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Platinum Assists in Coal Flue Gas Desulphurisation

The flue gas from coal-fired power stations contains particulates, nitrogen oxides and sulphur dioxide. The latter is generally held to be a major contributor to acid rain, a cause of much environmental damage, and thus its elimination from such flue gas is highly desirable. Various ways to achieve this are under development in a number of countries, including the U.S.A. where the 1991 Clean Air Act requires there to be a substantial reduction in the sulphur dioxide emissions, from the levels of 1980. Most existing processes require expensive reagents, involve reheating the flue gas and might require a landfill site where the captured sulphur can be dumped. The currently most frequently used method removes sulphur dioxide by a limestone scrubbing process.

However, researchers from the Georgia Institute of Technology in the U.S.A. have proposed the use of an electrochemical membrane desulphurisation process which is similar to other membrane separation processes except that it uses an applied electric field to achieve the separation, instead of the conventional pressure or concentration gradients (D. J. McHenry and J. Winnick, "Electrochemical Membrane Process for Flue Gas Desulfurization", *AIChE J.*, 1994, **40**, (1), 143–150).

Their process utilises the fact that sulphur oxides are the most acidic species present in the corrosive emissions from coal-fired power stations, and since they are therefore the strongest electron acceptors in the flue gas they can be electrochemically separated by a membrane. This consists of an inert chemically stable ceramic containing an electrolyte of $K_2S_2O_7$ with V_2O_5 which is held between two porous gas diffusion electrodes, made of lithiated nickel oxide. The structure is positioned inside a ceramic housing containing a baffled gas-flow channel, the baffles being treated with platinum to distribute the electric current. Simulated flue gas enters this cell through a heated glass tube containing a preoxidation catalyst of platinised silica gel which converts the sulphur dioxide to sulphur trioxide, after which the treated gas leaves the cell via a platinised alumina tube.

Platinum is additionally used to achieve good electrical contact to the electrodes, and a platinum wire reference electrode is positioned within the housing. The platinum wire and the platinised alumina tube serve to oxidise the sulphur dioxide completely. When current densities of between 0.5 and 500 A/m^2 are applied to the lithiated nickel oxide electrodes, a reduction in sulphur dioxide content of 90 per cent is achieved with almost a 100 per cent electric current efficiency.

The advantages of this method are that the electrodes remain stable during operation, no reagents are necessary, other than 1 to 2 per cent of the electric power output from the plant, the process occurs at flue gas temperatures so that reheating is not required, and the operation is continuous and totally enclosed. In addition there is no emitted waste, no liquids are pumped and oleum is produced.

While commercial and economic evaluations are still required, a full-scale design has been planned using a single set of stacks operating at 500 A/m^2 to achieve a 90 per cent reduction in sulphur dioxide. Savings are predicted when compared with conventional limestone scrubbing and using the new electrode material has led to an increase in cell lifetime.

Ruthenium Oxide Anode Coatings

Coatings containing platinum metals oxides have replaced many of the anode materials previously used by the electrochemical industry. The addition of various non-noble metal oxides to ruthenium oxide coatings is known to improve their selectivity and stability, and hence their performance. Now researchers at the Central Electrochemical Research Institute Karaikudi, India, have reported the effects of gradually replacing the titanium oxide in ruthenium-titanium oxide coatings with tin oxide (S. Pushpavanam and K. C. Narasimham, *J. Mater. Sci.*, 1994, **29**, (4), 939–942). With constant ruthenium content, the morphology and porosity are determined largely by the ratio of titanium oxide to tin oxide.