Sunlight Produces Water-Soluble Chemicals from Asphalt

S. F. Niles[1], M. L. Chacón-Patiño[2], S. P. Putnam[3], R. P. Rodgers[2], and A. G. Marshall[1,2]

1. Department of Chemistry and Biochemistry, Florida State University;
2. Ion Cyclotron Resonance Program, National High Magnetic Field Laboratory;
3. Department of Chemistry and Biochemistry, University of South Carolina

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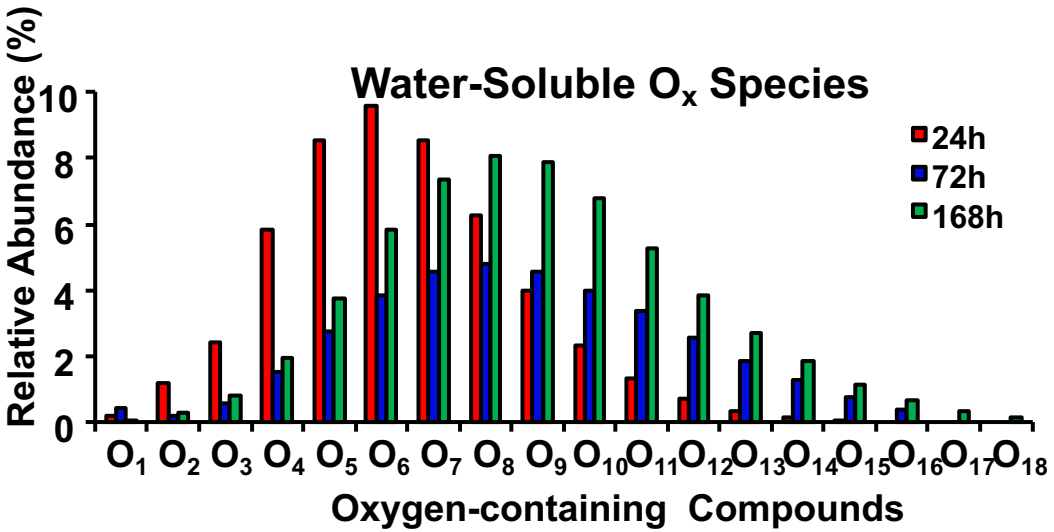
Road asphalt is comprised of aggregate (rocks) mixed with a binder composed of high-boiling-point petroleum-derived compounds. These compounds have been thought to be largely chemically unreactive and therefore relatively benign.

Recently, MagLab users have found that simulated solar irradiation of a thin film of asphalt binder layered on a water surface produces abundant oil- and water-soluble oxygenated hydrocarbons. This is important, because it indicates that water-soluble compounds leach into the water system from roads and highways as a result of photooxidation reactions.

The MagLab's unique ultrahigh resolution Fourier transform ion cyclotron resonance mass spectrometers were required to enable extensive compositional characterization of virgin asphalt binder, irradiated asphalt binder, as well as the water-soluble photoproducts. The results confirm photoinduced oxidation, fragmentation, and potentially also polymerization, as active processes involved in the production of water-soluble organic pollutants from road asphalt. The next step will be to assess the toxicity of these newly identified compounds in collaboration with researchers at M.I.T.



Relative abundances of water-soluble oxygen-containing compounds, where O_x on the horizontal axis denotes the summed abundances of all compounds containing x oxygen atoms. Data are shown after 24, 72, and 168 hours of simulated sunlight irradiation of road asphalt binder. This distribution plot of water-soluble oxygenated hydrocarbons is made possible by the MagLab's ultrahigh resolution Fourier transform ion cyclotron resonance mass spectrometry. These compounds were not present in the original asphalt. They were created by exposure to simulated solar irradiation.

Facilities and instrumentation used: Ion Cyclotron Resonance (9.4 T FT-ICR MS)

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