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Studies on Wollastonite Reinforced Recycled Polyethene (PE) Composites

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Abstract – The majority of thermoplastics are not feasible substituted and non-biodegradable. To overcome these issues, recycling is a part of an effort to reduce plastic waste and stop serious pollution problems. Therefore, a sustainable plastic waste management strategy must be established to manage a large amount of generated waste. Polyethene is one of the most widely used commodity thermoplastics because of its outstanding properties, in particular easy processability, recycling ability, the versatility of applications. Generally used mineral fillers for the Polyethylene compounding are talc, calcium carbonate, glass beads, mica, silica, fibres and calcium silicate compound [1]. In this wollastonite was taken in powder form and mixed with recycled polyethene at various proportions, extruded through a twin-screw extruder by the melt mix process. This extrudate can be pelletized and used for making standard specimens as per the international standard Tests. Flexural properties were studied on wollastonite based recycled polyethene composites. There is an improvement in the flexural property after adding wollastonite. The test result was compared with the base material and there is an improvement in the recycled material after reinforcing with wollastonite filler.

Key Words: Recycled polyethene, Flexural, Wollastonite, composites, injection moulding, Melt mix.

1. INTRODUCTION

Due to the relatively high aspect ratio and hardness, wollastonite is able to improve the tensile and flexural strength of polymer composites. Many types of research have been conducted to determine various properties of wollastonite reinforced polymer composites such as mechanical, flammability, thermal, and tribological properties in order to explore their potential in various applications. This review will focus on the mechanical properties of wollastonite reinforced thermoplastic composites. Overall, it can be concluded that the properties of wollastonite-filled polymer composites are the function of filler content, adhesion interactions of wollastonite particles with polymer matrix, size and shape of wollastonite particles. Further research and development are needed to widen its application[2]. Wollastonite is a calcium silicate mineral that has high thermal stability in different applications it gives the same strength as the original polyethene material. Additives play an important role to enhance the base material property, appearance cost-effectiveness etc [3] wollastonite is one of the inorganic fillers and minerals also this can be added as an additive with plastics it has very good thermal, mechanical resistance. The waste polyethene plastic was collected and it was reinforced with wollastonite with various weight proportions.

METHODOLOGY:

Material: Injection grade Recycled HDPE material was taken as a polymer base. The study was carried out after adding wollastonite filler into recycled HDPE material.

Additive: Wollastonite ($CaSiO3$) in the form of powder. The particle size of Wollastonite is 13.83 microns. Which was having 86.50% brightness compared with 100% MgO, Bulk density of 0.91 g/cc and chemical composition ($CaSiO3$) as Cao+Sio2 92.78%.

Process: Direct mixing techniques in a twin-screw extruder with melt mixing and process using an injection moulding process.

Experiment Method: Flexural property was carried out as per ASTM D790.

Study on wollastonite reinforced recycled polyethene (PE) composites: Virgin HDPE material coded as A1 was first tested. Recycled HDPE coded as B1, recycled HDPE+10% Wollastonite coded as C1, recycled HDPE+20% Wollastonite coded as D1, recycled HDPE+30% Wollastonite coded as E1, recycled HDPE+40% Wollastonite coded as F1. The test result of flexural strength for various compositions is mentioned in Table 1 and Graph 1, the Test result of flexural modulus for various compositions is mentioned in Table 2 and Graph 2.

Table 1

The test result of flexural strength as per ASTM D790			
S.NO	Sample description	Sample code	Flexural strength Mpa
1	Virgin HDPE	A1	19.7
2	Recycled HDPE	B1	18.1
3	Recycled HDPE+10% Wollastonite	C1	18.3
4	Recycled HDPE+20% Wollastonite	D1	20.1
5	Recycled HDPE+30% Wollastonite	E1	21.4
6	Recycled HDPE+40% Wollastonite	F1	23.3

Graph 1

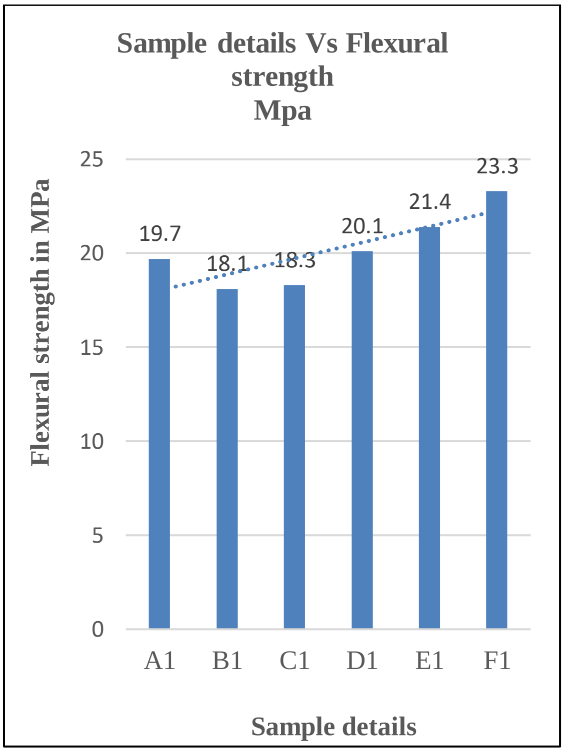
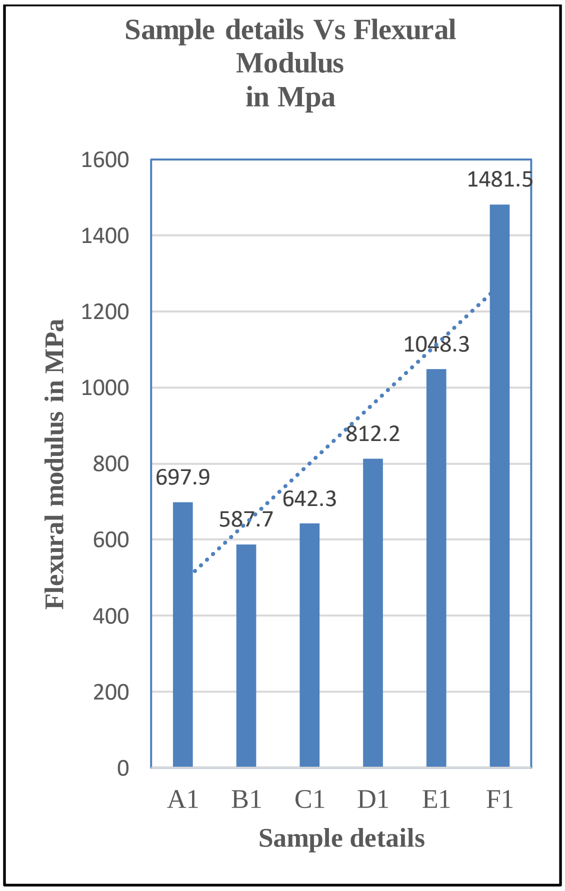


Table 2

The test result of flexural Modulus as per ASTM D790			
S.NO	Sample description	Sample code	Flexural Modulus Mpa
1	Virgin HDPE	A1	697.9
2	Recycled HDPE	B1	587.7
3	Recycled HDPE+10% Wollaatonite	C1	642.3
4	Recycled HDPE+20% Wollaatonite	D1	812.2
5	Recycled HDPE+30% Wollaatonite	E1	1048.3
6	Recycled HDPE+40% Wollaatonite	F1	1481.5

Graph 2



End Results: It has been observed that wollastonite reinforced recycled polyethene (PE) composites shown significantly higher flexural modulus than Recycled PE as well as virgin PE. It shows improvement after adding 20% to 40% of wollastonite in flexural strength. There is not much change observed in 10%. Compared to recycled polyethene wollastonite reinforced polyethene showed a gradual increase in flexural modulus.

3. CONCLUSIONS

The incorporation of filler like Wollastonite to the base recycled Polyethylen improves the flexural modulus and flexural strength for not only recycled polyethene, it improves virgin polyethene also. It can be concluded that where ever higher stiffness is required we can use wollastonite as filler. Wollastonite reinforced recycled PE can be used in various applications where original PE can be used so that the waste will be reused for applications.

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