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FAST BREAKING PAPERS - 2009

October 2009

PDF

Oliver C. Mullins & Alan G. Marshall talk with *ScienceWatch.com* and answer a few questions about this month's Fast Breaking Paper in the field of Engineering. The authors have also sent along images of their work.

Oliver C. Mullins

Alan G. Marshall

Article Title: Contrasting perspective on asphaltene molecular weight. This comment vs the overview of A. A. Herod, K. D. Bartle, and R. Kandiyoti

Authors: Mullins, OC;Martinez-Haya, B;Marshall, AG

Journal: ENERG FUEL
Volume: 22
Issue: 3
Page: 1765-1773
Year: MAY-JUN 2008

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SW: Why do you think your paper is highly cited?

Per its title, our paper addresses one of the most basic properties of asphaltenes—the most aromatic component of crude oil—their molecular weight. Published differences of this property ranged over at least a factor of 1000, with some reports having even larger disagreements.

Without resolution of this most basic property, the fields of petroleum and asphaltene science become severely limited precluding new efficiencies in the multi-trillion dollar petroleum industry.

SW: Does it describe a new discovery, methodology, or synthesis of knowledge?

In our paper, we utilize many different techniques to obtain a robust value of asphaltene molecular weight. In particular, we show the four different techniques of measuring molecular diffusion and six different methods of mass spectroscopy are now all yielding comparable results for asphaltene molecular weight.

Moreover, recent work shows that aggregation of asphaltenes in both solutions and in the laser desorption processes causes apparent molecular weights to greatly exceed actual molecular weights. Unfortunately, there had previously been greater reliance on

techniques which were quite susceptible to the unrecognized aggregation problems of asphaltenes.

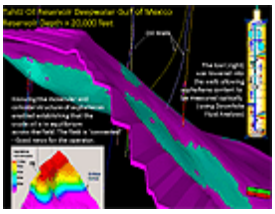
SW: Would you summarize the significance of your paper in layman's terms?

The most important property of chemical compounds is their elemental composition. For asphaltenes, there was no uncertainty here. The second most important property of chemical compounds is molecular weight.

For more than a generation, there had been orders of magnitude debate about this property of asphaltenes. Because of the importance of this property, every lab tried to measure it. However, many labs were ill-equipped to do so, and the controversy raged.

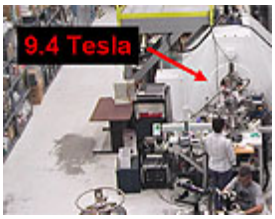
There have been many recent advances in asphaltene science using very sophisticated methods to resolve this issue. For example, the highest resolution mass spectrometer on earth, at the National High Magnetic Field Laboratory, Florida State University, has been used for exhaustive studies on this topic, showing what is correct, confirming other studies, and why previous results were in error.

Figure 1 [+] enlarge



Tahiti oil reservoir deepwater gulf of Mexico.

Figure 2 [+] enlarge



NHMFL instruments.

SW: How did you become involved in this research, and were there any problems along the way?

The authors of this paper are building a new field called "petroleomics," which is defined as the characterization of petroleum at the molecular level. The foundation of this field is to understand the chemical constituents and interactions of petroleum.

The objective of the field is to optimize resource utilization—including production, transportation, refining, heavy-end upgrading, and asphaltic paving and coating materials.

The reach of the industry is enormous. Chemists can play a decisive role in resource optimization, but only with the proper foundation. Petroleomics, while still rather young, is already proving its mettle.

SW: Where do you see your research leading in the future?

This research is already having enormous impact. For example, with newfound knowledge of the molecular and colloidal structures of asphaltenes—coupled with new technology—new solutions have been demonstrated for the largest uncertainty in multibillion dollar oil production projects, predicting the size of the subsurface oil reservoirs.

Ultrahigh resolution mass spectroscopy is pointing the way to identifying deleterious oil components, previously undetected until after costly problems had arisen.

SW: Do you foresee any social or political implications for your research?

Energy will remain one of the most important concerns of countries and peoples around the world and petroleum will be in the mix long into the future. In addition, for many countries mired in poverty, petroleum represents their best hope for a better life.

The vision of petroleomics is to codify petroleum science as a proper predictive science based on solid scientific and technical foundations. This is mandated for improving efficiency in the increasingly expensive arena of energy production. In addition, environmental concerns also mandate efficiency in order to minimize impact.

Moreover, it is now recognized that the world's oceans contain an enormous quantity of chemically altered asphaltenes from natural sources; likely a sufficient quantity to be of concern for the global carbon cycle.

We are now merging scientific disciplines and treating the world's hydrosphere and petroleosphere within a single fluid sphere. A single scientific leadership impacting both environment and industry is our goal.

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KEYWORDS: RESONANCE MASS-SPECTROMETRY; FLUORESCENCE CORRELATION SPECTROSCOPY; ELECTRONIC ABSORPTION-EDGE; ELECTROSPRAY-IONIZATION; CRUDE OILS; CARBONACEOUS COMPOUNDS; PETROLEUM ASPHALTENES; OPTICAL SPECTROSCOPY; ORBITAL CALCULATIONS; GAS-CHROMATOGRAPHY.

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2009 : October 2009 - Fast Breaking Papers : Oliver C. Mullins & Alan G. Marshall: Building a New Field "Petroleomics"

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