X. ISOMERIZATION OF NORMAL BUTANE

The isomerization of normal butane is carried out using aluminium chloride catalyst activated with HCl. This is the only plant in Germany for the isomerization of butane. The process, as used in Germany, is similar to one variation used in the United States. A simplified flow diagram of the process is attached as Fig.XXIII and a photograph of the three isomerization reactors is shewn in Fig. XXIV.

Each reaction vessel consists of a 1 metre diameter cylindrical vessel having a cone bottom. The straight section of the reactor is approximately 6 m. in length. Liquid normal butane of 95-96% purity is first dried by washing with 96% sulphuric acid. The dried feed is pumped under 18 atms. pressure through a preheater where it is heated to 95°C and then mixed with 100-150 cu.m. of recycle HCl gas for 1.6 cu.m. of liquid feed to give a 10% concentration of HCl in the reactor charge. The charge enters the base of the reactor near the cone, flows upward through a 2 m. depth of Raschig rings, then through a 1 m. bed of lump aluminium chloride occupying a volume of approximately 700 litres. Above the aluminium chloride, the material passes through an empty zone of 1-1½ m. in height to prevent aluminium chloride carry-over. The effluent from the top of the reactor is cooled to 25°C by indirect water cooling, and passes to a receiver from which some sludge is removed. The hydrocarbon-HCl mixture from the receiver is pumped through a preheater where the temperature is raised to 60°C and introduced near the top of a HCl stripping tower. The bottom temperature of the stripping tower is maintained at about 118°C to remove the butanes and any propane formed so that propane does not build up in the recycle HCl stream. Reflux is supplied to the top of the column by means of a water-cooled condenser in the ratio of 2.5 parts of reflux to one of overhead product. The recycle gas contains 80% HCl, 15% propane, and 5% isobutane. Make-up HCl is added to this recycle stream and it is mixed with the feed to the reactor.

The catalyst employed in the process is technical aluminium chloride containing a small amount of ferric chloride as an impurity. The ferric chloride is said to be essential for the reaction. The conversion of normal butane to isobutane per pass is 25-30% with an ultimate yield of 95-97%. Each reactor produces 250-300 kgs. of isobutane per hour. The consumption of aluminium chloride is 1% by weight of the isobutane produced. The consumption of HCl is 0.1 - 0.3% by weight of the isobutane produced.

FIGURE XXIV

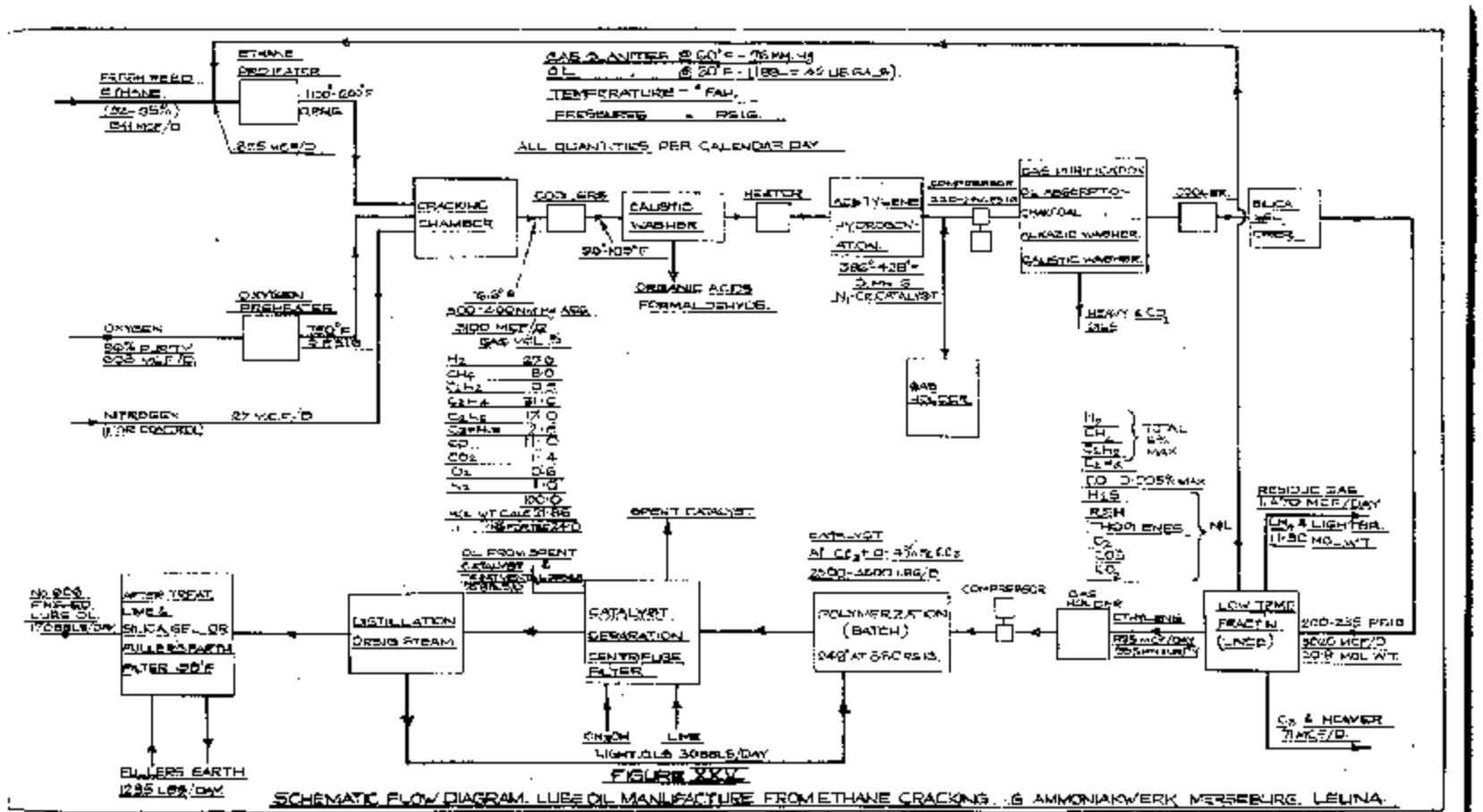

FIGURE XXV

SCHEMATIC FLOW DIAGRAM. LUBE OIL MANUFACTURE FROM ETHANE CRACKING. .G AMMONIAKWERK MERSEBURG. LEUNA.

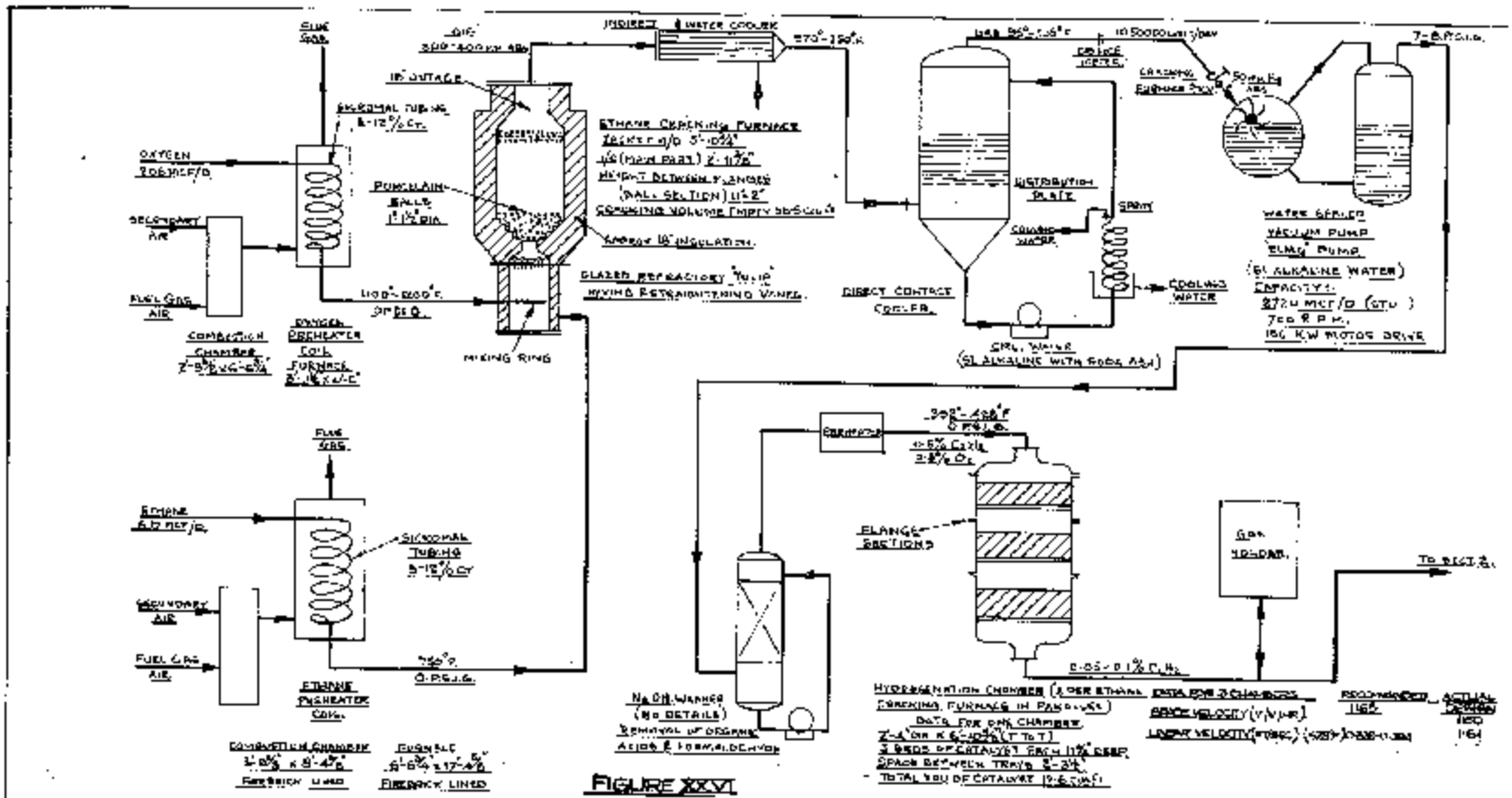

FIGURE XXVI

FLOW DIAGRAM SECTION I. LEUNA WORKS. LUBRICATING OIL FROM ETHYLENE. ETHANE CRACKING.

DESIGN DATA FOR ONE UNIT FOUR UNITS PARALLEL

According to the personnel interrogated, ordinary carbon steel is used in the construction of the reactor. It was reported that no corrosion trouble had been encountered with the use of carbon steel, although this appears very unlikely since the aluminium chloride sludge has been found to be very corrosive in a similar type unit. Difficulty was encountered, however, with deposition of aluminium chloride in the cooler at the outlet of the reactor. Apparently no effort was made to remedy this trouble.

This process has not reached the stage of development obtained elsewhere and it is doubtful whether anything new is to be learned from the Germans in the field of isomerization using aluminium chloride. The isomerization of pentane and hexane has not progressed beyond the laboratory stage.