Catalytic Production of Nitric Acid

ESSENTIAL STEP IN ARTIFICIAL FERTILISER MANUFACTURE

Our current standard of living is highly dependent on the use of artificial fertilisers in agriculture, and these in turn are equally dependent on the use of catalysts in their manufacture. Recognition of these facts was the basis of a recent symposium, organised by the Fertiliser Society of London, in which the full day meeting was devoted to the catalytic aspects of fertiliser production.

Among the papers presented on this occasion was an invited contribution from J. A. Busby, A. G. Knapton and A. E. R. Budd of Johnson Matthey dealing with the catalytic processes involved in nitric acid manufacture. (*Proceedings* No. 169, read 20th April 1978.) Although base metal catalysts are employed to a minor extent, nearly the whole of the nitric acid production in the world is carried out by the oxidation of ammonia over a catalyst consisting of a pack of rhodium-platinum alloy gauzes, and the opportunity was taken to review some of the principles and practice in the use of such catalysts, together with the recent techniques for NO_x fume abatement using Honeycat catalytic systems.

Process Chemistry

After a brief historic introduction, the paper considers in some detail the more important basic chemistry of the nitric acid process. The oxidation of ammonia with air to nitric oxide over rhodium-platinum gauze is one of the most efficient catalytic reactions known, giving yields of 95 per cent or more when operated at temperatures between 700 and 950°C. However, in spite of the widespread use of the process, the precise nature of the transient species taking part in the reaction at the gauze surface is still a matter of contention, as are the detailed mechanisms of rhodium and platinum losses from the gauze, or whether these volatilised elements participate catalytically when in the vapour phase.

A large section of the paper deals with the various interrelated factors that contribute to the efficiency of conversion of ammonia to nitric oxide, many of which have been the subject of an extensive research programme on an experimental nitric acid plant in Johnson Matthey for a number of years. Such factors as gauze composition, make-up of the gauze pack and optimisation of number of gauzes are discussed, and the basis of current practice in the industry is outlined.

It is concluded that the best available system would appear to consist of a plant in which the reactants are well filtered, but in which the inevitable contamination of the leading gauzes is catered for by additional layers in the pack. Any concomitant extra metal loss may be reduced to a low level by the use of a catchment gauze system based on a gold-palladium alloy.

Pollution Control

Greater awareness of environmental effects has led to a demand for the control of emissions, in particular the coloured nitrous plumes, from nitric acid plants. The platinum group metals again feature prominently and are used almost exclusively as the catalyst in emission treatment on account of their high intrinsic activity, durability and resistance to poisoning. The Honeycat system, in which the catalyst is supported on a ceramic honeycomb, is now a well established technology and can effectively and economically reduce emissions to a low level.

The presentation of the paper, by Dr. J. A. Busby, was accompanied by a film showing the direct electron microscope observation of the movement of metal on the rhodium-platinum wire surface during ammonia oxidation, leading ultimately to the marked surface restructuring associated with used nitric acid gauzes.

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