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Studies on wollastonite reinforced recycled polyethene (PE) composites

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Abstract –

Recycling polyethene plays an important role because the consumption of polyethene is more compared to all other plastic materials. Diverting discarded plastics from the refuse stream and turning them into new goods keeps these persistent materials out of landfills and the natural environment to improve the properties of recycled polyethene material, it was reinforced with a good filler[1]. To overcome this and make effective use of recycled polyethene it was reinforced with wollastonite[2]. 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. 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, Wollastonite, composites, injection moulding, Melt mix.

1. INTRODUCTION

Plastic goods are useful because they are durable, but this becomes a disadvantage when items are discarded. The natural processes that degrade many paper, cardboard and wood products in a few months don't affect plastic materials as much. In landfills, plastics accumulate, creating a volume of refuse that never seems to go away. In nature, plastic bits and pieces become unsightly nuisances and hazards to animals. Recycling plastic waste plays an important role in the upcoming days. After recycling, the strength of plastic material will decrease due to thermal degradation and reduction in chain length etc. In recent applications almost all plastics are filled with different filler to improve their properties, wollastonite is one type of filler it will improve the mechanical and thermal properties of basic plastic. Wollastonite is a calcium silicate mineral that has high thermal stability. Recycled polyethene with wollastonite filler will improve the strength of recycled plastic strength. For that plastic can be reused especially in plastics like polyethene for different applications it gives the same strength as original polyethene material. Usually, filler improves mechanical properties other additives like heat stabilizers enhance thermal properties and so on. Additives play an important role to enhance the base material property, appearance cost-effectiveness etc. 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 proportions.

MATERIALS AND EXPERIMENTS

Base 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.

Filler: 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.

Test Method: Tensile property is one of the mechanical properties. The test method of tensile property is ASTM D 638. Dumbbell shape (Type 1) test specimens were prepared as per the standard ASTM D638. The injection moulding process was used to prepare specimens. As per the standard five samples were tested and the average value has taken.

Study on wollastonite reinforced recycled polyethene (PE) composites: Virgin HDPE material coded as A1 was first tested. Then it was compared with 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 tensile strength at maximum load for various compositions is mentioned in Table 1 and Graph 1, the Test result of tensile modulus for various compositions mentioned in Table 2 and Graph 2, the Test result of elongation at break is mentioned in Table 3 and Graph 3.

End Results: It has been observed that wollastonite reinforced recycled polyethene (PE) composites show significantly higher tensile modulus than Recycled

HDPE and there is a much effect in tensile strength gradual decrease in elongation at break.

Table 1

The test result of tensile properties as per ASTM D638			
S.NO	Sample description	Sample Code	Tensile strength at maximum load Mpa
1	Virgin HDPE	A1	24.2
2	Recycled HDPE	B1	20.7
3	Recycled HDPE+10% calcium silicate	C1	20.7
4	Recycled HDPE+20% calcium silicate	D1	20.2
5	Recycled HDPE+30% calcium silicate	E1	20
6	Recycled HDPE+40% calcium silicate	F1	18.9

Graph 1

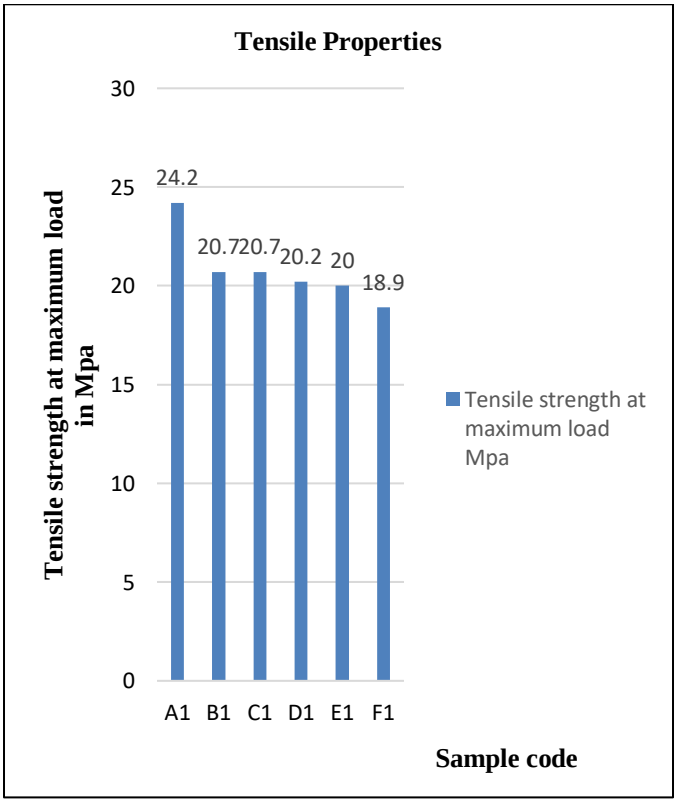


Table 2

The test result of tensile properties as per ASTM D638			
S.NO	Sample description	Sample Code	Tensile Modulus Mpa
1	Virgin HDPE	A1	722
2	Recycled HDPE	B1	508.1
3	Recycled HDPE+10% calcium silicate	C1	550.8
4	Recycled HDPE+20% calcium silicate	D1	730.5
5	Recycled HDPE+30% calcium silicate	E1	997.4
6	Recycled HDPE+40% calcium silicate	F1	1200.7

Graph 2

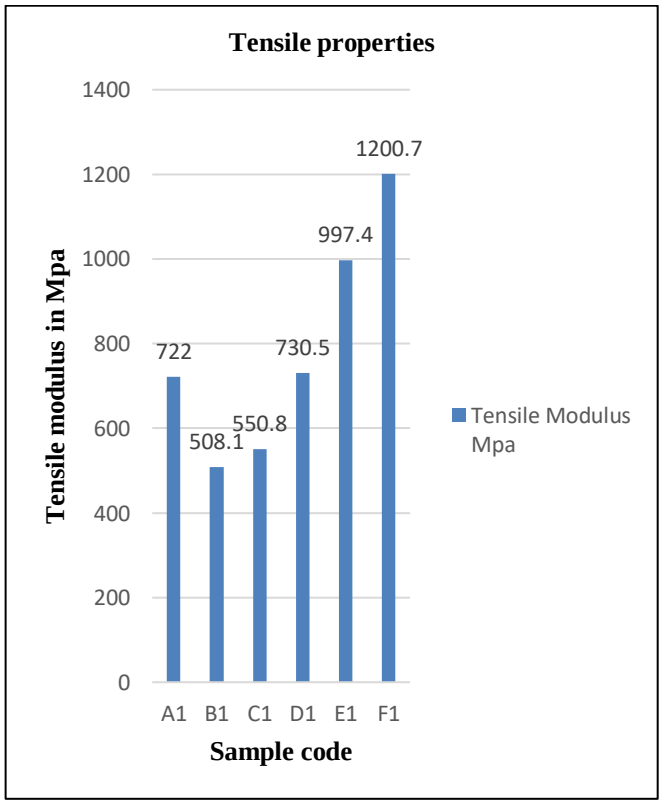
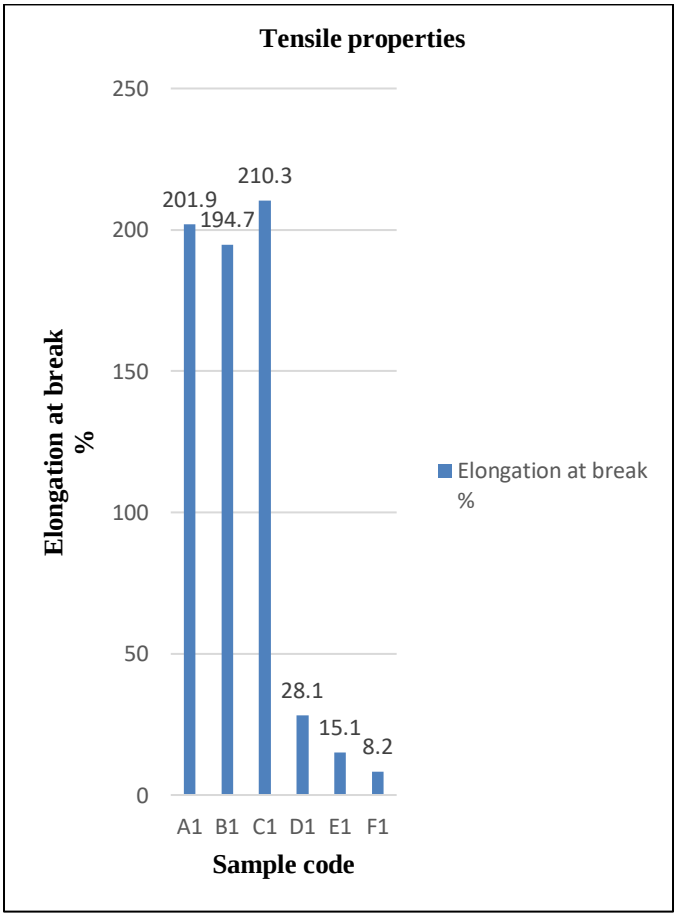


Table 3

The test result of tensile properties as per ASTM D638			
S.NO	Sample description	Sample Code	Elongation at break %
1	Virgin HDPE	A1	201.9
2	Recycled HDPE	B1	194.7
3	Recycled HDPE+10% calcium silicate	C1	210.3
4	Recycled HDPE+20% calcium silicate	D1	28.1
5	Recycled HDPE+30% calcium silicate	E1	15.1
6	Recycled HDPE+40% calcium silicate	F1	8.2

Graph 3



3. CONCLUSIONS

The incorporation of filler like Wollastonite to the base recycled Polyethylen improves the tensile modulus and there is no significant change in tensile strength and reduction in elongation at break It can be concluded that wollastonite can be added to polyethene material to achieve stiffness. To make use of recycled PE effectively. Wollastonite reinforced recycled PE can be used in various applications where original PE can be used.

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