A High-Temperature Reactor for the Synthesis of Hydrogen Cyanide

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The Andrussow process for the synthesis of hydrogen cyanide has become well established by now. It employs as catalyst platinum alloy gauzes through which a mixture of air, ammonia and methane is passed, enabling the following reaction to take place on the metal surface:

$$CH_4+NH_3+1\tfrac{1}{2}O_2 \rightarrow HCN+3H_2O+115 \text{ Kcal}$$

Yields of 60 to 70 per cent based on methane and of 60 to 65 per cent based on ammonia have been reported; approximately a third of the ammonia fed into the process is recovered as an aqueous solution of ammonium sulphate or bisulphate.

Higher yields of product may be obtained by the use of only ammonia and methane which react according to the following equation:

$$CH_4+NH_3 \rightarrow HCN+3H_2 - 100 \text{ Kcal}$$

In the presence of a platinum catalyst the reaction proceeds rapidly at 1100 to 1200C°, yielding hydrogen as a by-product. The energy required by this highly endothermic reaction must be supplied by transfer through the walls of the reaction chamber, and the development of a special tubular furnace enabled the process to be translated to a commercial scale. The reaction takes place in alumina tubes, approximately 2 metres long, 15 mm internal diameter, with thirteen such tubes bundled together and enclosed in a gas-fired furnace compartment.

One furnace comprises eight such compartments. The tubes are mounted in a header located in the top of the furnace which also incorporates a highly efficient water-cooled heat exchanger to cool the individual hot gas streams rapidly to a temperature below 300°C. The gas streams are combined into a manifold after cooling. The lower ends of the reactor tubes leave the furnace compartment through its floor and, to compensate for thermal expansion during heating and cooling, are connected via flexible couplings to a gas distributor.

Coke-oven or similar gas with pre-heated air is fed to three pairs of diametrically opposed burners in the furnace compartment. Air pre-heaters are placed in the flue ducts which conduct the waste gases at 1000°C to a waste-heat boiler.

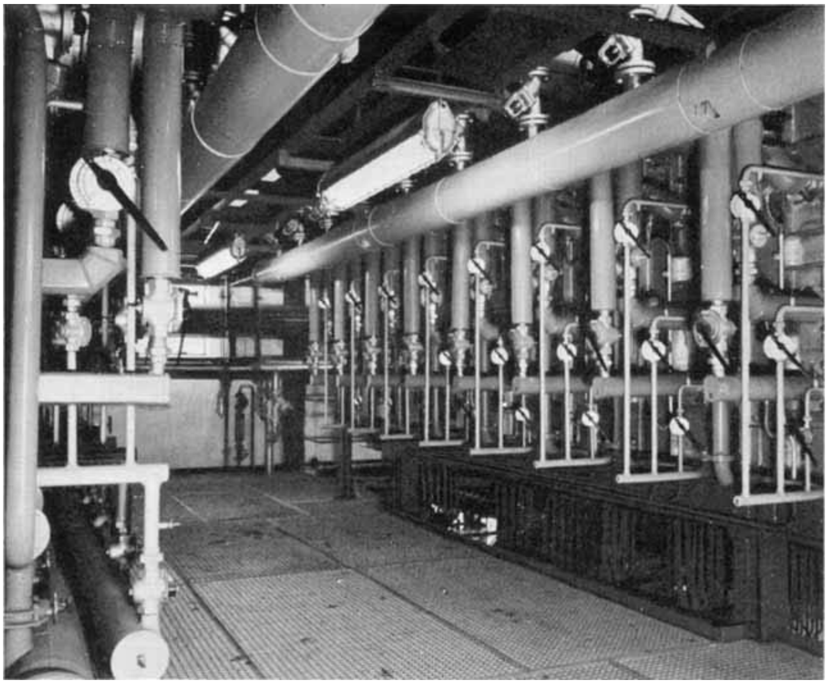
The catalyst completely coats the inner wall of each reactor tube, and although complex in nature, can be readily produced and applied to the tubes in a single procedure and requires no periodic regeneration. It contains 70 per cent platinum. Almost complete recovery of platinum from spent reactor tubes is obtained after a life of about twelve months.

A furnace with eight chambers achieves an output of 50 tons of hydrogen cyanide per month with an efficiency of 87 to 90 per cent based on methane, and 82 to 85 per cent based on ammonia. Approximately 10 per cent of the ammonia feed stock is recovered as ammonium sulphate.

Product gas leaving the reactor tubes has the following typical volume composition:

	Per cent
HCN	22.9
CH_4	1.4
NH_3	2.5
N_2	1.1
H_2	71.8

Unreacted ammonia is removed by washing with sulphuric acid. Hydrogen cyanide is obtained either as an aqueous solution by washing with water and subsequent distilla-



A reactor unit producing 50 tons a month of hydrogen cyanide. Eight combustion chambers each contain thirteen ceramic tubes in which methane and ammonia react in the presence of a platinum catalyst

tion, or by direct reaction to form further products, such as alkyl cyanides and cyanhydrins.

For a given output of hydrogen cyanide this process employs less than one-third of the volume of reactant gases used by the Andrussow process. This leads to a corresponding reduction in the size of the absorption equipment.

The tail-gas of the process consists largely of hydrogen (97 per cent V/V). If carbon monoxide is present in the methane employed as feedstock, it will still be present in the tail-gas and must be removed by conversion to methane if the hydrogen is to be used in hydrogenation processes or other applications which are sensitive to its presence.

Erosion and Transfer in Electrical Contacts

FURTHER WORK ON TRANSFER-INDUCTANCE CHARACTERISTICS

The phenomena of transfer in electrical contacts are very complex and are not yet fully understood, although the influence of circuit inductance has long been recognised. Work carried out in this field by the Electrical Research Association is reviewed by W. Nethercot in the Association's journal *Co-operative Electrical Research.* By using a new ultra-high-speed oscillograph it has been possible to study extremely short duration arcs in circuits with an inductance as low as about 0.1 microhenry, and the transfer-inductance characteristics of various contact materials normally used for relay contacts rated at up to 24 volts and 10 amperes have been observed with inductance values from 0.1 microhenry upwards. It is suggested that the relay designer might deliberately relate inductance to the transfer characteristics of his contact materials: the data obtained show that with platinum and palladium this value can be as low as 0.25 to 1.0 microhenry.