

FIAT FINAL REPORT NO. 239

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**FISCHER TROPSCH PLANT OF
HOESCH BENZIN, A. G. AT
DORTMUND, GERMANY**

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FISCHER-TROPSCH PLANT of HOESCH BENZIN, A.G.
at DORTMUND, GERMANY

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FIELD INFORMATION AGENCY, TECHNICAL

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FISCHER TROPSCH PLANT OF HOESCH
BENZIN A.G. AT DORTMUND, GERMANY

General Description of Plant.

This plant employed the medium-pressure Fischer-Tropsch process using cobalt catalyst. Synthesis gas was made by the usual procedure of manufacturing blue water gas from coke, followed by conversion of part of the carbon monoxide to hydrogen by a shift-catalyst in order to obtain the 2/1 ratio of hydrogen to carbon monoxide required for medium-pressure Fischer-Tropsch operation.

Synthesis gas production was at the rate of 900,000 to 1,000,000 m³ per day, and the average yield of primary product was 150 g. per m³. This means a total annual production rate of 50,000 metric tons of primary product, which is considerably less than the 90,000 at which this plant was rated before the plant inspection was made on April 22nd 1945.

The water-gas plant, gas purification units, shift-catalyst conversion unit, and other equipment connected with production of the synthesis gas were all of the usual types encountered in Fischer-Tropsch plants and require no further description here.

The catalyst chamber house contained 68 catalyst chambers of the usual concentric double-tube design used in other medium-pressure Fischer-Tropsch plants. These chambers were operated in three stages with indirect coolers after each stage. Following the final stage, gas pressure was reduced and the gas passed through the usual active carbon chambers to remove C₃ and C₄ hydrocarbons. This plant did not have facilities for recirculation of the gas through any stage.

Method of Plant Operation.

Of the 68 catalyst chambers, normally only 64 were in operation at any one time, the remaining four being out of operation for replacement of catalyst, etc. The following table summarizes the more important operating data for each stage:

<u>Stage.</u>	<u>First.</u>	<u>Second.</u>	<u>Third.</u>
Number chambers operating	40	16-20	4-8
Gas pressure, atmospheres	10	<10	<10
Temperature, °C	180-205	180-205	180-205
Gas contraction, %	50-60	35-40	30

The rate of feed of synthesis gas to the first stage was 1000 m³ per hour per chamber, which was the normal rate claimed for other Fischer-Tropsch operations.

Catalyst Procedure.

The catalyst used in this plant was secured from the central catalyst manufacturing plant of Ruhrchemie A.G. at Sterkrade-Holten. According to plant personnel interrogated, it contained cobalt, thorium, magnesia, and kieselguhr in the normal proportions. Since the manufacture of this catalyst has been described in considerable detail in other reports, no further data are given here.

The Hoesch Benzin procedure in adding fresh catalyst to the plant differs from normal practice as recommended by Ruhrchemie. Fresh catalyst is put into operation in any stage at this plant instead of the recommended practice of starting its operation in the third stage only.

Hoesch Benzin also claimed that regeneration of the catalyst with hydrogen does no good, despite the fact that this is a regular procedure at other plants. Periodically the catalyst is extracted with some middle oil from the process and then dried with heat, but, other than this, no attempt is made at regeneration in the plant. After service of 1500-2000 hours, the catalyst is removed and shipped back to Ruhrchemie as spent catalyst.

Products.

As stated earlier, average yield of primary product from this plant was 150 g. per m³ of synthesis gas. At times, under good operating conditions, the yield would be as high as 160-165 g. per m³.

The products obtained from the primary product, aside from the gasol (C₃-C₄) fraction, are approximately as follows:

Benzin	20-25%
Diesel Oil	30%
Heavy Oil	25%
Paraffin	20-25%

The benzin shows an octane number of 40-45, the Diesel oil has a cetane number of 100, and the paraffin wax is quite hard, having a melting point of 60-70°C. and an initial boiling point of approximately 350°C. At one time, this plant attempted to crack the benzin in order to obtain motor fuel with a higher octane number, but losses were too high, so this was abandoned.

Research and Special Products.

Interrogation revealed that little research had ever been carried out at this plant. Some research work had been done on motor lubricants, cutting oils, etc. with no particularly significant results. Although some work had been planned for tests of iron catalysts and a pilot plant built, the actual work had not been commenced.

Fatty acids amounting to one ton per day were recovered from the Fischer-Tropsch condensate water. This was worked up for the manufacture of soap and ethyl, propyl and butyl alcohols.

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