

IX ALCOHOL PLANT

The alcohol plant (Building 106) was erected in 1940. Here the olefins from the stabilizer over-head are absorbed in sulfuric acid and hydrolyzed to alcohols and some incidental polymer which is blended in motor fuel.

The C<sub>3</sub> and C<sub>4</sub> feed containing approximately 30% olefins is contacted for one hour with 58°Be. sulfuric acid by stirring in a water jacketed reaction vessel (Made by Lurgi) under 10-15 atms. pressure. Cooling water is used in the jacket during the summer months, but not during the winter. The temperature is not allowed to rise above a maximum of 45°C. Following the mixing period, the reactor contents are allowed to settle for 30 minutes.

The bottom layer from the reactor, that is the ester and acid layer, is drawn off to storage. This material is then charged to a second mixer where it is contacted with water at atmospheric pressure and temperature. This mixer operates continuously. The material flows into a separator where a polymer is taken off as the upper layer and sent to motor gasoline blending. The lower layer is then passed to a four-stage hydrolyzer of which the first three stills are shown by Fig. 26, page 78. Ester is hydrolyzed to alcohol by heating with open steam in the 4 stages, all maintained under a pressure of 0.2 atm absolute. The temperatures in successive stages are as follows:

- |    |         |    |          |
|----|---------|----|----------|
| 1) | 75-80°C | 2) | 80-88°C  |
| 3) | 88-95°C | 4) | 95-104°C |

The liquid from the 4th stage is 25% sulfuric acid; it is sent to the acid concentrator for concentration to 58°Be. and returned to the esterification reactor.

The vapors from the 4 hydrolyzers consisting of a mixture of alcohol and water of 50% concentration pass through a caustic washer to storage.

The upper layer from the primary contactors is the unreacted C<sub>3</sub> and C<sub>4</sub> hydrocarbon and polymer. It is drawn into a storage vessel containing steam coils and is vaporized from the storage vessel through a caustic washer into a gas holder. The material is then compressed and charged to a re-run column where C<sub>3</sub> and C<sub>4</sub> product is made overhead for use as bottled gas (treibgas). The small amount of polymer bottoms is blended into motor gasoline. The production of alcohols from 26-28 tons per day of Fischer-Tropsch C<sub>3</sub>-C<sub>4</sub> fraction is 2.0-2.1 tons per day of isopropyl alcohol, and 3.2-3.5 tons per day of a mixture of secondary and tertiary butyl alcohols.

The alcohol purification system consists of 6 bubble plate towers. The 50-50 water alcohol mixture from the hydrolyzers enters the first column containing 30 plates on the 16th plate. A small amount of caustic is introduced on the 18th plate. Open steam is

used for removing a small amount of polymer as an overhead product. The temperature at the top is 90°C., and at the bottom 120°C. The pressure is 0.6-0.8 atms. The bottoms from the first column enter the second column containing 36 plates on the 11th plate. Open steam is used to take overhead a water alcohol mixture containing about 75% alcohol. Water is withdrawn from the bottom of the column. Pressure in the column is 1.2-1.3 atms. and the temperature at the top of the column is 110-115°C.

The overhead from the second column enters the third column containing 70 plates, which is the benzol azeotrope column, on the 55th plate. 90% benzol is refluxed to the top of the column and impure isopropyl alcohol is taken off the 10th plate as a vapor, and the impure butyl alcohol is taken off the bottom of this column. This column operates under 2.2-2.4 atms. with a top temperature of 60°C and a bottom temperature of 104°C. The impure isopropyl alcohol passes to a 30-plate column entering on the 6th or 8th plate. Pure isopropyl alcohol is taken overhead and the bottoms returned to the azeotrope column on the 10th plate. The impure butyl alcohol is fed to a 20-plate column on the third plate. Pure isobutyl alcohol is taken overhead and a heavy residue is the bottom's product. The overhead from the azeotrope column is a mixture of alcohol, benzol and water. The mixture passes to a separator where a water layer is taken off and returned to the column on the 56th plate. The upper layer is then charged to a 60-plate column entering on the 20th plate. Direct steam is used for distilling overhead an alcohol-benzol mixture which is returned to the azeotrope column as reflux. Water is withdrawn as the bottom product from this column. 600 liters per month of 90% alcohol is added make-up.

Various seized records show that the alcohol plant also produced fusel oil, and "Dilanol". The latter is unidentified but may be crude higher alcohols. As derivatives of these primary products crude acetone, propyl ether and "Syrup Rheal" were also made.

"Syrup Rheal" appears to be a by product of the acetone manufacture but is not further identified. Research notes indicate that aluminium alcoholate was also being made at Moers but no information was obtained as to method or scale of manufacture or of commercial use of this product.

By a license agreement dated 15 July 1936 Rheinproussen obtained rights to dehydrate alcohols by an unspecified process covered by German patents (Listed) of the firm E. Merck, Darmstadt. Semi-annual accountings of the royalty payments due Merck, in accordance with this licence reveal the figures quoted below for alcohol production. For recent years monthly production figures are also given.

	Butyl Alcohol Kilograms	Propyl alcohol including that converted to acetone Kilograms
First half 1940	143600	48560
Last half 1940	387770	106840
First half 1941	376346	134216
Last half 1941	496203	252794
First half 1942	524178	278543
Last half 1942	276940	187511
First half 1943	617188	505359
Last half 1943	630282	566225
First half 1944	556654	638970

The distribution of the bulk of the alcohol shipments in 1944 is shown by Table XX page 79. The identity of "Sektoll" is not established. Another unidentified product, "Dilenol", was shipped almost exclusively to Geb Overlack, Meunchen-Gladbach. One or both of these products may be amyl alcohols which are known to have been made and are not otherwise accounted for in the shipping records. Mixed butyl-propyl ether was shipped in about the same quantities entirely to Overlack at M. Gladbach. From January through June isopropyl ether was shipped exclusively to Wiegant Svehne, Oberhausen, but in quantities of only about one ton per month. In July the shipments of this ether were as follows:-

I. A. Farben. Frankfurt/M	44 Tons
Pankower Transp. Berlin/Pankow	13 Tons
Chemische Fab. Gruenau, Berlin/Gruenau	14 Tons

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Figure 26.

First three of four alcohol stills,  
Building 118.

TABLE XX

Alcohol Shipments by Rheinpreussen in 1944

Metric Tons

Principal Consignees	<u>BUTYL ALCOHOL</u>		<u>ISO-PROPYL ALCOHOL</u>		<u>SEKTOL II</u>	
	<u>DEGUSSA</u> Buchhausen	<u>DEGUSSA</u> Frkfrt/M	<u>DEGUSSA</u> Mainz	<u>I-G FARBEN</u> Frkfrt/M	<u>PANKOWER</u> Transport Berlin/P.	<u>Gebrueder</u> Overlack M/Gladbach
January:	29.050	45.650	13.300	29.000	-	-
February:	49.800	15.360	-	29.350	-	7.950
March:	48.900	45.300	29.800	15.450	-	9.600
April:	31.400	44.100	32.000	-	26.000	7.300
May:	63.000	46.400	-	-	29.540	9.946
June:	-	-	-	14.850	14.200	5.500
July:	-	15.700	-	-	-	-