Study Examines Dispersion of Natural Nanomaterials in Surface Waters

Researchers from the Arnold School of Public Health's Environmental Health Sciences Department and the South Carolina SmartState Center for Environmental Nanoscience and Risk have completed a study on the dispersion of natural nanomaterials in surface waters. The resulting paper was published in The Science of the Total Environment.

Characterization and understanding of natural nanomaterials (NNMs) properties is essential to differentiate engineered nanomaterials (ENMs) from NNMs. However, NNMs in environmental samples typically occur as heteroaggregates with other particles, e.g., NNMs, ENMs, and larger particles.

Therefore, there is a need to isolate NNMs into their primary particles to better characterize their physicochemical properties. With this study, the researchers evaluated the efficiency of sodium hydroxide, sodium oxalate, and sodium pyrophosphate to extract NNMs from surface waters. The extracted NNMs were characterized for total metal concentration by inductively coupled plasma-mass spectrometry following full digestion; size distribution, elemental composition and ratios by flow-field flow fractionation; and morphology by transmission electron microscopy.

The researchers found that sodium pyrophosphate extraction resulted in the highest NNM concentration and the smallest NNM size distribution. Sodium hydroxide and sodium oxalate extraction generated heteroaggregates with a broad size distribution.

Further, the NNM extraction efficiency increased with extractant (sodium oxalate and sodium pyrophosphate) concentration. The concentration of metals in the sodium pyrophosphate-extracted NNMs compared to the total metal concentration was element-dependent and varied from as high as >80% for Cu, Zn, and Sr to as low as <5% for Al, Ti, and Nb.

The authors concluded that this study provides a simple protocol for NNM extraction from complex environmental samples and provides a better understanding of NNM physicochemical properties. The presented NNM extraction protocol forms the basis for ENM extraction from natural waters.