explained the equipment required and process variables associated with producing catalyst carriers in high volume by the cost-effective technique of extrusion. Extruder designs and therefore the shape of the extrudates depend on the material to be extruded. Catalyst supports used for reactions such as hydrotreating are produced using a twin contra-rotating screw. The wet metal oxide pastes, used to make the supports, are normally very abrasive and possess poor flow characteristics. However, in the extrusion process the precursor paste ('dough') needs to possess sufficient plasticity, lubricity and particulate cohesion to pass through a small orifice. In order to achieve this the support powder, for example Al_2O_3, is normally treated with dilute HNO_3 to help peptisation. The pH of this peptisation step has a large influence on the pore size distribution of the final material. At low pH (< 2) microporous materials could be produced. The plasticity and particulate cohesion of the 'dough' can be controlled by the introduction of one or more of a range of organic modifiers from wood flour to methyl cellulose. Addition of wood flour has the effect producing large voids in the extrudate upon calcination. This can lead to improved gas flow characteristics. Lubricity additives, such as graphite or stearates, can also be introduced.

Progress in Techniques for Catalyst Manufacture

Professor Friedrich Schmidt (Sud-Chemie, Germany) reviewed recent progress in techniques for catalyst manufacture. Large scale catalyst preparation is strongly driven by cost. It is, therefore, necessary to demonstrate a very significant performance benefit before it is viable for industry to make the investment to adopt a new technique for manufacture of a particular catalyst.

If organic solvents or organometallic precursors are to be used in precipitation or sol-gel preparations, significant plant modifications will be required. Such modifications, dictated by safety, environmental and engineering considerations, have prevented large-scale adaptation of these techniques for industrial catalyst manufacture. Exceptions include the manufacture of titanium silicalite (TS-1) and the Condea process for the manufacture of high purity Al_2O_3 from aluminium alkoxides. Sol-gel preparations are not restricted to stoichiometric compositions and can result in better control of the porosity of the final material. Professor Schmidt also suggested that use of supercritical CO_2 has the potential to greatly simplify solvent removal.

The conference organiser Barry Nay (BP Chemicals, Sunbury-on-Thames) thanked all the participants at the well-attended meeting and suggested that the next meeting of the RSC Applied Catalysis Group may take place outside Britain. Further information on events organised by the RSC Industrial Affairs Division, Applied Catalysis Group are obtainable from nayb@bp.com.

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Heterogenised Rhodium Catalyst

The search for a clean benign replacement for the industrial synthesis of amines (*N*-phenyl-*N'*-isopropyl-*p*-phenylendiamine and *N,N'*-di(1,4-dimethylpentyl)-*p*-phenylendiamine) used as antioxidants in vulcanising rubber, additives in biomimetic sensors and anticorrosive agents, has resulted in a one-pot synthesis using a platinum/carbon-based catalyst. However, this synthesis is not reproducible.

Now researchers at the Universitat Rovira i Virgili, Spain, have developed a reproducible one-pot synthesis to convert a primary amine into a secondary amine by imine intermediate formation (R. Margalef-Català, C. Claver, P. Salagre and E. Fernández, *Tetrahedron Lett.*, 2000, 41, (34), 6583–6588). The catalyst was prepared by immobilising preformed $[Rh(COD)(PPh_3)_2]BF_4$ and its iridium analogue on montmorillonite K10. The rhodium catalyst had the higher activity. The reaction is mild and solvent-free and the catalyst can be easily recovered and reused.