength of a concrete by knowing the percentage of Plastic Granules.

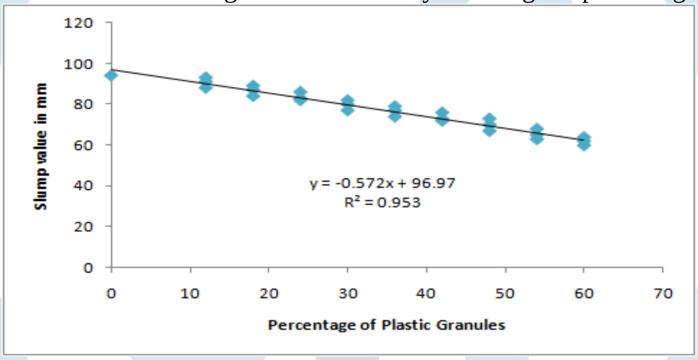

Figure 3 – Relation between W and P

As a result, the relationship between Slump value and plastic granules has been established as:-

W = -0.572 P + 96.97 …eqn. (5.3)

R^2 = 0.953

Now, eqn. 5.3 may be used to calculate the Slump value of a concrete by knowing the percentage of Plastic Granules.

3. Conclusions

In this work, a study was carried out to determine the effect of partially plastic granules and glass powder on compressive strength, Split Concrete tensile strength and workability. Compressive Strength and Its Relationship = S in MPa, Split Tensile Strength = T in MPa , Workability = W (Slump value in mm) and Percentage of Plastic Granules = P % were developed as –

S = -0.045 P + 19.64

T = -0.047 P + 4.574

W = -0.572 P + 96.97

References-

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