



## The analysis of fluorine in alumina using NMR

### Summary

Nuclear Magnetic Resonance (NMR) provides accurate, non-destructive analyses of fluorine in alumina for aluminum refiners. On-line measurements offer significant economic and process control benefits.

**progression, inc.** is the leader in the development and service of on-line NMR in the chemical and mining industries. In 2003 **progression** won the prestigious R&D 100 award for the development of its second generation on-line NMR system—the MagModule II™. Historically, **progression** focused its on-line efforts on the polymer industry; however, with the release of the MagModule II™, the company has successfully entered the minerals processing industry with on-line NMR. The underlying technology has already been proven in aluminum refining as laboratory NMR systems have been in use in this industry for several years.

### Benefits

The smelting process for the production of aluminum consists of the reduction of aluminum oxide ( $\text{Al}_2\text{O}_3$ —alumina) to aluminum metal using an electrolytic process. This process is based on an electrolyte known as cryolite ( $\text{Na}_3\text{AlF}_6$ —sodium aluminum fluoride). During the refining process, hydrogen fluoride emissions with potentially hazardous environmental implications are produced. This fluorine is removed from the atmospheric emissions using dry scrubbers containing alumina. Once the alumina becomes saturated, it is returned to the process, increasing its overall efficiency by replacing the lost fluorine. To prevent fluorine emissions to the atmosphere and control the efficiency of the manufacturing process, samples of the alumina and the cryolite are regularly taken for analysis to determine fluorine content.

The MagModule II on-line NMR analyzer can provide significant benefits by generating fluorine measurements automatically. These analyses can be fed directly to a plant's process control system for either closed loop or operator control. This improvement in control leads to increased process efficiency and reduced emissions.

### Sampling

Current wet chemical methods for fluorine determination are time-consuming operations, require skilled chemists and involve the use of potentially hazardous chemicals. The MagModule II fitted with a probe for fluorine determination offers a simple, non-destructive and rapid method for measurement of fluorine in alumina. Using **progression's** specially designed sampling systems, the instrument automatically samples and measures the alumina every 5 to 10 minutes eliminating the need for manual sampling and time consuming sample preparation.

### Calibration and results

System calibration and monitoring is performed by **progression**. Initial calibration is typically performed by the customer taking a series of samples from the instrument to be analyzed by a lab to provide reference data. Previous experimentation has demonstrated that the sensitivity to sample temperature is minimal.

