

conversion of ethylene to vinyl acetate, of propylene to acetone and to butyraldehyde. These one-phase systems offer economy in energy and a lower concentration of metal in the catalyst by comparison, for example, with cobalt.

Lastly, the development of rhodium hydroformylation technology for process licensing was described by Mr. N. Harris of Davy McKee. This process, developed by Union Carbide, Johnson Matthey and Davy McKee during the early 1970s for the hydroformylation of propylene, offers the advantages of high efficiency and low pressure operation, but a detailed knowledge had to be built up of the

effects of process variations such as rhodium concentration, temperature of operation, and carbon monoxide and hydrogen pressures, on both the efficiency of the process and on catalyst stability, while data had also to be accumulated on the effects of impurities in the feed stocks. All this information has been put to use as a basis for optimising the process design and for the formulation of guarantees for the licencees of the technique. Mr. Harris concluded his paper with the statement that an output of two million tons of the product, n-butyraldehyde, involved the use of less than one ton of rhodium.

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## A Detector for Formaldehyde Vapour

### SUPPORTED PLATINUM ELECTRODES USED IN ELECTROCHEMICAL SENSOR

Formaldehyde is an important industrial chemical with a wide range of applications. In aqueous solution it is used as a disinfectant, as a preservative and as an auxiliary agent in the textile, leather, paper and wood industries. However most formaldehyde is used for making resins which are then used in the manufacture of many products including plywood, chipboard and cavity-wall foam. Only extremely low levels of free formaldehyde are evolved from such products if the correct resin is used under appropriate conditions, and even where the resin is made significant levels of atmospheric formaldehyde are rare. However the gas has a pungent odour and an irritating effect on the eyes, and all parts of the respiratory system, and in Great Britain the Threshold Limit Value-Ceiling set by the Health and Safety Executive is only 2ppm.

While a number of analytical techniques are available for determining formaldehyde in the atmosphere, all have their advantages and disadvantages. Now, as a result of a joint research and development programme between Lion Laboratories Limited, of Cardiff, and Ciba-Geigy Plastics and Additives Company of Duxford, Cambridgeshire, an accurate pocket-size electrochemical instrument for detecting and determining atmospheric formaldehyde vapour has been produced.

The development and evaluation of this "Formaldemeter" has recently been described by P. M. Williams, I. R. Whiteside and T. P. Jones (*International Environment & Safety*,

1981, Guide Issue, 15-20). The detector incorporates a fuel cell which, although based upon a sensor originally developed by Professor H. L. Gruber and H. Huck of Innsbruck University, has been modified extensively at the University of Wales. Used in conjunction with its unique aspirating sampling system and related electronic circuitry, it can respond to atmospheric formaldehyde and provide a measurement of the vapour concentration.

The fuel cell electrodes consist of platinum-black supported on porous plastic, and are initially subjected to an activation process to prepare them for subsequent formaldehyde oxidation; in use they are separated by an immobilised acid electrolyte and are connected to the measuring circuit by fine platinum wires. When a sample is drawn into the detector any formaldehyde is adsorbed on the anode and spontaneously oxidised, producing an electron flow across the electrolyte to the cathode. As a result the potential across an external load resistance is changed, and this potential change is amplified and displayed on a digital meter. Following initial calibration, and with periodic in-the-field checks and adjustments, the meter provides a direct reading in formaldehyde vapour concentration units.

The Formaldemeter has high, but not total, specificity to formaldehyde and in addition it requires a short time delay between successive samples. Work to increase specificity and to develop a continuous monitoring facility is proceeding at both Duxford and Cardiff.