

## Asphaltenes and maltenes characterization of aromatic residue from heavy crude oil

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Characterization of asphaltene and maltenes obtained by precipitation of atmospheric residue from heavy crude (12°API) was carried out by elemental analysis and metals (Ni+V) content. Asphaltenes were precipitated from atmospheric residue abovementioned with n-heptane and n-pentane as solvents in a pressurized system with heating and stirring. It was observed that deasphalting removed metals simultaneously with asphaltenes leaving the maltenes with fewer amounts of Ni+V. However, sulfur is not removed in the same way as metals did during deasphalting due to the nature of sulfur molecules and its tendency to remain in maltenes.

The increasing production of heavy crude oils has forced petroleum refiners to deal with heavier feedstocks, which possess high amounts of asphaltenes. When sending these heavy feeds to hydroprocessing units the catalysts will be exposed to severe deactivation, in such cases deasphalting these heavy materials would be more appropriate to prepare suitable hydroprocessing feeds [1-2]. These heavy crudes are rich in sulphur and metals along with asphaltenes. Asphaltene fraction is the species that tend to cause most of the problems during petroleum transportation and refining. In addition, among all petroleum fractions, asphaltenes molecular structure is the least understood.

In this work we precipitated asphaltenes from atmospheric residue by using a pressurized system with stirring and heating. Precipitation conditions were: temperature of 60°C, nitrogen pressure of 25 kg/cm<sup>2</sup>, stirring rate of 750 rpm and contact time of 30 min. Solvent-to-oil ratio was 5:1 (vol/wt) and solvents used were n-pentane and n-heptane as reported elsewhere [3]. After precipitation, asphaltenes were washed under reflux conditions for 24 h and maltenes+solvent were distilled to recovered maltenes for further analysis.

API gravity was substantially increased after deasphalting when asphaltenes were separated from the feedstock. Sulfur content in maltenes was slightly reduced compared with the original atmospheric residue. On the contrary, metals (Ni and V) notoriously vary their concentration in maltenes. This behavior in both S and metals indicates that the amount of asphaltenic sulfur is lower than that of the asphaltenic metals, since most of the sulfur concentrated in maltenes and most of metals were found to be more concentrated in asphaltenes.

The increase in API gravity of maltenes compared with that of VR feedstock corroborates that apart from reduced impurities content deasphalted oil became rich in paraffinic-type molecules. The change in API gravity roughly indicates that maltenes are less aromatic at low amount of asphaltenes. It is to be considered for processing purposes that the low aromaticity of DAO will favor hydrocracking of heavy molecules into smaller ones. API gravity of maltenes obtained when precipitating asphaltenes with n-pentane is higher compared with using n-heptane as solvent due to the presence of microwaxes that cannot be properly dissolved by n-pentane since it takes longer time to dissolve them. In addition, when using n-pentane as solvent, a fewer yield of maltenes is obtained as observed in Table 1; however, the sulfur concentration is still higher in maltenes.

It is observed in this way that most of contaminants, mainly metals, are removed from the feedstock when precipitating asphaltenes. A better characterization of asphaltenes along with maltenes will allow for understanding their reactivity and design better upgrading processes or catalysts.

**Table 1**

Properties of feedstock (AR) and asphaltenes and maltenes precipitated with using n-pentane and n-heptane as solvents.

Property	AR	n-pentane		n-heptane	
		Asph	Malt	Asph	Malt
Maltenes, wt%	76.5	-	40.2	-	69.6
API gravity	5.6	-	11.27	-	10.01
S, wt%	6.02	8.1	4.29	8.52	4.62
Ni, wppm	98	284	30	263	59
V, wppm	498	1424	60	1356	314
C, wt%	81.8	82.4	82.6	81.6	82.78
H, wt%	10.46	7.67	11.53	7.35	11.22
N, wt%	0.73	1.67	1.03	1.57	1.09
n-C <sub>7</sub> insol. wt%	23.5	-	0.51	-	7.10

### References

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- [3] Centeno, G., et al. (2004) J. Mex. Chem. Soc. 48, 179-188 (In Spanish).