A Fully Integrated Hydrogen Diffusion System

FIRST COMPLETE MATTHEY BISHOP UNIT IN OPERATION

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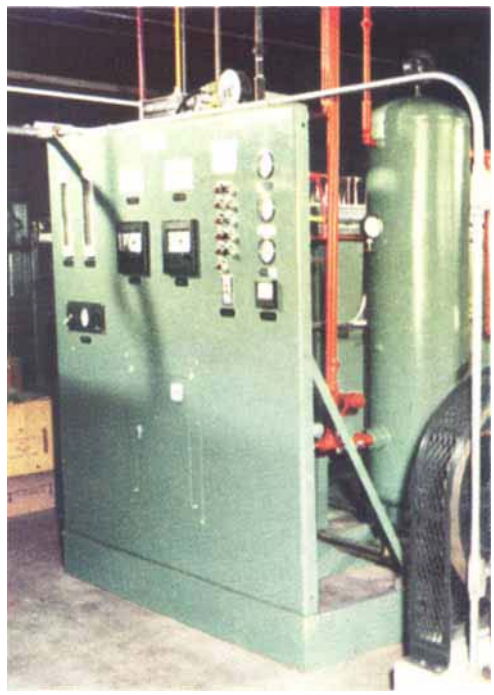
The principle of hydrogen diffusion through a silver-palladium alloy membrane, developed by Matthey Bishop Inc. over the past few years, is now being applied to complete systems for processing steam-reformed hydrocarbons and hydrogen-rich gas mixtures as well as commercial purity hydrogen.

The initial work on this alloy, which has remarkable stability as well as a hydrogen transfer rate more than twice that of pure palladium, was described in this journal by J. B. Hunter (1). The Company has since progressed from building a range of silver-palladium diffusion cells to the design and construction of commercial scale units (2) and then to supplying the diffusion system for plant used in the production of high-purity hydrogen from dissociated ammonia (3). Now, through a newly formed Apparatus and Systems Division, and based on some ten years of experience in the field, Matthey Bishop is providing fully integrated installations.

The first such installation, employing dissociated ammonia, has recently been put into service at Kreisler Industries Corporation, East Paterson, New Jersey. This unit is rated at 1500 standard cubic feet per hour of ultra-pure hydrogen, and provides the atmosphere required for a critical brazing operation in the manufacture of complex tubing assemblies for jet engines. A better and cleaner braze has resulted from the use of ultra-pure hydrogen, while hydrogen consumption has been reduced. This has made the task of stringent quality control easier while reducing cost.

The unit consists of an ammonia dissociator, a dissociated ammonia compressor and the diffusion system with controls, with an anhydrous ammonia bulk storage system provided by the ammonia supplier. The ammonia dissociator, rated at 2,500 standard



The main control panel of the Matthey Bishop 1500 cubic feet per hour hydrogen diffusion system installed at Kreisler Industrial Corporation

The rear view of the hydrogen diffusion system shows the ammonia dissociator in the background and the diffusion cell heating chamber at the right

cubic feet per hour, dissociates anhydrous ammonia over an iron catalyst at 955°C. The resulting gas, 75 per cent hydrogen and 25 per cent nitrogen (with traces of residual ammonia and water vapour) is raised from 10 to 250 psig by a heavy-duty reciprocating compressor, the pressure providing the driving force for diffusion. Eight Matthey Bishop Model B-71 diffusion cells are employed, each cell comprising a bundle of thin-walled small diameter silver-palladium alloy tubes manifolded together into a header and assembled into an outer envelope. This construction provides a thin membrane for diffusion, with high surface area in small volume and with high mechanical strength.

Within the cells the impure hydrogen at the moderate temperature of 370°C and at the increased pressure of 250 psig passes over the surface of the silver-palladium alloy. Only hydrogen can diffuse through the alloy, and a minimum of 90 per cent of the hydrogen present in the dissociated ammonia is recovered in the ultra-pure form. The remaining 10 per cent plus the impurities—nitrogen, water vapour and ammonia—are withdrawn continuously as a waste or bleed gas stream and vented to the atmosphere. In some cases this waste gas stream may be processed further and used.

References

1 *Platinum Metals Rev.*, 1960, **4**, (4), 130
2 *Ibid.*, 1962, **6**, (2), 47
3 *Ibid.*, 1964, **8**, (3), 91

Photochemistry of Platinum Metal Compounds

The photoresponsive behaviour of co-ordination compounds and the nature of the excited states involved have given rise to a considerable volume of literature during the last few years. Much of this has been concerned with compounds of cobalt, chromium and other transition metals, but among these interesting results have been reported on certain complexes of platinum, palladium, iridium and rhodium. A comprehensive review by A. W. Adamson and his co-workers at the University of Southern California (*Chem. Rev.*, 1968, **68**, 541), provides a valuable collection of data in this field.