

it commenced operations early in 1944 but full outputs were never achieved because of air raids, and erection of many parts of the plant was never completed. The following general information was obtained at Oppau from Dr. Saanksen (General Manager at Heydebreck), Dr. Muller Conradi and Dr. Schierenbeck.

The fundamental raw material for processes operated at Heydebreck was synthesis gas, (carbon monoxide and hydrogen), the greater part of which was to have been obtained from coke oven gas from the Upper Silesian grid system. As previously mentioned, the methane-oxygen process was used. Actually, a considerable amount of equipment for production of synthesis gas from coke was also installed and was used extensively for the early stages of operation of the Heydebreck plant.

(a) Higher Alcohols Synthesis - Iso-octane

From the standpoint of synthetic fuels, the most important activity at Heydebreck was the higher alcohols synthesis. Thirteen units were planned, each unit having one converter 1,200 mm. dia. and 18 M long. Each unit had a capacity of 150 tons/day crude product of the average composition - methanol 57%, propyl alcohol 1-1.5%, isobutyl alcohol 12%, and higher alcohols 10%, the remainder being water. Methanol was recycled and the remaining products worked up as at Oppau. The catalyst employed was exactly the same as at Oppau. Only six of the units were put into operation.

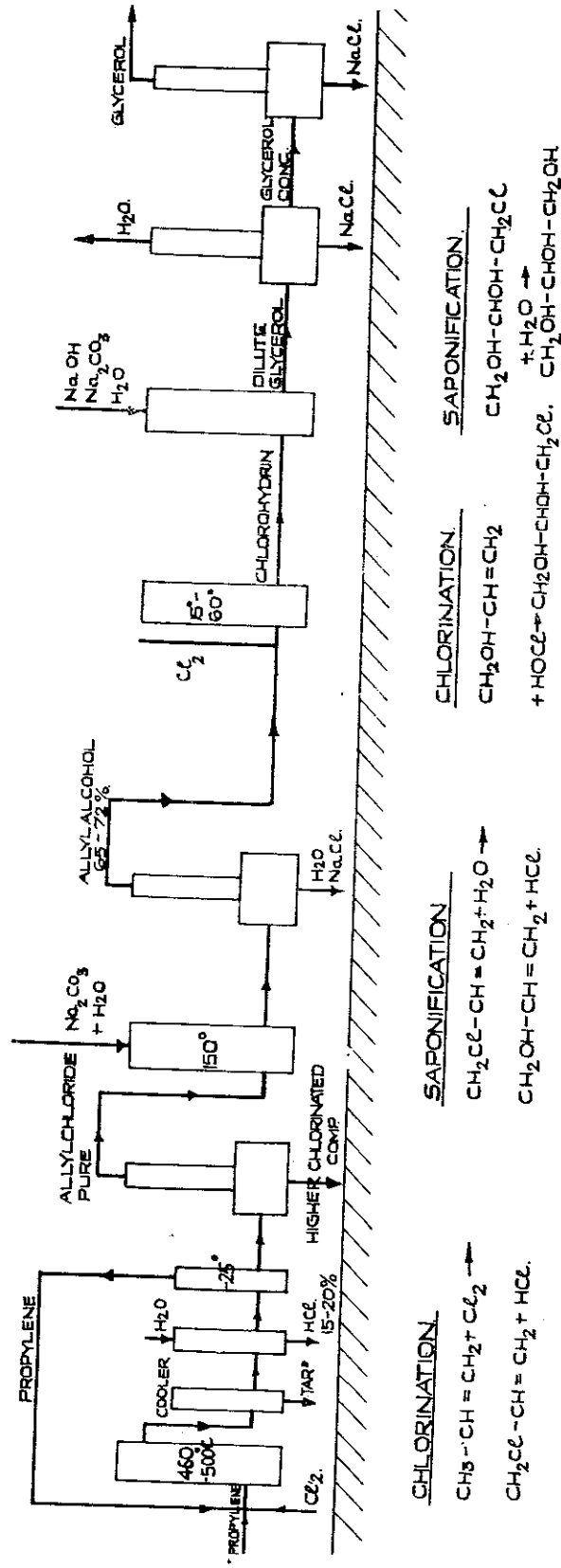
The isobutanol from the higher alcohols synthesis was converted into iso-octane by dehydration, polymerisation of the resultant butylenes and hydrogenation of the final polymer, the operating conditions for these steps being as follows :-

1. Dehydration Catalyst-alumina, reaction temperature-330-360°C, pressure-atmospheric.
2. Polymerisation Catalyst-10% phosphoric acid on coke. (Note: This does not check on the other information which indicates that the polymerisation catalyst is a magnesium silico phosphate). Temperature 120-160°C, adjusted to catalyst activity; pressure-around 20 ats, adjusted to maintain liquid phase conditions.
3. Polymer Hydrogenation 300 ats. pressure, nickel tungsten sulphide catalyst (5615).

The full capacity for iso-octane was to have been about 50,000 tons/year but the maximum achieved was only half this figure.

Alcohols of higher molecular weight than isobutyl alcohol, were hydrogenated over the same catalyst as was used for polymer hydrogenation in order to produce branched chain paraffin for use as aviation fuel components. The pressure employed was 300 ats., the reaction temperature 380-400°C. and the throughput was 2 M³/M³ of catalyst per hour.

FIG XIX.
PRODUCTION OF GLYCEROL.



OPPAU, DEN 29. MAY. 1945.

The crude product was distilled before it was suitable for use as a fuel component. When cut to an end point of 160-170°C the distillate product had a C.F.R. motor octane No. of 64 clear or 82 when leaded with 0.12% by weight of tetra ethyl lead. Cut to an end point of 110°C the product had a clear octane No. of 78-79, rising to 99-100 leaded. The planned capacity for this product was 30-40,000 tons/yr. dependent on the end point. Again, actual output was only 50% of this figure.

The cost of isobutyl or other higher alcohols fractions was said to be of the order of 80 pfg/kg including capital charges. It would therefore appear that the cost of iso-octane or 110° end point paraffin from higher alcohols hydrogenation must have been about 1,200 marks/ton.

The propyl alcohol from the higher alcohols synthesis was used for synthesis of glycerine by the process shown diagrammatically in Fig. XIX. No complete yield data were obtained for this process but it was stated that 1 ton of propylene gives approximately 1 ton of glycerol. The planned output of the glycerol plant was 6,000 tons/yr, but actual production never exceeded a 2,000 tons/year rate.

(b) Methanol

Heydebreck has three methanol stalls each with a single converter 800 mm. dia., 12 m. long and with a catalyst capacity of slightly under 3 M^3 . The catalyst used was the same as at Oppau, and it had a six months life at Heydebreck. The methanol output per unit, averaged over a six months period, was 140-150 tons/day, compared with 70-80 tons/day obtained in Oppau or Leuna units with the same catalyst volume. The improvement in output is due to the use at Heydebreck of

1. 300 ats. pressure.
2. A CO content of 18-20% in circulating gas.
3. Converters containing beds of catalyst with intermediate mixing and cooling chambers.
4. Higher efficiency interchangers.

Shortly after the start up of the plant in 1944, the methanol output was at least 80,000 tons/year. The impression was gained that by July 1944 an output corresponding to 120,000 tons/year was being obtained.

Dr. Muller Conradi stated that the total methanol production in Germany in 1944 was approximately 450,000 tons made up as follows:-

Leuna	200,000
Heydebreck	80,000
Waldenburg	80,000
Oppau	50,000
Auschwitz	60,000

In established plants the cost of methanol averaged 15 pfg/kg., this cost being made up of 9 pfg. for synthesis gas, 2 pfg. plant costs and 4 pfg.

capital charges. In the case of the newer plants the cost was of the order of 20 pf/kg., this allowing for a high rate of obsolescence. The capital cost per ton year of methanol in the newer plants was about 400 marks.

Practically all the methanol produced in Germany was converted into formaldehyde. Most of this was used for the manufacture of the explosive "Hexagen" although considerable quantities were condensed with acetylene to make 1,4-butene-diol for buna rubber.

(c) Ammonia

The capacity planned for Heydebreck was 200,000 tons/year. Only two stalls were actually operated, the total output being at the rate of 50-60 tons/day. These two stalls were of the old design and consisted of a single converter 800 mm. dia. and 12 M. long. It was intended that the later ammonia stalls should have a 1,200 mm. x 18 M. reaction vessel with catalyst beds and intermediate mixing and cooling chambers.

(d) Chlorine by Electrolysis

A plant for the electrolysis of 17,000 tons/year of salt was in operation. The chlorine was used in the glycerine process.

(e) Fatty Acids

These were being made at the rate of 20,000 tons/year by oxidation of paraffin wax. The paraffin wax was melted in aluminium vessels, catalyst in the form of a manganese soap was dissolved in the mass and air was blown in at a temperature of 80-90°C. The temperature was controlled by water coils and oxidation of each batch required 8-10 hours. The product was treated with soda solution, the resultant two layers were separated and the aqueous layer was subjected to steam distillation to remove hydrocarbons. The fatty acids were used in the form of sodium salts for soap.

(f) Kaurit

This is a urea formaldehyde resin which was sold as an adhesive for plywood. It was produced at Heydebreck at the rate of 20,000 tons/year using urea imported from Oppau. It was intended that Heydebreck should eventually have its own urea plant.

(g) Other Projected Activities

It was intended to build the following additional plants at Heydebreck :-

- (i) Oppanol 7,000 tons/year (no building or plant erection commenced).
- (ii) Hydrogen peroxide 24,000 tons/year (buildings erected but no plant).

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- (iii) S.S.lub.oil. This is made by polymerisation of pure ethylene (see Leuna report). A plant for the production of 22,000 tons/year was complete but was never operated. The ethylene was to be made partly by oxygen cracking of ethane pipelined from Blechhammer North, the remainder being separated from coke oven gas by Linde treatment.
- (iv) Tetra Ethyl Lead. It was proposed to make 2,400 tons/year and the necessary buildings had been erected.
- (v) Sodium Sulphide. It was intended to make 1,800 tons/year sodium sulphide which was required as a catalyst in coal hydrogenation plants. (No building or plant erection had commenced).
- (vi) Formamide and Formaldehyde. A production of 1,500 tons/month of formamide and 3,000 tons/month of formaldehyde was intended but no work had started on the plant.
- (vii) Concentrated Nitric Acid. A plant for 20,000 tons/month was projected.
- (viii) Calcium Ammonium Nitrate. Designs were being prepared for a plant for 130,000 tons/year.

(h) Bomb Damage at Heydebreck

The first raid on Heydebreck was in June 1944 when the synthetic glycerine plant was the only one to be damaged. There was another attack in July 1944 when the isobutyl alcohol distillation plant, the synthesis gas production plant including gasholders, the boiler house and the salt electrolysis plant were fairly badly damaged. The entire plant was shut down for four weeks. The isobutyl alcohol, the iso-octane and the methanol plants had just been restarted at full capacity and the glycerine and synthetic lubricating oil units put on line at a considerably reduced output when they were again badly damaged by air attack. After July 1944, raids followed at regular intervals of approximately one month and no appreciable production was possible.

B. AUSCHWITZ

This factory like Heydebreck is owned and operated by the I.G. The following very limited information on the products and production capacities of the various Auschwitz plants was obtained from Dr. Muller Conradi and Dr. Schierenbeck during the second visit to Oppau. More detailed information could be obtained from Dr. Durfeld (the managing director of Auschwitz), who, it is understood, is now at Leuna.

Buna rubber	3,000 tons/yr. ex acetylene from carbide.
Polystyrene	Capacity not stated.
Iso-octane	25,000 tons/yr. ex iso-butyl alcohol.