

Platinum Metals Catalyst Studies

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Three of the five chapters that make up this report will help to increase the understanding of catalyst deactivation and regeneration mechanisms in the industrially significant areas of naphtha reforming and pollution control, where platinum metals catalyst systems continue to find important applications. All catalysts become deactivated during use, and thus there is a growing interest in gaining a much greater understanding of the reactions involved.

The deactivation and regeneration of naphtha reforming catalysts is described by J. M. Parera and N. S. Figoli of INCAPE, Santa Fe, Argentina. The Universal Oil Products "plating" catalyst, introduced in 1949, based on a bimetal-acid catalyst, for example, platinum-rhenium-sulphur/alumina, is more selective and more stable than platinum/alumina, and is currently the most widely used commercially. Catalyst deactivation is discussed in terms of coke deposition, poisoning by sulphur and nitrogen compounds, decrease of metallic and support areas and chloride concentration, heavy metal deposits, and fines formation and deposition. All these characteristics are reversible except the decrease in support area and heavy metals deposition. With the most commonly used commercial, naphtha-reforming catalysts, the main reactions of the process are controlled by the acid function of the catalyst, in spite of the great initial deactivation of the metallic function. These catalysts have platinum contents of about 0.3 per cent and the activity of the metal in the operating conditions used is enough to produce all the olefins that can be isomerised or dehydrocyclised on the acid function. The steps used for catalyst regeneration are also indicated, including coke elimination by controlled burning, oxychlorination to redisperse the metal function and restore the acid function, reduction

with hydrogen, and passivation by sulphiding.

In the chapter by D. B. Dadyburjor of West Virginia University, Morgantown, U.S.A., the effects of deactivation in changing catalyst selectivity are examined in a number of hydrocarbon reactions including those involving platinum-rhenium-sulphur on alumina. The overall conclusions from this chapter are that the various modes of deactivation including coking, poisoning and sintering, all change the selectivities of the different reactions.

The deactivation of stationary source air emission control catalysts is reviewed by J. R. Kittrell, J. W. Eldridge and W. C. Conner of the University of Massachusetts and KSE Inc., Amherst, Massachusetts, U.S.A. Supported platinum catalysts feature strongly among the favoured candidates both for the oxidation of volatile organic compounds to carbon dioxide and water, and for the reduction of nitrogen oxides to nitrogen and water, where ammonia may be used as the reducing agent (selective catalytic reduction). The authors review the morphological changes which take place during catalyst deactivation, deposition of poisons on the active surface, reactions between the feed and active catalyst sites, and solid-state transformations of the catalyst to form inactive solids. The mobility of platinum on oxide supports is well known; in reducing environments at higher temperatures the platinum particles grow to raft-like structures and eventually to large three dimensional particles. In oxidising environments, the platinum is also mobile on the surface as PtO_x , where $x < 1$, but the interactions with the support can be more favourable as the PtO_x wets the surface. Consequently a platinum on alumina catalyst which has become deactivated in a reducing environment can be redispersed in an oxygen-rich environment.

D.T.T.