Surface chemistry of oil sands clay minerals

Cliff T. Johnston

Crop, Soil and Environmental Sciences, 915 West State St., Purdue University, West Lafayette, IN 47907

The clay- and silt-size fractions of a suite of good-to-poor processing oil sands ores were characterized using spectroscopic, structural, thermal analysis and chemical methods. Poor bitumen extraction is generally correlated with ores that contain higher proportions of clay minerals, although the specific clay minerals responsible for poor recovery are not known. This is due, in part, to the fact that the mineralogy of the oil sands is complex and the contribution of clay-organic interactions present in this system are poorly understood. Quantitative mineral analysis, thermal analysis and FTIR spectroscopy were used to identify and quantify the clay minerals present. Kaolinite was the dominant clay mineral present followed by illite and interstratified phase of illite-smectite and kaolinite-smectite with quartz being the dominant mineral phase present overall. Bitumen recovery and the amount of degraded/oxidized bitumen present were determined using a Syncrude batch extraction unit followed by analysis using scanning laser confocal microscopy at several excitation wavelengths to determine the extent of bitumen degradation. Surprisingly, kaolinite was positively correlated with the amount of degraded bitumen and negatively correlated with bitumen recovery (both highly significant with $P < 0.01$). Some residual bitumen and associated organic phases were present in these samples. Thermal analysis with evolved gas analysis, elemental C and N analysis, and FTIR spectroscopy were used to examine the nature of the organic phases and coatings present. EGA-TGA and FTIR spectral analysis were useful in characterizing the nature of the degraded bitumen and its relationship to the surface chemistry of kaolinite will be presented.

Notes