ASPHALTENE MOLECULAR AGGREGATION PECULIARITIES

A.P. Losev
(scientific supervisor: I.D. Bolotova)
Gubkin Russian State University of Oil and Gas

Despite the impact of asphaltenes in many technological and economic spheres, some of their fundamental molecular properties have remained poorly studied. Studies of asphaltene solutions, particularly with aromatic solvents such as toluene, could give important information regarding the concentration at which the asphaltene aggregation begins.

The object of this research was to determine the presence of asphaltene molecular aggregates below reported critical micelle concentrations both in solutions of precipitated asphaltenes and in solutions of crude oils.

The solid asphaltenes and crude oil have been provided by the "TATNEFT" oil production company and used as received. As a solvent, "chemically pure" grade toluene was used.

The optical absorption spectra in the NUV (visible) range (315–750 nm) have been studied using a KFK-2 photocolorimeter equipped with a set of narrow-band light filters.

The refractive index dependences were obtained with using IRF-454 B2M refractometer allowing to measure refractive index in the range from 1.2 to 1.7.

The absorption spectra and refractive index dependences was measured and analyzed.

The shape of optical absorbance spectrum was found to be sensitive to the details of asphaltene aggregation process. In dilute solutions, these processes are apparently determined by the net concentrations of asphaltenes; other oil constituents play a secondary role. The experimental data indicate that molecular solutions of asphaltenes are possible only for concentrations below 1 mg/l. With increasing asphaltene content, more and more molecular aggregates are formed. Asphaltene dimers evidently are the pre dominant species in the range of 5-15 mg/l, while stable dimmer pairs are predominant at concentrations near 90 mg/l.

Gradual increase of average complexity in an ensemble of coexisting asphaltene molecular aggregates is incompatible with the notions of "critical concentrations". In particular, this type of aggregation is quite distinct from conventional micellisation process with step-like changes at CMCs.

The author is grateful to Dr. Igor N. Evdokimov, ass.prof. Nikolai Yu. Eliseev and to Inna D. Bolotova for their help and advice.