On-stream XRF for real-time monitoring of trace elements at sub-parts-per million levels.

Real-time, on-stream grade analysis using X-ray Fluorescence (XRF) process is widely used in the minerals processing industry. By monitoring feed (input) and tailings (waste stream) grade in a processing plant, recovery can be tracked and upsets detected. This technique is widely used for many base metals, including Cu, Pb, Zn; detection limits for existing commercial instruments are typically in the range 10-100 parts-per-million (ppm). This lack of sensitivity precludes the use of these analysers for monitoring precious metals such as the platinum group elements (Pt, Pd, Rh, Ru, Ir and Os) and gold that are mined at concentrations of a few ppm or less.

Our group is developing XRF analysers capable of measuring sub-ppm concentrations of elements in the range Z=30-92. The measurements are performed directly on a slurry stream without sampling or material preparation, making the approach well suited for real-time analysis and control applications. A system designed to measure light platinum group elements (Pd, Rh and Ru) is operating successfully in a platinum concentrator plant with a dry-basis 1-std precision of 0.05 ppm.

Achieving these low detection limits requires careful optimisation of each component of the analyser and in particular, the X-ray source and detector. Extensive use is made of Monte Carlo simulation techniques to solve the multi-dimensional design optimisation problem. In this paper, we discuss the design choices and present performance results for measurements of some key industrial elements. Applications in both minerals industry and environmental monitoring are discussed.