STUDY OF TALC FILLED POLYPROPYLENE- A CONCEPT FOR IMPROVING MECHANICAL PROPERTIES OF POLYPROPYLENE

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Abstract

Talc is a important filler for polypropylene (PP) and Non halogen flame retardants (ammonium polyphosphate) is used with PP. It does not generate toxic gases and corrosive smokes during combustion. The addition of flame retardants will lower the flammability of PP. Talc improves the mechanical properties (stiffness, flexural strength, modulus etc) and heat deflection temperature. Two types of mechanical testing have been done to determine the mechanical properties, which are flexural test and tensile test .In this study, the improvement of mechanical properties have shown with increasing suitable percentage (by weight) of talc for a new applications .

Keyword- *Stiffness, Talc, FR, PP*

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1. INTRODUCTION

1.1 Talc.

Talc is a hydrated magnesium sheet silicate with the chemical formula $Mg_3\ Si_4\ O_{10}\ (OH)_2$. Talc is practically insoluble in water and in weak acids and alkalis. It is neither explosive nor flammable. Although it has very little chemical reactivity

Above 900°C, talc progressively loses its hydroxyl groups and above 1050°C, it re-crystallises into different forms of enstatite (anhydrous magnesium silicate). Talc's melting point is 1500°C.[1,3]

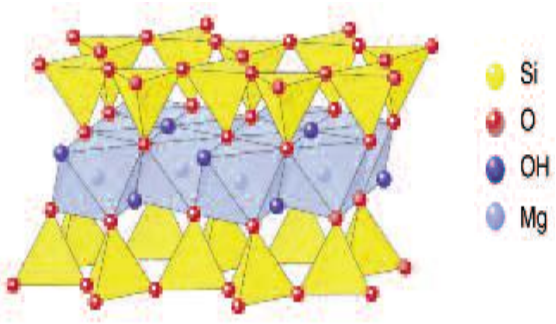

Fig. 1.0 Chemical bonding structure

1.2 Polypropylene.

PP (a semi-crystalline) is very popular as a high-volume commodity plastic. However, it is referred to as a low-cost engineering plastic. PP offers good fatigue resistance, good chemical resistance, good environmental stress cracking resistance, good detergent resistance, good hardness and contact transparency and ease of machining, together with good processibility by injection moulding and extrusion.[1]

- PP is not hazardous to health.
- Easy to produce, assembly and an economic material.

1.2.1 Properties.

The mechanical properties of PP depend on several factors and are strongly influenced by the molecular weight. The molecular weight of PP is normally estimated from the simple Measurement of viscosity melt flow rate is more commonly used to measure the viscosity. General observations suggest that an increase in molecular weight, keeping all other structural parameters similar, leads to a reduction in tensile strength, stiffness, hardness, brittle point.[1,2]

Stiffness, Flexural strength, Ultimate modulus, heat deflection temperature and some other mechanical properties can be increase by filling suitable percentage of talc and modifier with PP for various new mechanical and electrical applications.[1,7]

1.3 Flame Retardant.

Non halogen flame retardants (ammonium polyphosphate) are used. It does not generate toxic gases and corrosive smokes during combustion and high temperature processing.

The char foam act as an effective barrier against heat and oxygen which slows down the diffusion of gaseous pyrolysis products to the combustion zone.[4,8]

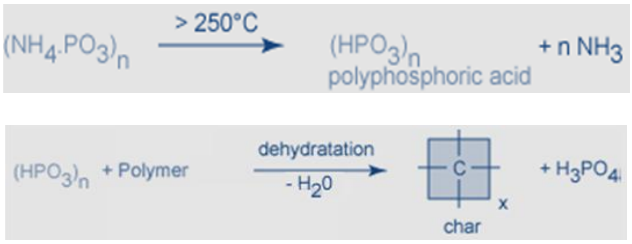

Fig. 1.1 chemical reaction of flame retardant

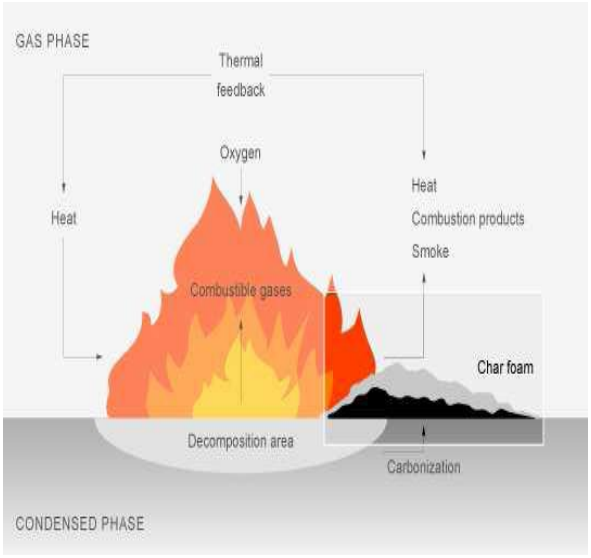

Fig. 1.2 Illustration for mechanism of intumescent flame retardant

1.4 Talc filled polypropylene.

Talc is the most important filler for polypropylene. Grades filled with 10% ,20%,30%, 40% and about 50% of talc by weight have been produced. Both homo polymer and copolymer grades of PP are used. Talc filled grades offer higher stiffness, better surface aesthetics, lower coefficient of thermal expansion, lower shrinkage, and improved scratch and mar resistance than non-filled grades. Heat deflection temperature and mould shrinkage are also improved by the addition of talc. Flexural modulus increases with added talc at the expense of tensile strength.

Flexural modulus should be around or above 1400MPa for a good product[1,5]. In some cases, impact modifiers are added to maintain the impact strength, but at the expense of stiffness. Filled copolymer grades offer higher yield elongation at the expense of tensile yield strength. Typical applications for talc filled polypropylene are high-heat environments, such as under-the-hood automotive parts, appliance components, and thermoformed packaging products including microwaveable products [2].

2. EXPERIMENTAL PART.

2.1 Material.

A sample (polypropylene composite) is prepared by injection moulding. Modifier(1.5 to 5.0) and fire retardant (0.3 to 5.0) by weight are used. Color (1.0 to 4.0 % wt) is used for surface finishing and brightness. Stiffness, heat deflection temperature and some other properties are increased by using suitable weight percentage of talc, modifier etc.

2.2 Sample dimension and testing.

- Length- 115 mm, Thickness- 3.2 mm, Width- 12.8 mm
- Tests (Tensile & Flexural),at 5 kg are performed on universal testing machine.
- Melt flow index tester is used for MFI measurement (as shown in given table).
- Heat deflection temperature is measured
- By heat deflection temperature tester filled with silicon oil (as shown in given table).

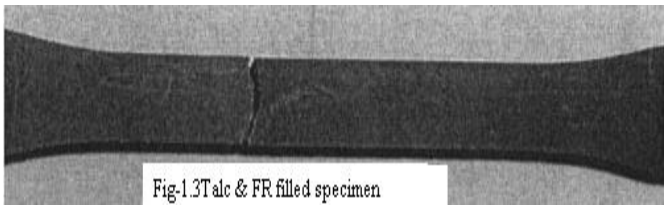

Fig-1.3Talc & FR filled specimen

3. RESULT & DISCUSSION.

In this paper, we are studying about the mechanical properties of talc and FR filled polypropylene.Different weight percentage of modifier is used in between flame retardant and talc for improving stiffness, heat deflection temperature and some other properties. These are shown by tensile testing and flexural testing, table and graph. These tests are performed on universal testing machine and samle is prepared by injection moulding technique.

Different tests are performed on different PP/filler samples. Values of tensile strength, flexural strength, ultimate modulus,etc are directly calculated by universal testing machine and heat deflection temperature tester, melt flow index tester,etc.

3.1 Tensile testing.

Table-3.1, Shows result for tensile testing using talc and flame retardant filled polypropylene.

Property	PP-unfilled	PP-talc10	PP-talc20	PP-talc30	PP-talc50
Tensile strength at peak load(Kg/Sq cm)	271.729	258.539	257.916	255.615	239.502
Ultimate modulus(MPa)	447.423	488.724	598.859	769.925	946.160
Secant modulus(MPa)	320.003	451.554	461.190	576.488	599076
Elongation (at peak) (%)	13.51	8.40	8.04	5.46	3.62
MFI(Melt flow index)(gm/10 min)	25	04	10	09	07
HDT(Heat deflection temperature) @0.455 ^{0}C	87	100	105	115	125

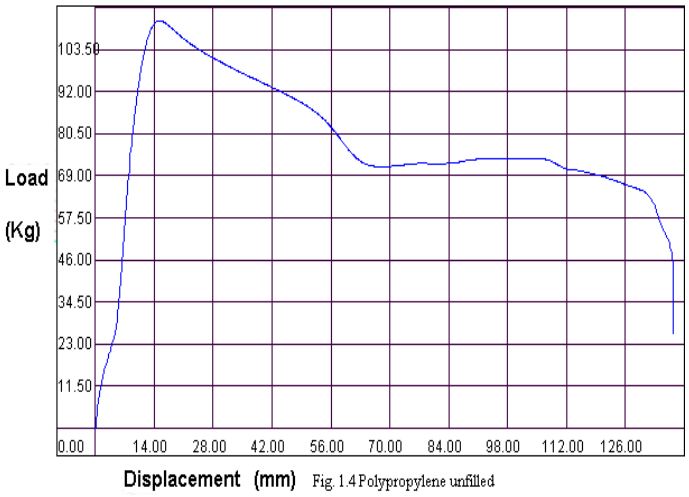

Fig. 1.4 Polypropylene unfilled

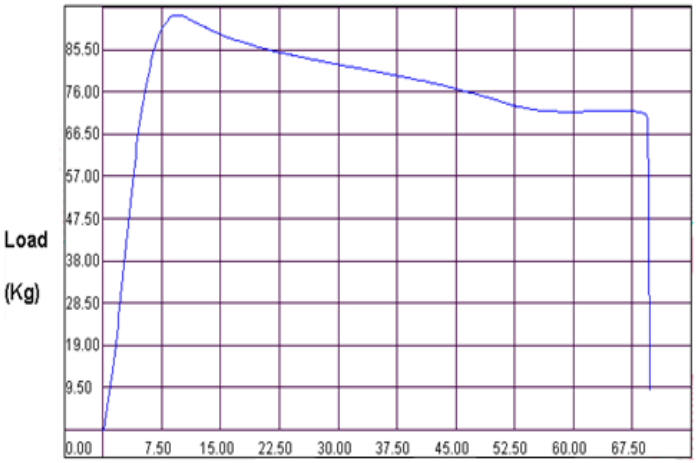

Fig. 1.5 PP- 10% talc

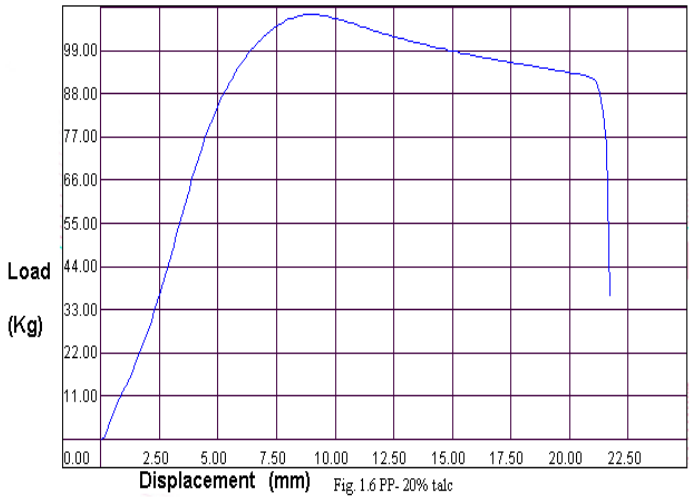

Fig. 1.6 PP- 20% talc

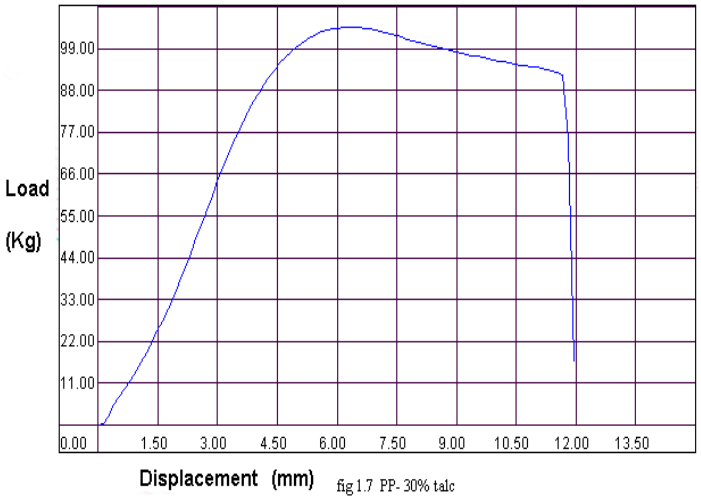

fig 1.7 PP- 30% talc

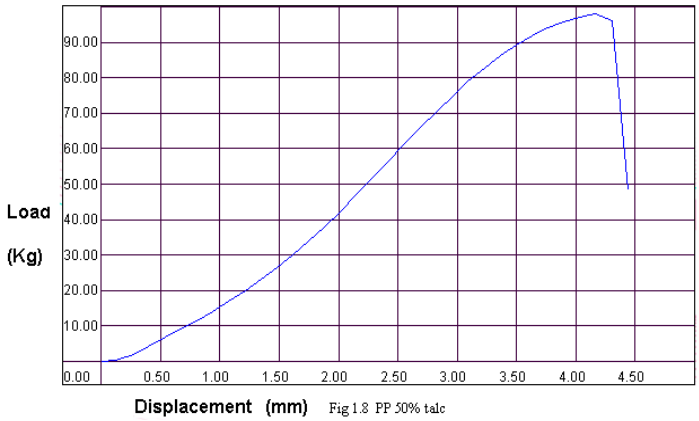

Fig 1.8 PP 50% talc

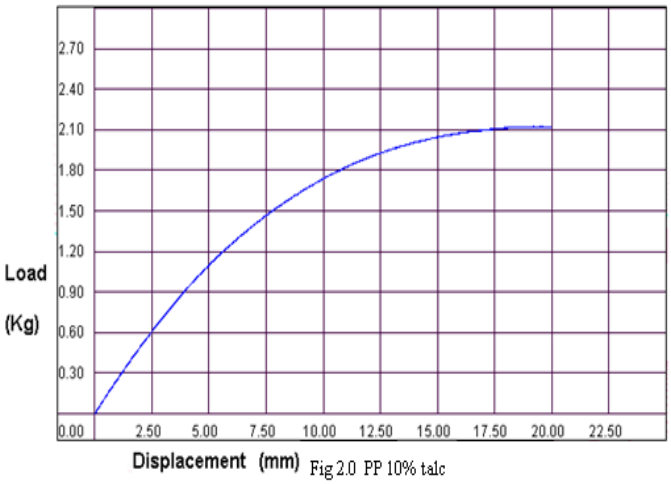

Fig 2.0 PP 10% talc

3.2 Flexural testing.

Table-3.2, Shows result for flexural testing using talc and flame retardant filled polypropylene.

Property	PP-unfilled	PP-talc10	PP-talc20	PP-talc30	PP-talc50
Flexural strength at peak load(Kg/Sq cm)	233.116	242.958	270.195	320.435	336.342
Ultimate modulus(MPa)	2045.895	1753.594	2484.258	4676.249	7891.171
Secant modulus(MPa)	1234.673	1493.802	2004.942	2992.800	4941.946
Deflection (%)	19.92	19.56	19.25	17.85	09.86

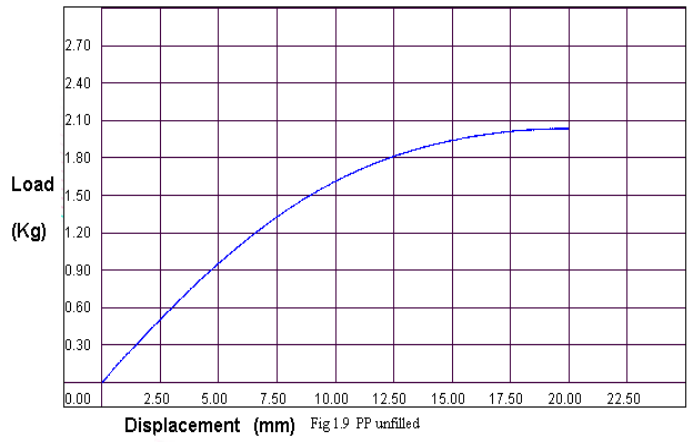

Fig 1.9 PP unfilled

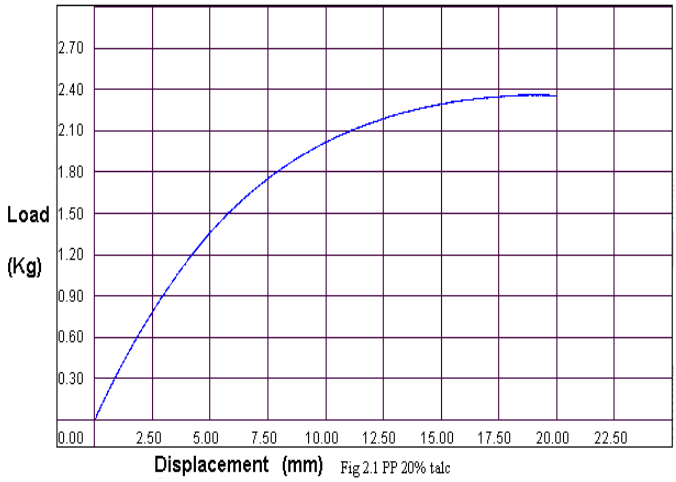

Fig 2.1 PP 20% talc

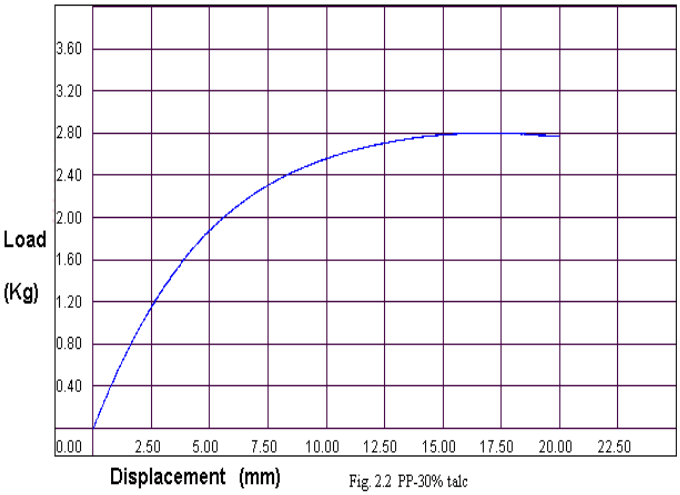

Fig. 2.2 PP-30% talc

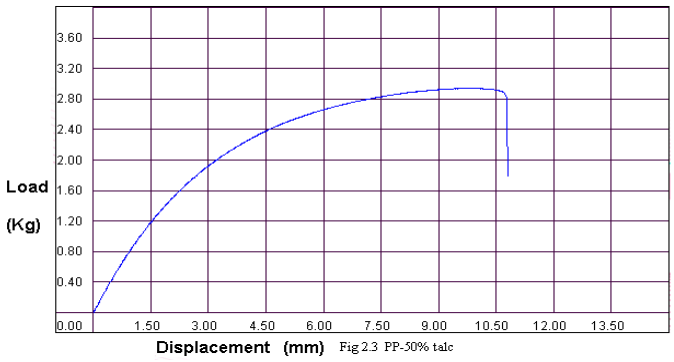

Fig 2.3 PP-50% talc

3.3 Effect of filler on tensile strength.

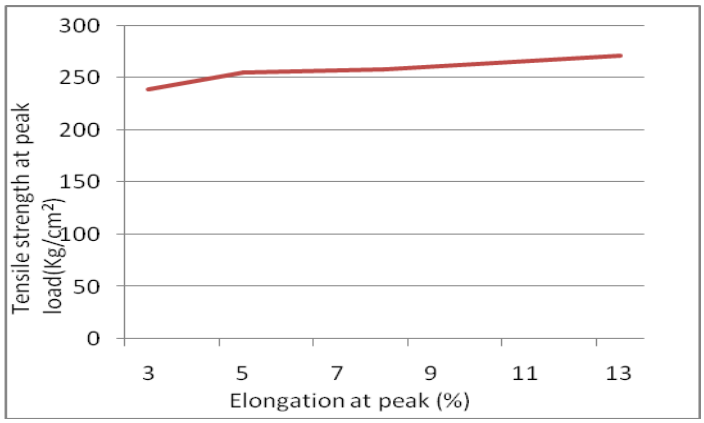

Fig-2.4

Modifier is used for strong chemical bonding and it improves Heat deflection temperature & stiffness.Fig 2.4 shows variation of tensile strength at peak load with elongation and tensile strength decreases with filler % increases.

3.4 Effect of filler on flexural modulus

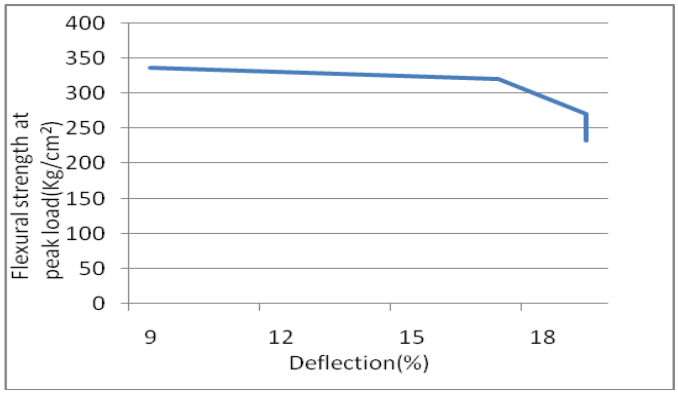

Fig-2.5

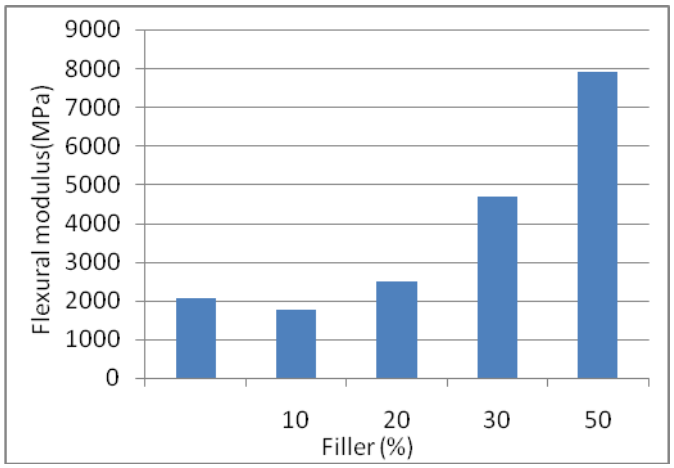

Fig-2.6

Fig-2.5 and Fig-2.6 shows the variation of flexural strength with filler % and deflection % of PP/filler composite. Flexural modulus increases with increases filler but it shows good result for 30 – 50 % talc filled PP in case of stiffness, modulus, HDT as shown in figure above.

ACKNOWLEDGEMENTS

Authors gratefully acknowledge the facilities available at the NFT (pvt) Ltd, Udhamsingh nagar, India. SK sincerely thanks to my guide (Dr Urmila) and Mr.Rasik and Mr. Jitendra kumar for helping me in theoretical and practical section.

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