Study of effect of density and tensile property on RP / SD Polymer Composite

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***Abstract*—For the development of positive approach towards green in our day to day life usage of recycled plastic material with stonedust is appreciable. The present investigation work focus impact of adding stonedust in RP using stearic acid as a binding material and its mechanical behaviour. Proposed work carried out to create new polymer composite for designing new reliable products. Total 16 test samples were prepared for analysis using different proportions of Recycled Polymer/ stonedust. Tensile and density property investigation were carried out with UTM and densitometer using dog-bone shaped test samples. These properties were important to determine the strength of proposed material. It is observed that with the increase in % of stonedust and stearic acid the tensile strength and density increases but not remarkable as recycled polymer consists of mixture of polyolefins. Experimental analysis were observed change in tensile strength highly affected by change in stone-dust particle size and % of binding material.**

***Index Terms*—Density, Tensile strength, Recycled polymer, filler stonedust, RPSD polymer composites**

I. INTRODUCTION

Solid waste generation is a continually growing problem at global, regional and local levels[1]. The negative health effect due to waste depends on these wastes as a major source of living has been highlighted by several research groups noted that solid waste management is a global issue and that it is a growing source of concern in developed and developing countries directly translates to an increase in solid waste generation[8]. Plastics have been with us for more than a century, and by now they're everywhere, for good and for ill. To reduce plastic waste and negative effects, recycling programs have been implemented in many parts of the United States, but remain underutilized [5]. Stone Crushing Industry is an important industrial sector in the country engaged in producing crushed stone and act as raw material for various construction activities such as construction of Roads, Highways, Bridges, Buildings, Canals etc [4]. Polymer composites have better properties than RP more stiffer and stronger than the continuous matrix phase. When designed properly, the new combined material exhibits better strength than would each individual material [5]. Density plays a key role for designing an engineering component or deciding the application of a material particularly where weight is an important factor [6]. The density values indicates purity of the material or it may be change due to change in the composition as the filler is added. A tensile strength test is a mechanical test performed on packaging materials to determine the maximum load that can be applied to a material before it ruptures or tears. In essence it is a 'pulling' test used to measure the strength of plastics [2]. It is important in product design helpful in material selection for engineering applications ultimate judging quality, processing ability and behavior of new product material under load. These tests are conducted by companies to guarantee quality control, using internationally standardized methods in the production of all plastic products [3].

II. Methodology

A) Preparation of RPSD polymer composite

prepare with known weight of recycled Polymer blended with stone dust, using stearic acid as mention in table no 3 with help of twin screw extruder at 400 to 500^{0}C to form a polymer composite. The mixture than reinforced in a plastic injection molding machine and molding process done at 165-190^0 c with machine speed is 30% to 45% and applied pressure is 40% to 60 %. The dog-bone shaped mold specimens are drawn out from die set and allow them to cool down to room temperature at 27^{0}C.

B) **Density test** was conducted as per ASTM D792 using METTLER densometer. The specimen is weighed in air, and then weighed when immersed in distilled water at room temperature. Density was calculated using the formula

$$\text{Density} = \frac{\text{Wt. of specimen in air x density of the liquid}}{\text{Wt. loss in the liquid}}$$

C) **The tensile strength** of a material quantifies how much elongating stress the material will endure before failure [9][10] . Tensile strength testing was performed dog-bone shape RP and RPSD test specimens as per ASTMD 638 using universal testing machine. Both tests were carried out in miltech research laboratory Higna road, Nagpur.

Figure 1 Test specimen Sample used for Tensile Strength analysis

The formula for calculating tensile strength can be seen below.(Wikipedia,2012)

$$6 = \frac{F}{A}$$

6 = Tensile strength (Tensile strength is calculated in N/mm^2 (MPa)
F = Force (Force is calculated in Newton (N)
A = Area (The cross sectional area of the piece (mm^2)

III. EXPERIMENTAL ANALYSIS

IV.

SR NO	Specimen code	Recycled polymer %	Stone Dust % 25µm/45 µm	Filler partical size 25µm/45µ m	Stearic Acid %	Density in gm/cm^3	Tensile strength Mpa
1	RP					0.956	
2	RPSDA-1	95	5	25µm	2	0.973	9.92
3	RPSDA-2	90	10	25µm	2	1.01	11.33
4	RPSDA-3	85	15	25µm	2	1.046	10.83
5	RPSDA-4	80	20	25µm	2	1.072	10.9
6	RPSDB-1	95	5	25µm	5	0.99	10.46
7	RPSDB-2	90	10	25µm	5	0.999	9.69
8	RPSDB-3	85	15	25µm	5	1.018	11.27
9	RPSDB-4	80	20	25µm	5	1.029	10.42
10	RPSDC-1	95	5	45 µm	2	0.963	10.59
11	RPSDC-2	90	10	45 µm	2	1.035	10.55
12	RPSDC-3	85	15	45 µm	2	1.073	9.69
13	RPSDC-4	80	20	45 µm	2	1.082	10.07
14	RPSDD-1	95	5	45 µm	5	0.993	18.1579
15	RPSDD-2	90	10	45 µm	5	1.028	18.2275
16	RPSDD-3	85	15	45 µm	5	1.053	18.2570
17	RPSDD-4	80	20	45 µm	5	1.068	15.4814

RESULT

A) Graphical Representation

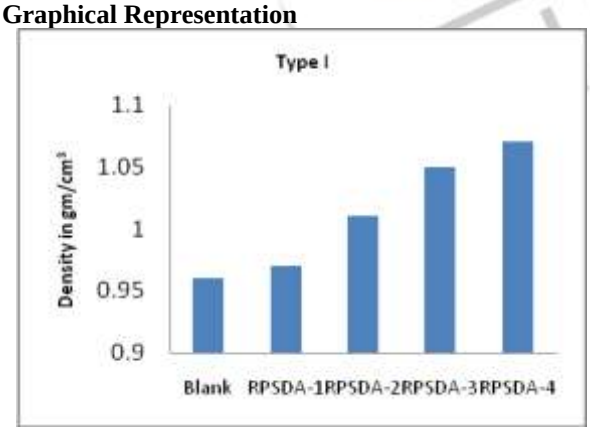

Figure 4.1. Densities of TYPE I test specimens

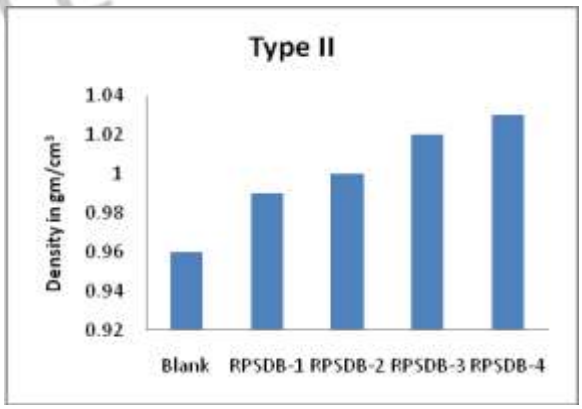

Figure 4.2 Densities of TYPE II test specimens

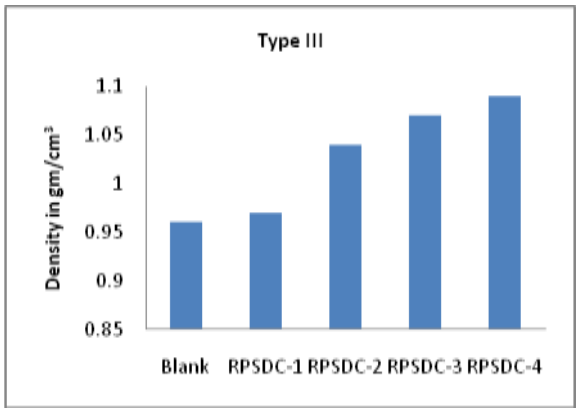

Figure 4.3 Densities of TYPE III test specimens

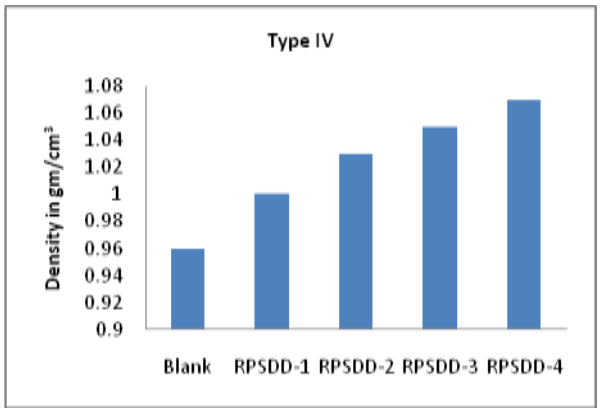

Figure 4.4 Densities of TYPE IV test specimens

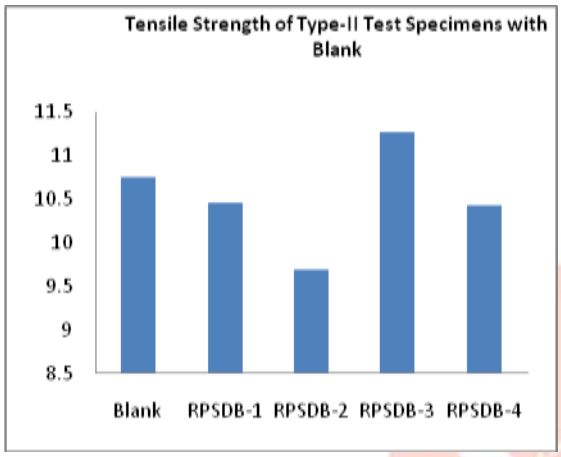

Figure 4.5 Tensile strength of TYPE I test specimens

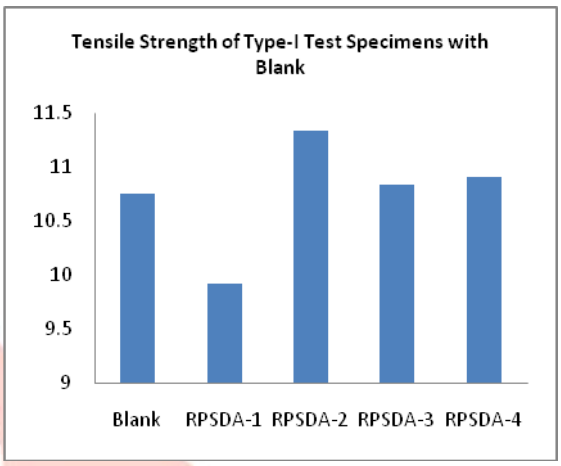

Figure 4.6 Tensile strength of TYPE II test specimens

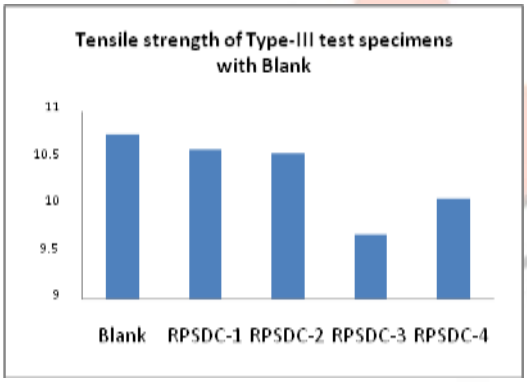

Figure 4.7 Tensile strength of TYPE III test specimens

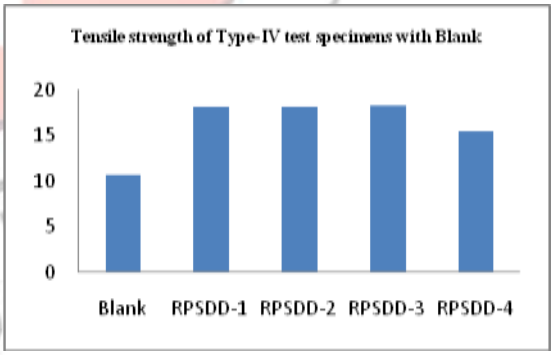

Figure 4.8 Tensile strength of TYPE IV test specimens

B. Observations

1) For Density

As per discussion from graph 4.1 to 4.4 it is observed that densities of test specimens goes on increasing with the % of filler stonedust. Comparing figure 4.1and 4.3 (25µm and 45µm particle size of filler but same % of stearic acid) , figure 4.1 and 4.2 (having 25µm particle size of filler same particle size of filler but different % of stearic acid), figure 4.2 and 4.4 (having 25µm and 45µm particle size of filler but same % of stearic acid) , and figure 4.3 and 4.4 (having 45µm particle size of filler but different % of stearic acid)) no remarkable change in sequence of tensile strength of polymer composite is observed.

2) For tensile strength

As per discussion from graph 4.5 to 4.8 it is observed that tensile strength of test specimens goes on increasing with the % of filler stonedust. Comparing figure 4.5 and 4.7 (25µm and 45µm particle size of filler but same % of stearic acid) , figure 4.5 and 4.6 (having 25µm particle size of filler same particle size of filler but different % of stearic acid), figure 4.6 and 4.8 (having 25µm and 45µm particle size of filler but same % of stearic acid) , and figure 4.7 and 4.5 (having 45µm particle size of filler but different % of stearic acid) no remarkable change in sequence of tensile strength of polymer composite is observed.

V. CONCLUSION

Densities and tensile strength of all test specimens increases with the increase in filler percentage as the molecular weight of polymer composite increases. But the filler size (25 and 45 µm) and increases in % of binding material (stearic acid- 2 and 5%) does not participated for any remarkable change in density and tensile strength as recycled polymer being a reprocess material and consists of mixture of different polyolefins with different % in different test specimens. Densities and tensile strength of all RPSD shows strength of polymer composite and hence increases applicability of RPSD in market.

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