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Research Article

Ageing Characterization Studies of Polyurethanes Based on Natural Resources

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Abstract

Polymers can be natural or synthetic molecules. They are very large molecules having high molecular mass which are formed by joining of repeating structural units on a large scale. The repeating structural units are derived from some simple and reactive molecules known as monomers and are linked to each other by covalent bonds. In the present study we mainly focus on Synthesis of castor oil based flexible polyurethane and its composites. In this study four fibre selected are cotton, jute, sisal and hem. The compound was further subjected to stabilityof polyurethane and their composites under thermal ageing

Introduction

Bio-based materials are now receiving considerable attention in the promotion of sustainable chemistry in the production of materials by its replacement of petroleum-derived raw materials in the production of different products needed in various industries. These bio-based materials are a great alternative to fossil based materials Due to renewable feedstock use, easy degradation, easy accessible source and use of low energy for production. Plant oils contain about 15 different fatty acids. Some of them are saturated, including lauric, palmitic, stearic, arachidic, behenic, and lignoceric acids; some are unsaturated, including oleic, petroselenic, linolenic, α-linolenic, γ-linoleic, roughanic, and erucic acids; and two of them are unusual fatty acids, ricinoleic and vernolic acids. These fatty acids have chain lengths of 12 to 24 carbons, with one to three double bonds for unsaturated fatty acids. Vegetable oils are vital biorenewable resources extracted from various plants and are normally named by their biological source, such as soybean oil and palm oil. Chemically, vegetable oils consist of mainly triglycerides formed between glycerol and various fatty acids (Verhe, 2004). Most fatty acids are long straight-chain compounds with an even number of carbons and the double bonds in most of these unsaturated fatty acids possess a cis configuration. However, some fatty acid chains, like those in ricinoleic and vernolic acids, bear functional groups, hydroxyl and epoxy groups respectively (Belgacem and Gandini, 2008). The physical state of vegetable oils depends on both the nature and the distribution of the fatty acids. Polyurethane foams are low-density cellular

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polyurethane materials with limited and reversible resistance to compression. Proper selection of catalyst formulation in the preparation of polyurethane foams influences the properties which are required for a number of applications in upholstery for furniture, bedding, mattresses, transportation seating and also used in every type of vehicles including automobiles, from buses to aircrafts

Materials and methods

Synthesis of castor oil based soft polyurethane

Castor oil based soft polyurethane was synthesized by using 4,4-methylene bis (cyclohexyl) isocyanate with castor oil as polyol dissolved in ethylmethyl ketone at NCO/OH mole ratio 5:2. The reaction was carried out in a three neck flask equipped with a reflux condenser at 80^0C for 45 minutes under nitrogen atmosphere. The obtained castor oil based polyurethane was stirred well in a plastic cup using a glass rod in the presence of catalyst dibutyltin laurate and poured into a flat mould coated with silicone realizing agents to cast the neat sheet. The polymer was allowed to settle for 12hr in a flat surface without any disturbance.

Synthesis of castor oil and fibre based polyurethane

Castor oil and fibre based polyurethane was synthesized by using 4,4-methylene bis (cyclohexyl) isocyanate with castor oil as polyol dissolved in ethylmethyl ketone at NCO/OH mole ratio 5:2. The reaction was carried out in a three neck flask equipped with a reflux condenser at 80^0C for 1hr under nitrogen atmosphere. Two natural fibre sisal and jute and two synthetic fibre hem and glass was added to the synthesized castor oil based polyurethane and then the mixture was stirred well in a plastic cup using a glass rod in the presence of catalyst dibutyltin laurate and poured into a flat mould coated with silicone realizing agents to cast the neat sheet. The polymer was allowed to settle for 12hr in a flat surface without any disturbance.

Result and Discussion

STABILITY OF POLYURETHANE AND THEIR COMPOSITES UNDER THERMAL AGEING

Thermal ageing of the polyurethane and their composites are shown in the table 5.5 and 5.6. There is a great weight loss observed in the hard polyurethanes and their composites compared to soft polyurethanes.

Polyurethane & its composites	Weight loss (%)
PUHR1	0.03
PUHR1J	0.08
PUHR1S	0.06
PUHR1H	0.05
PUHR1G	0.06
PUHR2	0.01
PUHR3	0.02

Table 1.1: Weight loss of hard polyurethane and its composites under thermal ageing

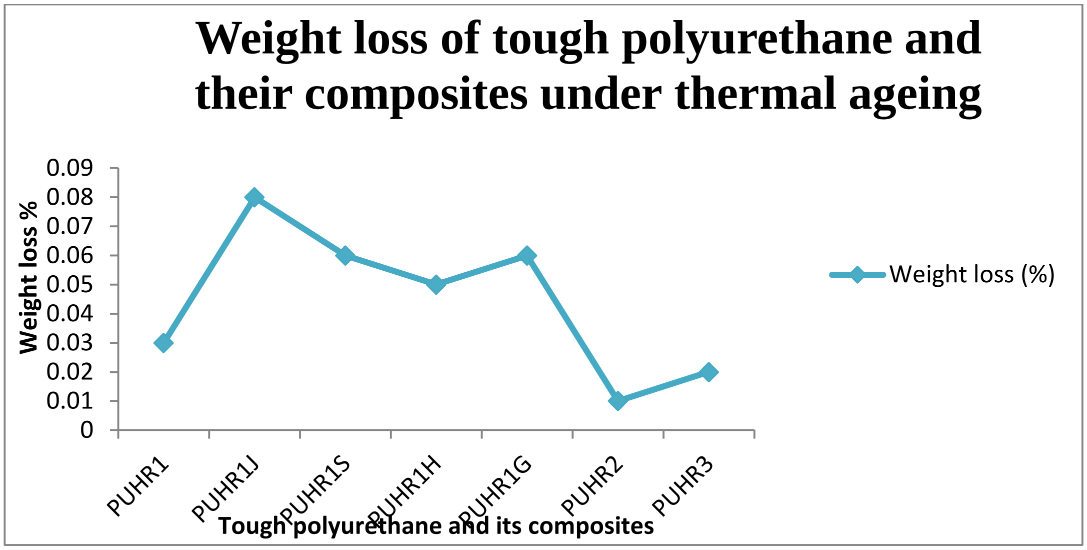

Chart 1.1: Weight loss of hard polyurethane and its composites under thermal ageing

Polyurethane & its composites	Weight loss (%)
PUSR1	0.08
PUSR1J	0.12
PUSR1S	0.14
PUSR1H	0.09
PUSR1G	0.07
PUSR2	0.04
PUSR3	0.05

Table 1.2: Weight loss of soft polyurethane and its composites under thermal ageing

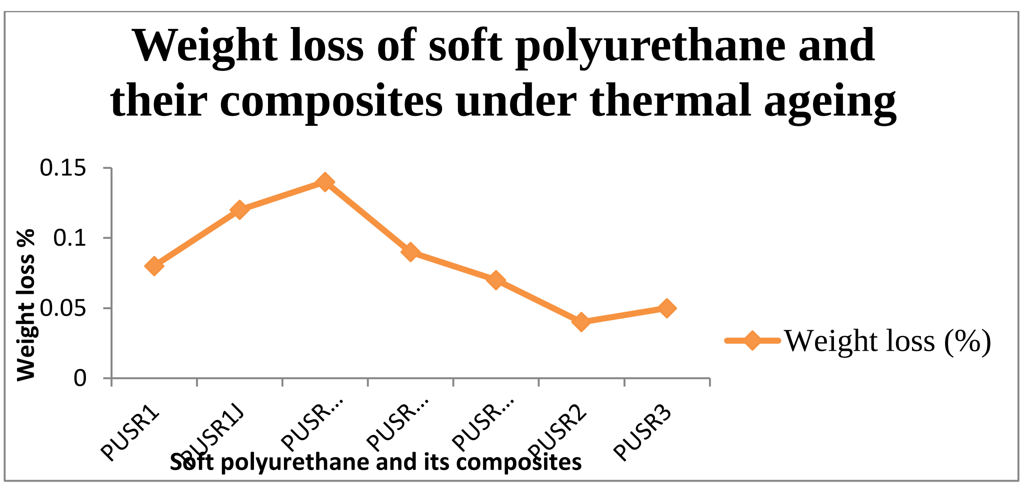

Chart 2.2: Weight loss of soft polyurethane and its composites under thermal ageing

Conclusion

We were able to synthesize castor oil based soft polyurethane and it's composite. The synthesized compounds were subjected for FT-IR and XRD. The polyurethane compounds subjected stabilityof polyurethane and their composites under thermal ageing, From the above ageing studies it is clear that the hard polyurethane and their composites are having slight increase weight less in the acidic, basic and hydrolytic conditions

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