TORBED* Process Reactor Technology
Application Description

DRY GAS SCRUBBING

Aluminium smelting companies all over the world are facing increasingly stringent regulations governing the emission of acid vapours. Basic dry scrubbing methods have been used since the 1960s in an effort to clean up the exhaust gases from these smelters but these techniques are often too inefficient to economically meet the requirements of current air emission legislation.

The use of venturi reactors, fluidised beds and reactant recycling systems have been explored, but these methods usually lead to increased processing time and/or significant pressure drops across the system which waste considerable amounts of energy. In some instances, up to 20 times more reactant is needed to scrub the exhaust gases. These technologies also call for large ancillary processing plants with additional capital investment.

In 1990, Comalco Aluminium Ltd were exploring methods of removing hydrogen fluoride from the exhaust gases of their aluminium smelter in New Zealand by using the incoming feed material for the aluminium pots as the scrubbing medium. Their main aims were:

- to save energy by reducing the pressure drop across the reactor
- to eliminate alumina wastage
- to achieve world standards for the emission of fluoride and particulates.

The company had been introduced to the TORBED Expanded Bed Reactor ('EBR') concept two years previously, and were impressed by its ability to achieve far greater slip velocity between solids and gases than is possible with other technologies. A pilot TORBED EBR based plant was therefore designed and set up in New Zealand. This study proved beyond doubt that the TORBED EBR was capable of scrubbing the gases to the required degree, simply by passing the alumina **once** through the exhaust gases.

A TORBED reactor 5 metres in diameter was then built so that any problems regarding bed stability and aerodynamic behaviour of the feed material could be identified and solved. After this stage had been completed, a full-scale prototype TORBED reactor was built. Its design was based on two chambers, each 6 metres in diameter, which were configured so that they could operate either as a single stage reactor or as a two-stage counter-current operation.

Before the prototype had been installed, Comalco envisaged that at least 30 TORBED reactors would be needed to clean up the exhaust gases. The refinements incorporated in the developmental stages, however, meant that the reactors were more than three times as efficient as had been anticipated. As a result, only 13 dry scrubbing units, each with a single stage TORBED reactor, were needed as part of the $NZ94 million (US$60m) gas emission project. Subsequently, Comalco have also equipped their Bell Bay Smelter with a further 6 TORBED reactor units

Reactor processing power

- each TORBED reactor treats a gas flow-rate of 380,000 m^3/h in a single pass system for both the gas stream and the alumina particles
- emission levels for both gaseous hydrogen fluoride and particulates are approximately 1 mg/Nm^3, which is comparable to the best performance figures for any dry gas scrubbing systems, anywhere in the world
- despite the outstanding processing efficiency, no extra power was required as the TORBED reactor creates only a low pressure drop across the system. As a result, the dry scrubbing units could continue to use the six existing 1 MW exhaust fans, whereas the use of alternative systems would have meant upgrading existing fans.

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