

OPTIMIZING XRF CALIBRATION PROTOCOLS FOR ELEMENTAL QUANTIFICATION OF MINERAL SOLIDS FROM ATHABASCA OIL SANDS

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As world reserves of conventional oil keep decreasing, there is greater incentive to further develop the Athabasca oil sands of Alberta (Canada). Oil sands being composed of coarse sand, silt and clay solids (80–85%), bitumen (5–15%) and water (1–5%), complete extraction of bitumen from such heterogeneous mixtures is not easy. Studies have shown the adverse effects of some types of mineral solids on bitumen recovery. Quantitative analysis of the elemental composition of mineral solids in ores is then of great importance to the oil sands industry. Two calibration protocols were developed here and implemented for accurate determination of major and minor elements in oil-sand solids by wavelength dispersive X-ray fluorescence (WDXRF) analysis using a fusion-based procedure. Commercially available standards do not span the ranges of element concentrations found in the mineral solids from oil sands. As such, calibration standards for seventeen elements were then designed by mixing pure synthetic oxides or geological reference materials, in order to mimic the elemental concentrations of oil-sand solids fractions. Measurement conditions were optimized to ensure best signal-to-background ratio and minimum line overlap. The limit of detection, calibration ranges and global relative uncertainty of the resulting calibration curves are reported, showing absolute precision of 0.1–10% for each element analyzed. The development of elemental compositions-based processability markers to identify problem ores yielding poor bitumen recovery ahead of extraction in commercial operations will be discussed.

Key words: oil sands, XRF, mineral solids, calibration, elemental composition