FR.

copy 11

ITEM NO. 30
FILE NO. XXIII - 16

COPY NO. 25

Unclassified 10/15/45 JC

Classified ~~SECRET~~
Auth: C. I. O. S.
Date: 4 April 1945
Initials: R. M. C.

OIL TARGETS IN RUHR AND HANOVER AREAS

Oriel; J. a.

SECRET

COMBINED INTELLIGENCE OBJECTIVES SUB-COMMITTEE

~~SECRET~~

OIL TARGETS IN RUHR AND HANOVER AREAS

Reported By

Col. J.A. ORIEL
Min. of Fuel & Power

CIOS Targets Item 30
Fuels & Lubricants

COMBINED INTELLIGENCE OBJECTIVES SUB-COMMITTEE
G-2 Division, SHAEF (Rear), APO 413

~~SECRET~~

23 p. diagr.

TABLE OF CONTENTS

Personnel of Team

Col. J.A. ORIEL

S E C R E T

REPORT ON A VISIT TO GERMANY FROM 4th TO 21st APRIL, 1945, BY COL. J.A. ORIEL.

INTRODUCTION.

Although several plants were covered in this visit, the report will be written in the order of what I consider to be the greatest importance.

Part of these visits were undertaken with the Ruhr Party under the leadership of Dr. Parker, whilst the Hanover area was investigated together with Mr. Evans of C.A.F.T. and Mr. Vincent, who was kindly released from C.A.F.T. operations to accompany me on this work.

(I) INTERROGATION OF DR. BROCKHAUS AT HANOVER.

Dr. Brockhaus, the Manager of Elwerath, Deurag and Nerag Group, was found to have been Chairman of the Petroleum Planning Committee for the Greater Reich during the war. The other members of the Committee were:-

Vice-Chairman: Dr. Boeder, the Rhenania Company.
Dr. Engel, the Vacuum Oil Company.
Dr. Schlecht, the Deutsche Erdöl A.G.
Dr. Brunk, the Deutsche Gasolin.

Dr. Brockhaus gave me a list of the dispersed refineries throughout the country, known as "Ofens". There are forty units in seventeen locations, and the list is attached.

He also gave me a list of smaller batch still distillation equipment, known as "Rosts", which are built in the ruins of factories throughout the country.

Of "Dachs", that is underground lubricating oil plants, he gave us four locations. The one at Porta, Nr. Minden, is being reported on separately as it was visited by the writer. The second was being built by the Rhenania Company and was situated in Osterode in the Hartz Mountains. This one was said to be somewhat larger than the Porta installation, and probably also had furfural extraction. It was mainly to operate on Vienna crude, but would not be completed for another three or four months. The

D.E.A. were erecting one at Ebensee in Austria, and were carrying out dewaxing using dichlorethane. He thought it was operating in conjunction with the "Ofens" 23 to 30. Lastly there was an "Ofen" at Alte Post, Nr. Pirna, operated by the Deutsche Gasolin, again probably working on dichlorethane.

He knew of only two "Taube", which are cracking plants, one by the Wintershall A.G. at Cassel, near Messinghausen, and another by the Continental Oel A.G. on the Danube, but he did not know at the moment the condition of these two plants.

A "Jacob" apparently is a primitave cracking plant working in conjunction with an "Ofen", and these were projected in conjunction with many of the "Ofens", but the one at Boegerhof was the only one that he knew of that had had work definitely carried out upon it.

He had nothing new to offer regarding "Schwalben" or "Kuckuck".

(II) THE UNDERGROUND LUBRICATING OIL PLANT AT PORTA.

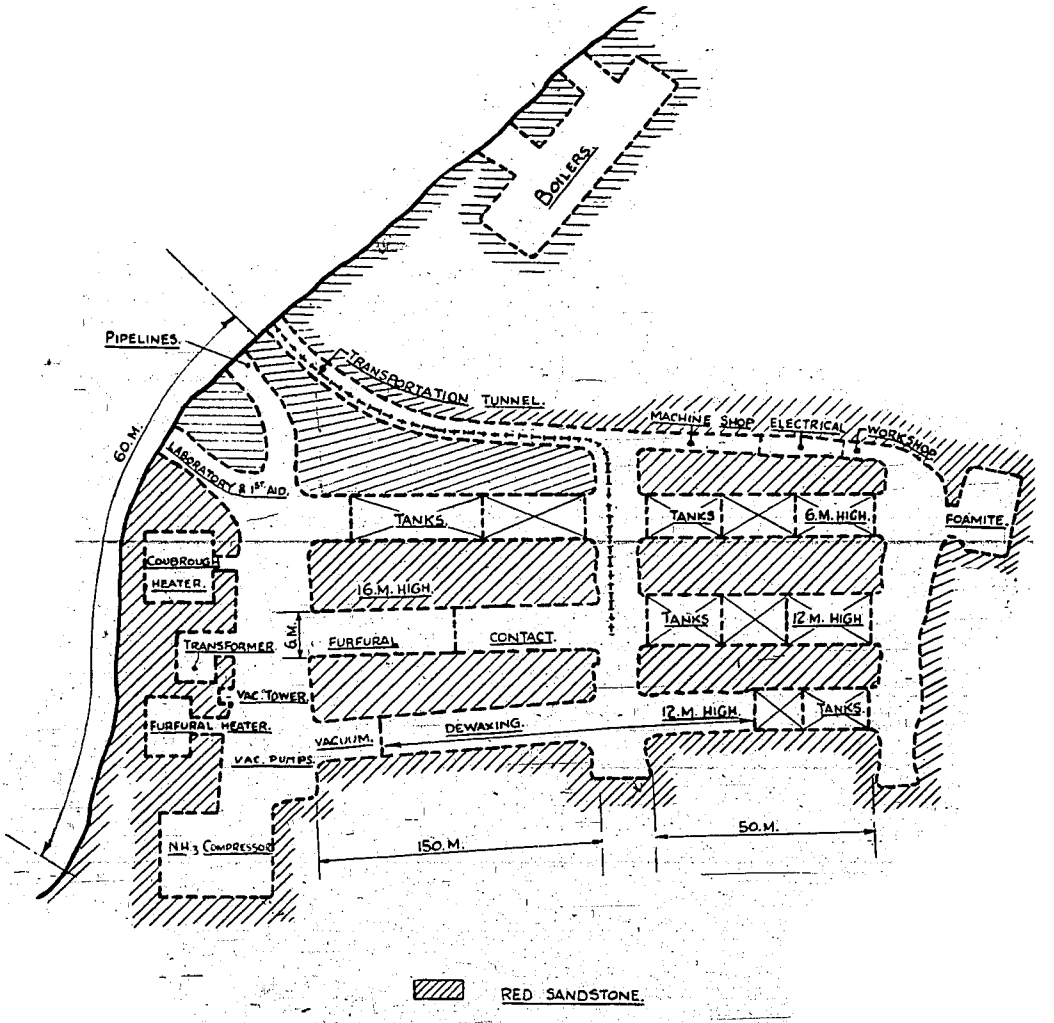
Attached is a sketch plan showing how the lubricating oil plant at Porta is installed in the underground workings. The exact situation of this plant is shown on Army Map P. 3 (Detmold), Scale 1/100,000, Co-ordinates 807052.

The fitting in of the equipment into such a confined space was a really remarkable engineering feat. and as one can see from the drawing, a considerable amount of equipment, valued approximately at £500,000 (erected) has been installed underground. The plant is almost ready for operation, and although it has not been operated could, I think, be operated as soon as the pipelines are completed, that is with about two or three weeks' more work. The capacity of the plant for lubricating oils is 280 tons a day input of topped crude, which is received by tank wagon from various dispersed distillation units. The process is reasonably clear from the drawing, consisting as it does of a Coubrough unit, which takes off gas oil, spindle oil, neutral oil and a light cylinder in the first stage, and in the second stage (using a 1:1 kerosine mixture and a vacuum of 25 mm.) distils off a heavy cylinder, leaving about 20% bottoms. In case of aero-engine oils, a distillate having a 12° Engler viscosity at 70°C. was prepared, leaving a 40/50 penetration asphalt as residue.

The fractions were furfural treated, dewaxed by solution in a mixture of trichlorethane and trichloremethane, and then contact filtered, using clay. No acid treatment was used as during the war colour was considered to be immaterial.

The only interesting technical feature of this underground plant was the dewaxing plant, which was of quite a novel construction. They had decided to give up the conventional Dorr-Oliver filter which they had originally installed at Misburg, chiefly on account of distortion of the filter drums. A new type of filter had been devised by the Edeleanu Gasellschaft, but unfortunately owing to the arrangement under which these plants are built, it was impossible to obtain any drawings. The plant is built entirely under the Geilenberg plan, and the work is all carried out under the Organisation Todt, and until the plant has been completed no drawings are handed over to the operating company. However, all the information should be available with Dr. Grote, at Bingerstrasse 11, Berlin. The plant was designed by Edeleanu, but constructed by R. Wolf of Magdeburg.

The main change in construction from the usual Dorr-Oliver type of filter is that the filtering is done on a type of endless chain, allowing each section to have a more thorough washing than is the case with the Oliver filter. No results were available, but this new construction should be followed up as actively as possible.



Underground Lubricating Oil Plant at

Porta nr. Minden

Westphalia. 6

(III) REFINERY OF THE DEURAG/NERAG AT MISBURG, AND THE FIELDS AT NIENHAGEN CONTROLLED BY THESE COMPANIES AND THE ELWERATH.

Present on the plants were:-

Refinery Manager:	Herr von Eynatten.
i/c Lubricating oil (Nerag):	Freeherr Herreman.
i/c Cracking (Deurag):	Herr Meditsch.
i/c Laboratory:	Dr. Hundsdoerfer.

The organisation of this Company was somewhat difficult to understand as part of it was owned by the Elwerath Company and part Government owned. Deurag was responsible for the distillation and the cracking part of the establishment, whilst Nerag was responsible for the lubricating oil production.

The plants in existence were as follows:

A. Deurag.

(1) An atmospheric topping plant of the continuous tube still variety, with an intake capacity of 700 tons a day. This is quite a conventional unit and is in condition to operate.

(2) A U.O.P. coking plant, working at 18 atmospheres. Its capacity is 330 tons/day, and the feed consists of a misture of:-

(a) Excess topped crude;
(b) Furfural extracts;
(c) Asphalt from the propane deasphaltisers;
(d) Wax from the dewaxing plant.

This plant is also in a suitable condition to operate.

(3) A U.O.P. polymerisation plant, designed for 40 tons/day of liquid propane/butane mixture containing 30% unsaturates. The absorber, designed for operation at 17 atmospheres, and the stabiliser were in working condition, but the polymerisation plant itself is not in a suitable condition to work and has had an unfortunate life history from the beginning.

It was built in 1939 by the U.O.P., but owing to the difficulties of transport when war broke out no catalyst arrived. Finally it was decided to obtain catalyst from the U.O.P. via Japan, and the order was placed and executed. The catalyst got as far as Russia, when the war

between Russia and Germany broke out, so that naturally it never arrived in Germany. A correspondence then began with the Ruhr Chemie regarding the provision of catalyst, and Ruhr Chemie provided a phosphoric acid catalyst which they claimed had proved suitable as a polymerisation catalyst in other plants. Within twenty-four hours of using this catalyst it was caked into a solid block, and considerable difficulty was experienced in digging it out. Ruhr Chemie, however, insisted that this was a suitable catalyst, and further experiments were carried out on the Ruhr Chemie pilot plant, where they claimed to get success. Deurag then built a pilot plant, and again blocked everything up on this in a very short time. However, by perseverence they discovered that one of the reasons for their troubles was air getting in with the fields gas from Nienhagen, and they took steps to exclude air from the gas to the main polymerisation plant, having already had a run of at least 240 hours on the pilot plant. Unfortunately for them, however, at this stage the bombing began to be much more of a nuisance, and every time they were ready to start the polymerisation plant it was bombed. Finally the bombing became so intense and the polymerisation problem the least of their difficulties, that the repairs to the polymerisation plant were always placed at the bottom of the list after each bombing, with the result that what is left of it has still never been operated

(4) A pressure distillate treater. A four-stage, 180 tons/day continuous sulphuric acid treater. The plant is in sound workable condition, but the Doctor sweetening plant has been destroyed and no attempt at repair has been made.

(5) A small rerun unit for treated distillate, capable of distilling 180 tons a day of treated pressure distillate. The light gasoline cut is combined in the rectifying column with Casinghead gasoline from the gas recovery unit. The heavy gasoline has an end point of 210°C. This equipment is all in order.

B. Nerag.

(1) A combined atmospheric topping and vacuum crude distillation unit, intake 600 tons/day. Designed by the Texaco Development Company. The atmospheric unit on Nienhagen crude gives:

15% gasoline of 210°C. end point;
20% kerosine
5% gas oil.

In the vacuum unit, 30% on the crude is distilled over,

consisting of a little gasoil, spindle, neutral and light cylinder oils, leaving a 30% bottoms on crude. This unit is in working order.

(2) Propane deasphaltising plant. It is an I.G. modification of the Kellog system, capacity 180 tons/day, and built by Uhde. It operates with 800% propane by volume, giving 45% cylinder oil on the residue and 55% of asphalt of penetration 15/40, melting point 50/60. The apparatus consists of one settling and one washing stage, and previously was in duplicate in order to remove resins, but only one unit of the equipment is now used. This equipment is in good condition.

(3) Furfural extraction plant. Almost completely destroyed. On this plant they ran to two V.I.'s; a motor oil of 74 V.I. and an aero oil from the cylinder of 90/95 V.I. The work was carried out in two separate units, one on neutrals and the other on cylinder oils.

(4) A Coubrough unit, which was used chiefly for the distillation of crude down to aero oils. In this case instead of distilling off 40% in the atmospheric plant, 32% only was distilled off in the atmospheric unit, the 68% residue going to the Coubrough unit, in the first stage of which gas oil, spindle, neutral and light cylinder were distilled off. In the second stage, with a 1:1 kerosine mixture, and under 25mm. of vacuum, a heavy cylinder distillate was obtained, leaving a 20% bottoms on the crude. This bottoms had a penetration of 40/50 and the heavy distillate was 12° Engler at 70°C. This unit has been completely removed and is now underground at Porta (q.v.)

(5) Contact filter plant, designed by Lummus, used for the decolorisation of aero oils, and the neutralisation of motor oils. It was of the normal pipe still type, using Sweetland presses. All the used earth was recovered, using a recovery plant of a German type, built by Otto Wilhelm Strassund, using triple wash. Four tons of spent clay were washed with 15 cu.M. of gasoline in three washes. The whole plant consisted of three revolving drums of about 8 cu.M. capacity. The vessel revolved at 10 r.p.m. and was stem coiled and jacketed. The gasoline was recovered by continuous distillation, and the gasoline was recovered from the clay by heating in a reverberatory furnace. The gasoline used had a boiling range of 60° to 90°C., and it was claimed that the total loss of gasoline was 1% on the gasoline used. This plant is in a workable condition.

(6) An acid treating plant was installed early in 1945 to replace the Furfural plant which had been destroyed. It

was only capable of the manufacture of motor and industrial oils. It was a continuous plant with three centrifuges, built by Ramisohl and Schmidt in the city of Oelde. The centrifuges had a capacity of 3,000 litres/hour neutral oils and 1,600 litres/hour of cylinder oils. This plant is in almost new condition. The acid sludge from this plant is burned, and generates low pressure steam at 3 atmospheres. This apparatus is also in workable condition.

(7) Dewaxing Plant. This was the original benzol/acetone plant designed by the Texaco Development Company. It originally consisted of three Oliver filters of 30 sq.M. surface each, but was totally destroyed in 1941. On rebuilding, six Oliver filters were put in, but two cast iron filters similar to the Olivers were constructed by R. Wolf of Magdeburg.

The process was run without any repulping, and the yield was 80% of oil, except in the case of aero oils, when the yield was 70%. The oil content of the wax was said to be not more than 5% on the cylinder oils, and about 10 to 12% on the spindle and light machine oils. The dewaxing was carried out to -15°C., except in the case of the hot steam cylinder oil, which is not furfural refined, and the pour point of which was -3°C. This plant is also in a workable condition.

Summary.

Plants available for operation at Misburg are:-

Deurag: Atmospheric topping plant.
U.O.P. coking plant.
Pressure distillate treater.
Small rerun unit for treated distillate.

Nerag: Combined atmospheric topping and vacuum crude distillation unit.
Propane deasphaltising plant.
Contact filter plant.
Acid treating plant.
Dewaxing plant.

Normal Production in tons/month.

Cracked gasoline	210°C. end point	4,200
Straight run gasoline	150°C. " "	3,000
Kerosine	180/285°C.	7,000
Gasoil		3,000

Coke (to Siemens and I.G. for electrodes)	2,800
Aviation gasoline	Nil.

Slack Wax.

From spindle oil:	30/32°C. melting point.	To I.G. for fat manufacture.
From neutral oils:	50°C. melting point.	" "
From cylinder oil:	60°C. melting point.	To Cracking Plant.

In addition to the normal production of lubricating oil given under the separate plants above, 1,500 tons/month of axle grease consisting of 50% spindle and 50% furfural extract were made.

Stocks on hand at Misburg.

Materials for operation:

Acetone	16 tons
(100 tons needed to start dewaxing)	
Benzol	9 "
Furfural	180 "
(sufficient, but no plant)	
Terrana and Nordal earths	300 "
(plus a further 100/200 tons at Porta)	

Petroleum products:

Crude oil	Nil
60% topped crude	3,000 tons
Raw pressure distillate	180 "
Raw cylinders and neutrals	1,200 "
Dubbs mixture	500 "

Crude tanks destroyed, but sufficient tankage available to enable plant to run. One power house has been destroyed, but sufficient power can be made by the remaining

power plant to keep what is left of the refinery in an operable condition.

(IV) NIENHAGEN FIELD.

Present:

Dr. Martin Schunck,	Vice-President of Elwerath, Deurag & Nerag.
Dr. Ing. Oscar Diecher,	Fields Technical Manager, Elwerath.

The field was bombed two days before occupation by the Allies and some tanks destroyed, but in the main the wells are in quite operable condition.

The total capacity is 350 tons/day, and the average depth of the wells 500/1,500 Metres. During the war, a hole was drilled to 3,800 M., but proved to be dry, but nevertheless afforded considerable satisfaction to the management of Elwerath in that it was the deepest well in Germany. The drilling rate throughout the war has been 80,000 M./year, and forty modern rotary drilling rigs are said to be in existence. The wells are all pumping wells, with electric pumps. At the time of the visit, no power was available, but power comes from the Uberlandwerke at Celle, some little distance away. There is a diesel generator on the field of 500 kVA, which can be got to work in two weeks. All pumps and motors are in order, and 6,000/8,000 tons of tankage are available. The gas collecting system and the propane separation plant will require ten to twelve weeks to repair.

The crude contains 2% to 50% of salt water, according to the well, and the salt content of the water is 16%. The separation is carried out on the field by heating to 60°C. and passing through centrifuges, of which there are three. They have from time to time used a demulsifier supplied by I.G., which goes under the name of "Dimulsan". The whole of this equipment, together with the necessary steam plant, is in working condition.

The loading facilities will require about a week for complete repairs, and the railway between Nienhagen and Misburg is probably in working order. There is one locomotive on the field, which operates on a propane/butane mixture, capable of pulling 10/15 trucks of 15 tons capacity each, whilst another steam locomotive exists at the salt works nearby, capable of pulling 15 trucks of the same size.

Neighbouring Oilfields.

Other fields in the neighbourhood are:-

Owner Elwerath:

Mölme, Nr. Hildesheim.	30	tons/day
Hohenassel	100	"
Wessendorf (flowing wells, 40 kilos. N.E. of Celle).	150/200	"

Owner Wintershall, A.G.

Nienhagen	100	"
Eicklingen (Nr. Nienhagen)	100	"
Fuhrberg (W. of Nienhagen)	150	"

Owner Deutsche Vakuum, A.G.

Hanigsen	150	"

We were also told of a gas field owned by the Elwerath near Bentheim (Holland) at a depth of 2,200/2,300 M. It is estimated to have a capacity of 500,000/700,000 cu.M. of gas a day, but is at present worked at 250,000 cu.M. Of this, 200,000 cu.M./day are piped away for rubber manufacture, the remaining 50,000 cu.M. being used for motor fuel.

(V) UNDERGROUND HYDROGENATION PLANT IN THE BUECKEBERG MOUNTAINS.

This underground working was said to be in the village of Kleinen Bremen, south of Minden. It is not difficult to spot the quarry as one enters the village, and as one climbs the road it is possible to see where the workings begin on the left-hand side of the road.

There are considerable workings on this side of the road and there were nine quite extensive galleries. On the other hand, it was difficult to say whether it was intended for a hydrogenation plant, and unfortunately it was impossible to have a guide who knew anything of this working. I personally am inclined to think that this was not intended for hydrogenation, chiefly on the ground that there seemed to be no provision being made either outside or inside for the reaction chambers. It is my understanding that the "Schwalben" usually have their reaction chambers on the outside of the quarry.

On the other side of the road was another considerable underground working, in which there was a very impressive off-loading platform from the main railway which

led into the underground working. Up to the time we were there, the only machinery which had been discharged was two large planing machines, and these were not yet installed.

However, considerable boxes of literature appear to have been thrown hurriedly into some of the chambers on this side of the road, and we removed anything that was marked "Secret" and handed it over to "T" Force, 21st Army Group. These were all of immediate operational interest, and they showed considerable detail of airfields and underground installations in conjunction with them. My own opinion is that the whole of this Bueckeberg area should be visited by a team of two or three fairly agile investigators, as the whole area appears to be honeycombed.

(VI) RUHR CHEMIE INSTALLATION AT HOLTEN.

A visit was paid to the Ruhr Chemie installation at Holten, Nr. Sterkrade. The personnel available were the Acting Manager, Herr Spanier (who was little more than a caretaker); the Manager of the "O.X.O." plant, Dr. Landgraff, who really was responsible for the plant; the Power Engineer, Herr Matz, and a Chemist, Herr Arthur Schreiber.

The plant was very badly hit, and little or nothing of technical value could be obtained by an examination of the rubble. Most of the drawings were available in the basement of the plant, although they were in such confusion that it was very difficult to get anything much in a short space of time.

The Fischer plant was conventional, with Dubbs cracking plant for preparation of olefines, and a certain amount of work was going on on polymerisation and aromatisation. The Fischer plant used the normal catalyst consisting of:-

100	parts	of	Cobalt,
5	"	"	Thorium,
8	"	"	Magnesium,
180/200	"	"	Kieselguhr.

The Kieselguhr came from the Hanover area, and the production for the whole of the Fischer plants in the Ruhr was of the order of 4 tons (in terms of Cobalt) per day. The suggested iron catalyst was to consist of:-

100	parts	of	Iron,
2.5/4	"	"	Copper,
10	"	"	Lime,
15	"	"	Kieselguhr.

The catalyst was made from the nitrates by precipitation with carbon dioxide. This catalyst was not made on a large scale up to the time of our visit, but was looked upon as being a suitable material.

There were obvious signs of considerable building activity at certain parts of the plant where they were evidently constructing cracking plants, combined probably with polymerisation, but these plants had not been completed.

A considerable amount of laboratory work was being carried out on the dehydrogenation of the paraffins for the manufacture of "O.X.O." and lubricating oils. For some time they had worked on dehydrogenation of propane and butane, using a conventional aluminium chromium catalyst, and it was alleged that the addition of 0.2% of cobalt reduced carbon formation. The dehydrogenation was being carried out at 590°C. and approximately atmospheric pressure. Their conversion was 24% per pass, and using 250 cc. of catalyst they dehydrogenated 20 litres of butane per hour. The conversion was reduced after three months to 18% per pass. None of this work was of a very high calibre.

Then they went on to the dehydrogenation of C_{16} to C_{18} cuts for use in the "O.X.O." plant. The catalyst in this case was thoria and chromia. The method alleged to have been adopted was as follows:-

Silicon carbide was treated with nitric acid to remove impurities, dried and heated to 650°C. A solution of thorium nitrate and chromium nitrate was then made up as follows. 21 grams of thoria as nitrate and 7 grams of chromia as nitrate were dissolved in water to make up a 3% solution. 200 cc. of cleaned silicon carbide, equivalent to 280 grams, were then placed in a rotating pot at 250°C., the pot being inclined at an angle of 45° to the vertical. The 3% solution mentioned above was then sprayed into the pot, and the whole took four to five hours to be sprayed. The salts were claimed to be deposited in this way on the carborundum, and the granules were heated slowly to 520°C., and lastly to 850°C., in a muffle furnace for two hours, when the catalyst was ready.

The catalyst was then transferred to a tube and at 560°C. hydrogen was passed over it at a rate of 200 litres/hour for five minutes. Then this was followed by nitrogen and the whole tube evacuated to 20 mm. of mercury. The C_{16} to C_{18} was then introduced at the rate of 150 cc. of liquid per hour. The catalyst life was said to be three months, and the yield was 15% to olefines C_{16} to C_{18}, 6% to olefines lower than C_{16}, 2%/3% gas, and 0.5% carbon, the

remainder being unchanged.

In order to improve this, barium oxide was added to the carborundum before the addition of the thoria and chromia; 12 grams of barium oxide were added to the catalyst containing 21 grams of thoria and 7 grams of chromia, but results were inconclusive.

The "O.X.O." Process.

The information on this process was given by Dr. Landgraff, and the patents in connection with the process were all taken out in the name of the Ruhr Chemie.

The work originally commenced in connection with a study to convert ethylene into aldehyde, and the raw material used was an ethylene cut containing even as low as 20% ethylene. It was stated that a dilute mixture was even better than a concentrated mixture of ethylene, because the reaction is a fairly active one.

The work started in the gas phase at a pressure of 160 atmospheres, using the usual Fischer-Tropsch cobalt catalyst.

Note A: The general type of reaction to cover this synthesis, as also those using the higher olefines mentioned later, would seem to be:-

C_2H_4 (Ethylene) $+ CO + H_2 \longrightarrow CH_3.CH_2.CHO$ (Propyl aldehyde)

Work went on then using α-butylene and butadiene, and claims were made that adipic acid could be made using this process, but no evidence was forthcoming.

Note B: Possible reactions would be:-

$CH_3-CH_2-CH=CH_2$ (α-butylene) $+ 2CO + H_2$

$CH_2=CH-CH=CH_2$ (Butadiene) $+ 2CO + 2H_2$

$\longrightarrow CHO(CH_2)_4CHO$ (Hexanedial) $\xrightarrow{O_2} COOH(CH_2)_4COOH$ (Adipic acid)

Instead of hexanedial, cyclohexane might be formed by ring closure, splitting off water and picking up two hydrogen atoms. This gives adipic acid readily on oxidation.

The bulk of the work was carried out on two cuts

of olefines ranging from C_{11} to C_{17}, which cuts for experimental purposes were sent to Holten from the Ruhr Chemie. These were further separated into four cuts as follows:- C_{11}/C_{12}, C_{13}/C_{14}, C_{15}/C_{16}, and C_{17}. These cuts, which contained about 40% olefines, the balance being paraffins, were treated separately, and it will be apparent from the process (see Note A) that a carbon atom was added to each cut so that the end products were aldehydes and alcohols from C_{12} to C_{18}. The catalyst used was, as stated, the ordinary Fischer-Tropsch catalyst, but magnesium was excluded if at all possible. The olefines were passed together with sulphur-free water gas, containing 39 parts of carbon monoxide to 45 parts of hydrogen, over the catalyst, the temperature in the first stage being 135°C. and the pressure 150 atmospheres, the temperature being controlled by means of steam pressure. The process was intermittent, each cycle taking 20 minutes.

After the material had been in contact with the catalyst it was filtered through "filter stone" and then distilled so as to remove any by-products. The aldehydes produced were distilled under vacuum at about 180°C., using a vacuum of 2 to 5 mm. of mercury absolute. The bottoms were secondary alcohols, esters, etc., and the distillation was carried out in a batch system and not continuous.

The aldehydes were then passed together with pure hydrogen over a nickel catalyst to convert them into alcohols. The temperature was 180°C. and the pressure was the same as for the first reaction.

Up to the time of our visit, it was intended to supply the finished alcohols to Henkel for soap manufacture, but we were also shown a schematic arrangement whereby they intended making sulphonic soaps. The detail of this was not gone into thoroughly at Holten, because it was already clear that details had been obtained by the Ludwigshafen party.

The curious point was that in spite of heavy bombing and the apparent failure to get the Fischer-Tropsch plant working, the whole of the plant for this "O.X.O." process had been built without any priority, and was almost in a condition to commence operation when we arrived.

Construction had commenced in 1939/40 and carried on as and when possible. This factor may have affected the economics of the process as plant costs were given as RM.11,000,000. Taking amortisation at 10%, a return of 90 pf./kilo was obtained on the alcohols. The olefines were charged at 45 pf./kilo, this being based on the olefine content (40%), the paraffins being returned. The figures were based on "O.X.O." costs, so that "O.X.O." showed a

profit.

Henkel and I.G. were shareholders, and were to carry out the sulphation of the alcohols.

(VII) BOTTROP.

This plant was not examined thoroughly, as it had already been investigated by the Hydrogenation Party. It was a centre for the manufacture of aviation gasoline, and the octane number of the hydropetrol from the gas phase 700 atmosphere plant was 78.5 (I.G. Motor Method).

With .09% of T.E.L. the octane number was 89
" .115% " " " " " " 91.

It was claimed by the people at Bottrop that the gasoline there was regarded as the standard for aviation gasoline for the Reich, and it was here that we were told that the main testing stations for aviation gasoline were at Spandau and Derben, Derben being the main testing station as far as Bottrop was concerned.

From records it would appear that the production of aviation gasoline at Bottrop rose to 34,000 tons in 1943, since when they had struggled steadily to keep up that production, but gave up finally in January of this year.

It was claimed that all the cresol inhibitor for the Reich was made at Bottrop.

This plant is interesting from the point of view of its having a Pett Broch system, which, however, had not worked satisfactorily on coal, and also a 700 atmosphere gas phase hydrogenation plant, both of which are being reported in detail separately.

(VIII) SCHOLWEN.

This plant was very badly damaged and was the worst seen by the writer. It was a plain straightforward hydrogenation plant manufacturing about 200,000 tons of aviation gasoline. The Manager, Dr. Jost, was the least co-operative man we found in Germany, and a recommendation was made for his imprisonment and further interrogation.

In addition to the straightforward hydrogenation plant there were also plants for the dehydrogenation of the naphthenes in the total gasoline (a report on which has been made from Ludwigshafen) and a plant for the manufacture of iso-octane, a report on which was given in connection

with the Wesseling visit. With regard to the latter, however, it should be pointed out that whereas the plant at Wesseling had not operated, the plant at Scholwen had operated, and apparently quite successfully.

The alkylation part of the equipment was a straightforward sulphuric acid alkylation plant, but the mixing and general equipment was almost of an amateurish kind. The equipment was very heavy, cumbrous, and showed signs of having been designed by a chemist rather than by a chemical engineer.

It was interesting to note that although they had in the early days polymerised their butylenes, they had in recent years gone over to alkylation of iso-butane with butylenes.

(IX) GELSENKIRCHEN.

The building of this plant commenced in 1937, and operation commenced in 1939 and ended on 13th June, 1944. The total cost of the plant was RM.300,000,000.

A considerable number of the staff were available, although the Director, Dr. Pross, was absent in the nearby town of Gelsenkirchen, which at the time of our visit was still in enemy hands.

The process was again straightforward hydrogenation for the manufacture of aviation gasoline, octane number 72, which with 1.2 cc./litre of T.E.L. gave an octane number of 89.

The annual production was 345,000 tons. The iso-butane produced was sent to Scholwen for the manufacture of alkylates, and the n-butane was sold as motor gas.

At Gelsenkirchen we heard about the new catalyst 7846, but we understood at the time that this catalyst was already known to the Ludwigshafen Party.

Further particulats of this plant are available, but as it was thoroughly investigated by the Hydrogenation Party it is not intended to repeat them in this report.

(X) THE TOPPED CRUDE POSITION IN GERMANY.

In discussing the refining situation in Germany, it was apparent throughout that the question of the disposal of topped crude had taken up a considerable amount of thought. Quite a voluminous correspondence existed in the files of Dr. Brockhaus on this question, which was becoming so acute that considerable quantities were being dumped in suitable quarry pits, and instructions had gone out to

certain key power stations to turn over from coal burning to fuel burning.

The reason for this, of course, is apparent in that the production from the dispersed refineries, or "Ofens", was unbalanced. The intake capacity for crude oil was 3,000 tons/month approximately, and the yield as follows:-

15% gasoline,
35% diesel oil,
50% residue.

As very few of these had any cracking facilities attached to them, and in fact as there were no completed cracking plants as far as one could ascertain either underground or dispersed, the disposal of this 50% residue was becoming a very serious problem to the German petroleum industry.

APPENDIX I.

"OFENS"

No.	Location	Company Responsible
1/2	Boegerhof	Nerag
3/4	Bunkensen	"
5/6	Messinghausen	Dea
7/8	Muehlenbein	Nerag
9/10	Muehlental	Wintershall
11/12	Tuernitz/Treisental	Dea
13/14	Weitnegg/Donau	Donauoel
15/16	Spitz/Donau	Dea
17/18	Petzenkirchen/Erlauf	"
19/20	Alte Post b. Pirna	Gasolin
21/22	" " " "	SS u. Gasolin
23/30	Ebensee a. Traunsee Oberdonau	Dea
31/32	Statzendorf (noerdl. St. Poelten)	SS u. Vakuum
33/34	Hauskirchen (" Zistersdorf)	SS
35/36		Fanto, Ver.ung. Mineraloelwerke A.G. Ungar. Oelwerke A.G. Szong.
37/38	Eschenbach (oestl. Gemuend)	
39/40	Grosscheinbart (suedwestl. Zistersdorf)	

"ROSTS"

No.	Location	Company Responsible
I	Mech. Weherei Hannov. Linden	Nerag.
II	Zuckerfabrik Salzwedel	Dea
III	Teutonia, Misburger Portl.-Zementwerke, Anderten	Nerag.
IV	Harpener Bergbau, Zeche Rob Müser b. Dortmund.	
V	Ruhrchemie, Holten.	
VI	Kattowitz	

APPENDIX II.

CODE NAMES

SCHWALBE	-	Hydrogenation plant.
KUKUCK	-	Iso-octane and polymerisation plant.
DACH	-	Lubricating oil plant.
TAUBE	-	Cracking plant.
OFEN	-	Dispersed distillation plant.
ROST	-	Batch distillation plant.
JACOB	-	Primitive cracking plant in conjunction with an "OFEN".

A4775 Wt.19195 175 7/45 Gp.959 Fosh & Cross Ltd., London