جـــــامعـــة المــــلك فهـــد للبتـــــرول والمعـــادن
King Fahd University of Petroleum & Minerals

Studying Filler Effects of Asphaltene in High Density Polyethylene (HDPE)

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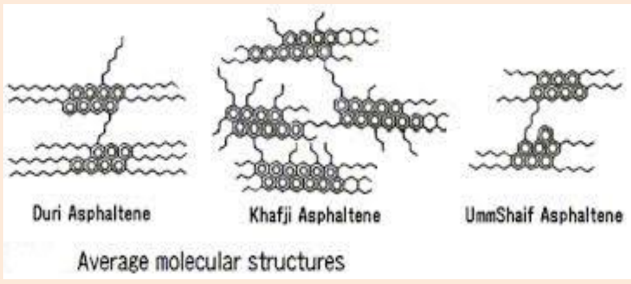
overview

This work aims to evaluate the potential uses of undesirable substance from crude oil (asphaltene) as filler to High Density Poly Ethylene (HDPE).



The asphaltene was mixed in different % with a pure high density poly ethylene (HDPE) using a blender instrument under a temperature of 375 ºF. Then several sheets were made from these solid mixtures using Carver Hydraulic Press instrument under the same temperature, 375 ºF.

Several tests were thencarried out on the asphaltene HDPE composites including:

A) Infrared Spectroscopy.

B) Thermogravimetric analysis.

C) Mechanical Testing.

Introduction

Asphaltene is a solid undesirable material found in crude oils. It is known to lower quality of petroleum products, clog well formations and flow lines, and is a concern for refiners. Hence, The oil and gas industry has expressed a need for technologies to increase the value and provide a more environmentally friendly end application for asphaltene byproducts.

Among these needs is a need for reinforcement /filler for polymer composites to achieve good combination of mechanical strength, viscoelastic properties and thermal stability in addition to cost reduction and improved processing characteristics.

Possible applications for the asphaltene HDPE polymer composites are any application where these polymers are currently used : With a high strength-to-density ratio, HDPE is used in the production of plastic bottles, corrosion-resistant piping, geomembranes, and plastic lumber, 3-D printer filament, Bottle caps, Chemical-resistant piping, Coax cable inner insulator, Food storage containers, Corrosion protection for steel pipelines, Personal Hovercraft; albeit too heavy for good performance, Water pipes for domestic water supply.

Results

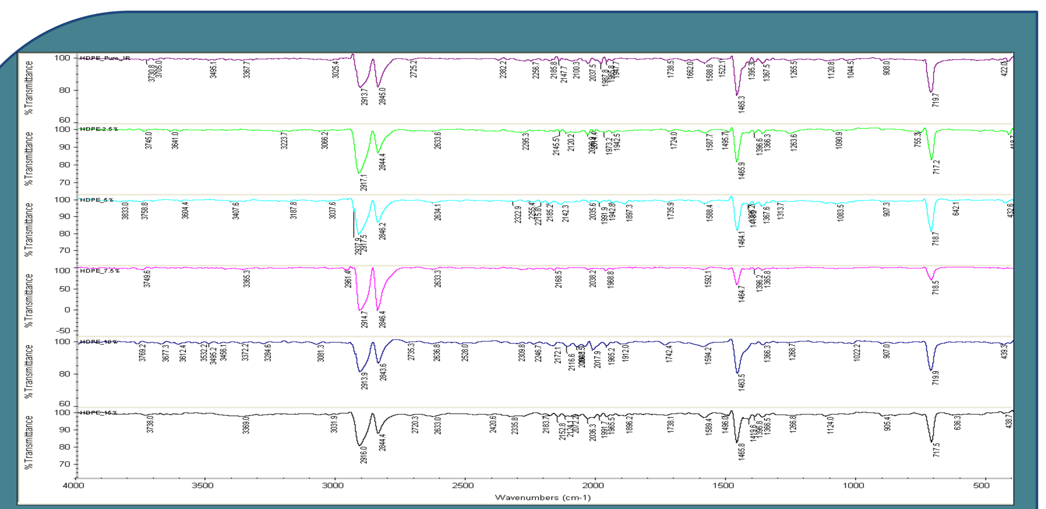


Figure 1. IR Spectra for Different Asphaltene HDPE Composites

Mechanical Testing Data for Asphaltene HDPE Composites

% Composite	Max Load (N)	Tensile Strength (MPa)	Elongation (%)	Modulus (MPa)	Yield Stress (MPa)
0	193.58	33.75	334.19	875.15	19.39
2.5	194.43	33.90	334.15	846.28	19.40
5	195.57	34.10	334.25	1009.03	20.56
7.5	170.13	29.67	48.91	869.80	17.88
10	169.54	29.56	51.19	862.61	17.95
15	171.33	29.87	334.19	957.58	18.71

Table 1. Mechanical testing data for different % of ashpaltene HDPE composites

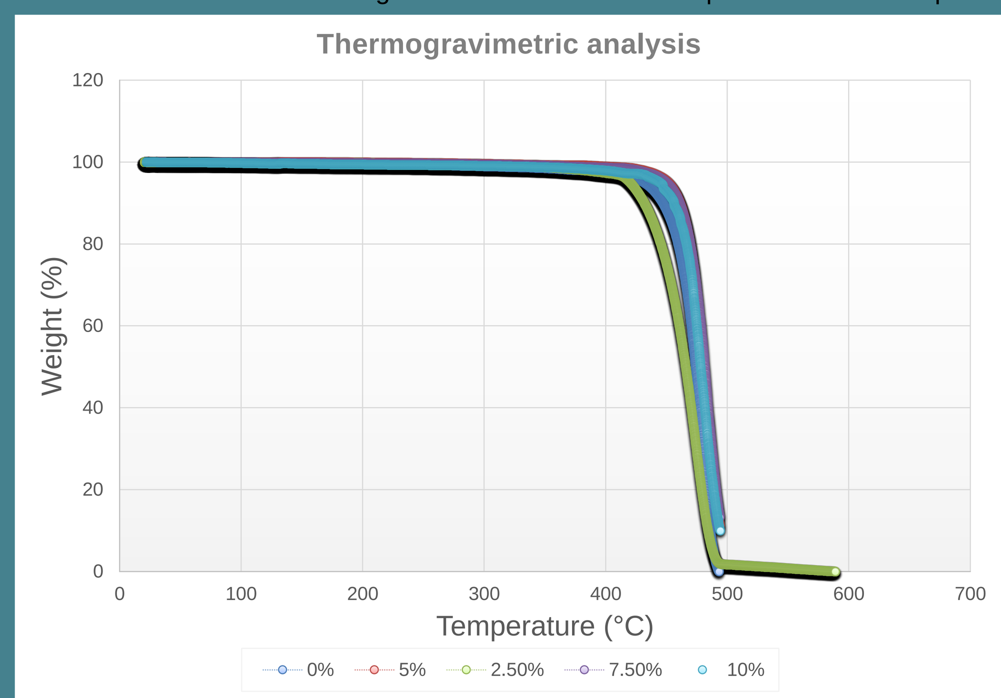
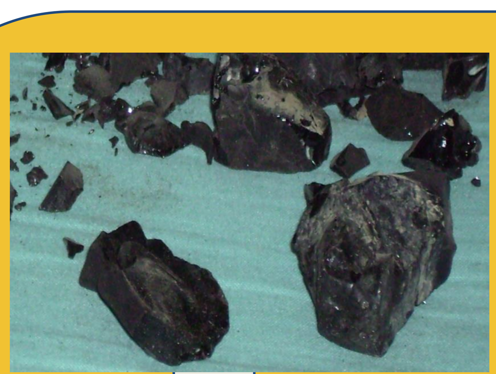
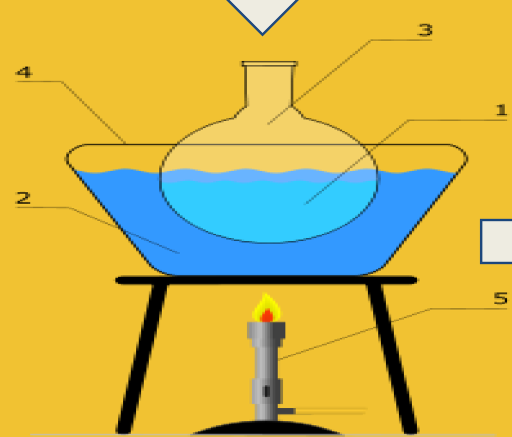


Figure 2. Thermal Stability for different asphaltene HDPE composites

Experimental Section



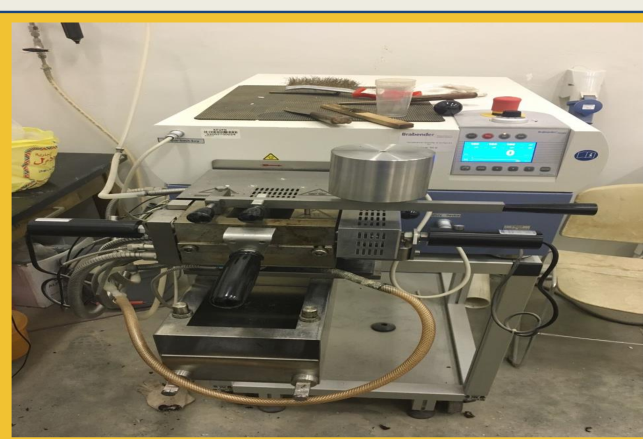
Heptane



filtration

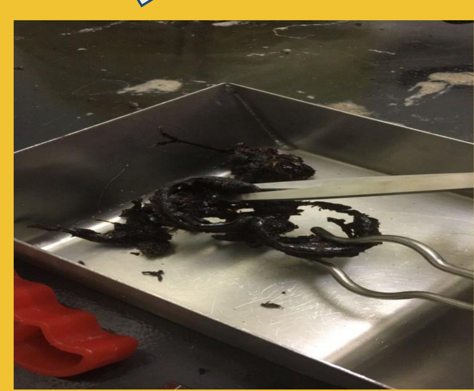
Ashphaltene and HDPE

Mix at 375 ºF



Blender

Carver Hydraulic Press



Asphaltene HDPE composite sheet

Conclusion

Undesirable asphaltene has been used to prepare functionalized asphaltene. The products obtained have been mixed with High Density Polyethylene (HDPE) in 5 different percentages, 0%, 2.5%, 5%, 7.5%, 10% and 15% and the resultants were analyzed by TGA, IR and for mechanical properties . The IR results showed no significant differences for the different % compositions while the mechanical test showed an enhancement of tensile strength, elongation ability, Young's modulus and yield stress properties with increasing percentage of functionalized asphaltene in the HDPE. In addition, the thermogravimetric analysis showed that for the 2.5% and 5% composites showed less thermal stability than the 0% pure HDPE. Nevertheless, the 7.5% and 10% composites showed an enhancement of the thermal stability against the 0% pure HDPE.

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