

34 per cent butylene-2 and 6 per cent butane is one-seventh to one-eighth of that of ethylene; the absorption rate of a 95 per cent mixture of butylene-2 with butane is less than one-fourteenth that of ethylene.

### Commercial Process

Operation of the oxidation process on a commercial scale is generally carried out using mixtures obtained from cracking processes and containing about 90 per cent olefin with corresponding paraffins. The latter do not take part in the reaction and act only as inert diluents. Olefin reaction and oxidation of the catalyst solution are usually carried out in separate stages, the removal of the acetone or methyl-ethyl-ketone and their subsequent purification being achieved by steam-stripping and distillation operations. Over 95 per cent conversion of the olefins to the ketones is obtained, and final yields of purified acetone and methyl-ethyl-ketone exceed 92 per cent and 85 per cent respectively.

Among the advantages of the direct oxidation of olefins using palladium chloride as a homogeneous liquid phase catalyst is that mixtures of olefins and saturated hydrocarbons may be used as feedstocks without prior separation and that the products are obtained in high purity. Only one main product is obtained, and its output is not dependent on the manufacture or sale of a second product. The life of the palladium chloride/cupric chloride catalyst solution is virtually unlimited, as homogeneous catalysts are not prone to deactivation by poisoning as are supported heterogeneous catalysts.

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### References

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- 2 J. Smidt, W. Hafner, R. Jira, R. Sieber, J. Sedlmeyer and A. Sabel, *ibid.*, 1962, **74**, 93
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## New Homogeneous Catalysts for Hydrogenation

### PLATINUM-TIN CHLORIDE COMPLEXES

None of the noble metal complexes previously found active for homogeneous hydrogenations has efficiently catalysed the hydrogenation of ethylene and acetylene, but it has recently been reported by workers at du Pont in a letter to the American Chemical Society (1) that the complex compound formed by interacting chloroplatinic acid with stannous chloride dihydrate in methanol in the absence of air will catalyse these reactions at room temperature and atmospheric pressure. Acetylene yields a mixture of about 25 per cent ethylene and 75 per cent ethane.

The role of the stannous chloride is to accelerate the rate at which the unsaturated hydrocarbon becomes co-ordinated to the platinum, and also to stabilise the platinum compound against reduction by hydrogen. The mechanism of the catalysis is not discussed, but complex anions derived from

stannous chloride and chloroplatinic acid in which the platinum is in the +2 oxidation state were characterised as their triphenylmethylphosphonium salts.

In a second communication, from Professor Wilkinson and his co-workers in the Inorganic Chemistry Research Laboratories of Imperial College (2), the preparation of analogous Rh(I), Ru(II) and Ir(II) complex anions having the formulae  $[\text{RhCl}(\text{SnCl}_3)]_2^{4-}$ ,  $[\text{RuCl}_2(\text{SnCl}_3)_2]^{2-}$  and  $[\text{IrCl}_2(\text{SnCl}_3)_2]^{2-}$  is also described; these were isolated as their tetra-alkylammonium salts.

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### References

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