8)	Firm of Eisfeld, Othfresen	42 190 kg
9)	Pulverfabrik Hamm, Au/Sieg	103 550 kg
10)	Pulverfabrik Adolzfurt, Bretzfeld	45 260 kg
11)	Hüttenwerke, Oker/Harz	19 470 kg
12)	I.G.Farbenind. Premnitz/Westhavelland	111 390 kg
13)	Süd-Chemie AG., Heufeld/Obb.	19 310 kg
14)	Spiesz & Sohn Leiningen	17 670 kg
15)	Kali-Chemie A.G., Hönningen/Rhein	19 400 kg
16)	Papierfabrik, Lautenthal	19 340 kg
17)	Pulverfabrik Adolzfurth, Crailsheim	20 200 kg
18)	Thür. Zellwolle, Schwarza/Saale	122 840 kg
		1 376 280 kg

Crude Gasoline		
1)	ASW Böhlen	4 973 kg
2)	Hauptverwaltung Dresden	405 kg
3)	ASW Hirschfelde	3 888 kg
4)	ASW Espenhain	7 477 kg
		16 743 kg
Diesel Oil		
	ASW Hirschfelde	1 780 kg

TABLE IV

Documents Relating to A.G.S.Werke-Espenhain

A -- From Parcel 4182

1. Leitende Angestellte des BKW Espenhain (43 names)
2.* Annual production charts:
   a. Nebenbetriebe
   b. Teerverarbeitung
   c. Schwelerei
   d. Braukohlenbriketterzeugung
3.* Produktions-Schema in Jahresleistungen
4. Teerverarbeitungs-Arbeitsweise der Anlage
5. Plant plot plan for March 1944
6. Brikettfabrik I. Kohlenflusschema
7. Lurgi-Spülgasschwelofen
8. Schema der Teeröl-Extraktion (Edeleanu, 20-10406)
9. List of stocks on hand, April 1945
10* Tracing Flow sheet of Tar distillation and separation
11. Schema zur Rohsäurefabrik, C 3164
12. Parallel-Schattung (Phenol-Plant)
13. Anlage der H_2S Gewinnung
14. Clausanlage
15. Anschriften (Brockenschwefel)
16. Versand-Bericht für Monat März, 1945) These have addresses
17* Versand-Bericht für Monat 1945) of sulphur users who convert cellulose
18* Summary of plant cost
19. ASW Rufnummern der Hc-Dienststellen
20. Espenhain ASW Fernsprechteilnehmer-Verzeichnis
21. Personal history of E. Thamerus
22. Personal history of A. Schlecht

B -- From Edeleanu GmbH

1. Schema der Paraffin-Gewinnung 20-10417
2. Schema einer Entparraffinierungs-Anlage 10-10595
3. Lageplan der Teerzerlegung Espenhain 10-10345
4. Schema der Terröl-Extraction, 20-10405
5. Positionsliste der Apparate und Maschinen für die Extractions-Anlage Espenhain.
6. Die Zerlegung von Schwelteeren usw. (Reprint)
7. Schema der Paraffin-Trennung 20-10406i
8. Positionsliste...zum Fliess-Schema 20-10406i
9. Schema der Teeröl-Extraktion 20-10406i
10 Positionsliste...zum Fliess-Schema 20-10406i

TABLE III

A. G. S. WERKE-ESPENHAIN

SHIPPING REPORT FOR JANUARY 1945

Coke to Brabag-Zeitz:	14 909 000 kg
" " Brabag-Magdeburg:	1 145 000 kg
	16 054 000 kg
Tar to Steinwerk Wittig:	12 227 000 kg
" " Pölitz/Pommern:	1 252 900 kg
Schaffhausen/Schweiz:	490 210 kg
	13 970 110 kg
Light Oil to Böhlen:	2 389 870 kg
Solvent Naphtha to Böhlen-Brabag	186 500 kg
" " " Hirschfelde	42 680 kg
	229 180 kg
Moloh Oil to Hamburg	36 660 kg
Heavy Naphtha to the Alte Lager: SDK II	5 720 kg
Brown Coal Coke (Industrial Coke)	
By Order of the Hako	
Consignee	
1) Kraftwerk Süd - Connewitz:	10 813 000 kg
2) Kurmärkische Zellwolle - Wittenberge:	5 349 000 kg
3) Wilhelm Vogel - Lunzenau:	1 865 000 kg
4) Henkel GmbH - Genthin:	1 084 000 kg
5) Junkers Flugzeugwerke - Köthen:	962 000 kg
6) Kursachsen AG., Karsdorf:	961 000 kg
7) Wiede & Söhne - Trebsen:	736 000 kg
8) Kammgarnspinnerei - Wiesenburg:	238 000 kg
9) Kartonfabrik - Eichicht:	44 000 kg
	22 052 000 kg
Crude to various firms by orders of the Hako	688 000 kg
Heating Oil: (Consignee)	
1) M.A.U.R.E.B.M. Swinemünde	3 642 730 kg
2) Kriegsmarinearsenal Kiel Brandsbek/Holstein	1 883 850 kg
3) KMA. Gotenhafen Danzig-Weichselbahnhof	660 660 kg
	6 187 240 kg
Special Diesel Fuel II	
1) Kriegsmarinearsenal Kiel Brandsbek/Holstein	606 800 kg
2) M.A.U.R.E.B.M. Swinemünde	182 080 kg
3) Fritz Wagner Magdeburg	114 080 kg
4) Testing Station Rechlin/Müritz	38 230 kg
	941 190 kg

Diesel Oil	
1) M.A.U.R.E.B.M. Swinemünde	762 710 kg
2) Marine - Austrüstungsstelle Wesermunde	620 070 kg
3) Altes Lager Espenhain	11 200 kg
4) ASW Bohlen	4 150 kg
	1 398 130 kg
Solvent Naphtha to Hirschfelde:	50 800 kg
Solvent Naphtha for Reichsbahn Engelsdorf	89 290 kg
	140 090 kg
Hard Wax:	
Nordd. Mineralowerke Politz	425 670 kg
Soft Wax:	
Nordd. Ölmuhlenwerke, Hamburg-Eidelstedt:	153 120 kg
Electrode Coke:	
1) V.A.W. - Schwarzkollm:	338 930 kg
2) Voigt & Co., Dresden	68 740 kg
	407 670 kg
Brown Coal-Tar Residue	
1) By order of the Firm Fritz Stenzel K.G. Haale/Saale	243 110 kg
2) By order of the Firm W. Priem & Co. Magdeburg	86 510 kg
	329 620 kg
Schwelertassen	
By order of the Firm Fritz Stenzel K. G. Haale/Saale	1 747 000 kg
Raw Phenolic Acids	
1) Dr. F. Raschig Werke-Espenhain	1 243 040 kg
2) Ammoniakwerk Merseburg Leunawerke Krs. Merseburg	148 490 kg
3) The Firm of August Nowack Bautzen	100 740 kg
	1 492 270 kg
Sodium Phenolate	
The Firm of Dr. F. Raschig Ludwigshafen/Rhein	57 040 kg
Common Lye	
ASW - Bohlen	1 104 560 kg
Crushed Sulfur	
1) I. G. Farbenind. Frankfurt/M	47 460 kg
2) Kurm. Zellwolle Wittenberge	416 940 kg
3) Dr. C. Costard, Leipzig	21 590 kg
4) The Firm of Heydenreich, Leipzig	17 100 kg
5) Wolff & Co., Cordingen	35 960 kg
6) Kausch & Co., Lüneburg	18 980 kg

(Table I continued)

Item	Estimated cost in Reichsmarks
10. Water facilities	10,600,800
11. Espenhain power plant	36,221,100
12. Mölbis power plant	48,955,700
13. Telephone facilities	17,968,100
14. Power transmission facilities	2,915,100
15. Land	26,563,500
	430,355,900

*Item 8 is broken down into the following subclasses:

Building supervision	7,983,800
Workshops and storage	6,806,700
Living quarters	6,523,000
Administration	3,286,900
Removing overburden	1,619,200
Fire & air-raid protection	2,807,700
Streets & sidewalks	7,315,400
Railroad tracks	2,473,500
Locomotives	295,500
Misc. (laboratories, lighting, etc.)	5,501,600
	44,613,300

B. Plant Production

The production of the plant from initial operations in 1941 through 1944 is summarized in Table II.

TABLE II

Product	Metric Tons			
	1941	1942	1943	1944
1. Brown coal briquets	499,964	1,541,791	2,706,066	2,696,000
2. Tar from Schwelerei	64,556	179,564	302,695	297,000
3. Coke from Schwelerei	234,631	767,866	1,362,478	1,400,000
4. Fuel oil	--	12,877	63,141	42,778
5. Diesel oil	--	--	1,534	14,699
6. Hard Wax	--	--	2,099	6,541
7. Soft wax	--	--	1,315	4,676
8. Electrode coke	--	--	3,996	7,080
9. 25% Crude phenols	--	4,160	26,339	32,000
10. Sulfur	--	--	10,925	22,000
11. Carbolic acid	--	--	1,119	9,600

C. Shipment Schedule for January, 1945

A schedule showing the shipment of these products to consumers throughout Germany for the month of January, 1945, is presented in Table III, (pages 6 to 8).

BOMB DAMAGE

Bomb damage was relatively light and the management estimated that partial operation could be established in three weeks and that the plant could be completely restored at a cost of 4-10,000,000 marks. A complete file of bomb damage had been kept by the management. The file was left with the management with instructions to hold it for other investigations.

PERSONNEL INTERROGATED

The following men were interviewed:

Dr. Erich Thamerus, Acting Plant Director
Dr. Hans-Leo Haken, Tar Plant Superintendent
Mr. Wolfgang Hummel, Plant Engineer
Dr. Carl Mueller) Engineers in De-waxing Plant, re-
Dr. Widdecke) presenting Edeleanu, G.m.b.H.

Prior to the end of the war, the director of the plant was a Friedrich Schwarz, who had been put in charge late in 1943 primarily because of his loyalty to, and activities in, the Nazi Party. He, however, had disappeared just before the occupation of the area by the American troops, and management of the plant had been assumed by Dr. Thamerus, who had been one of the three department heads who had actual technical qualifications.

DOCUMENTS

Documents available for further and more detailed study are listed in Table IV (Page 9). Those marked with an asterisk (*) are in the present report.

G. S. Bays, Jr.
J. P. Jones
B. L. MacKusick

the removal of H_2S, which was converted to 24,000 tons per year of sulfur by the Claus process. The phenolic water and a phenol-containing fraction of the light oil were processed for the recovery of 7,000 tons of crude phenols which were sent to the adjacent Raschig chemical plant for use in making synthetic resins. The light oil, amounting to 150,000 tons, was sent to the Brabag hydrogenation plants at Böhlen and Zeitz. The remaining 205,000 tons of tar was processed in the tar distillation, benzol SO_2 extraction, and ethylene dichloride dewaxing plants for the production of 64,000 tons of diesel oil, 71,000 tons of fuel oil, 13,000 tons of hard paraffin, 13,000 tons of soft paraffin, and 12,000 tons of electrode coke. The hard and soft waxes were sold for the production of fatty acids, soaps and lubricating oils.

The separation of the tar, which comprised primarily paraffin hydrocarbons, into diesel oil, fuel oil and waxes, was accomplished by a combination of solvent dewaxing and solvent extraction recently developed by the Edeleanu Company and employed only at Espenhain. The raw tar was separated into high quality diesel oil and fuel oil by a combination of SO_2 and benzol extraction. The extraction process produced an intermediate raffinate which was dewaxed in two stages with ethylene dichloride as a solvent. The dewaxed intermediate raffinate was recycled to the extraction system. In Figures IIA and IIB are shown, diagramatically, the material flows in this separation and treatment of the brown-coal tar. Also indicated are various inspection data given by the plant officials as being "average." In actual practice, some mild cracking took place in the step labeled "Distillation with Inert Gas." This was deliberate and was done to transform a substantial amount of the softer wax (isoparaffins) to hard wax (normal paraffins) by removal of the side chain. This second (cracking) distillation was said to be a quite important feature of the plant.

CONTINUOUS "BAND FILTER"

Interesting features of the plant were the large horizontal centrifuges used for eliminating wax from the extract solution from the waxy oil, the use of two stage dewaxing which the Edeleanu people claimed made possible the production of a hard paraffin fraction of extremely low oil content (not more than 1-2%) and the unique design of the "band filters" used for the higher temperature, or hard paraffin, dewaxing stage. The band filter, designed by Edeleanu, and manufactured by the R. Wolf Company of Magdeburg, is of particular interest because of its construction which permits an especially efficient washing of the wax cake. The filter was totally enclosed. A photograph

of the filters is given in Figure III. The filter elements consisted of 40 rectangular pans, each about 1½' x 6', arranged adjacently to form a continuous belt 6' wide. The bottom of each pan was covered with a filter cloth, on top of which was a filter paper. As the pans moved horizontally the solvent oil wax slurry was poured in, the liquid filtered off by suction, and successive portions of wash-liquid added and passed through the filter cake. The pans containing the washed wax cake moved around the sprocket to an inverted position for removal of the cake by blowing with air. Since the sides of the pans were several inches high, washing could be accomplished by alternate complete flooding and draining of the cake in the horizontal position. It was claimed that a wax having an oil content of about 0.3% could be produced and operation of these filters was considered so successful that even larger units with pans about 12 feet long, had been installed in the underground lubricating oil refinery, Dachs I, at Porta near Minden. A drawing of these filters was obtained from Professor Terres, Director of the Edeleanu Company, at Altenburg Castle, Altenburg, Germany, (originally listed as 30/10.03, in Berlin). These drawings will be discussed in the report on the Edeleanu Company and will be available in the captured microfilmed documents.

PLANT STATISTICS

A. Plant Cost

The cost of the plant, as estimated just prior to construction, is summarized in Table I. This table was prepared from a volunious financial statement found at the plant. Actual costs differed somewhat as a result of exigencies of war.

TABLE I

	Item	Estimated cost in Reichsmarks
1.	New Espenhain Strip Mine	78,918,300
2.	Low Temp. Carbonization Plant #1	30,728,100
3.	" " " " #2	43,684,100
4.	Tar Finishing Plant	30,030,100
5.	Sulfur Recovery Plant	6,012,700
6.	Phenol Recovery Plant	6,062,100
7.	Enlargement of Briquet Plant	632,900
8.	Shops, offices, raid shelters, etc.	*44,613,300
9.	Design Cost and Interest	46,450,000

cont'd

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Personnel of Team

G. S. Bays -	U. S. Petroleum Administration for War 9 and 12 May 1945
J. P. Jones -	U. S. Petroleum Administration for War 9 and 12 May 1945
B. L. MacKusick -	U. S. Petroleum Administration for War 9 and 12 May 1945
W. A. Horne -	U. S. Petroleum Administration for War 12 May 1945.
L. King -	British Ministry of Fuel and Power 9 May 1945

A. G. SACHSISCHE WERKE-ESPENHAIN,

Espenhain, Kreis Borna, Germany

INTRODUCTION

The Espenhain Werke is a large brown-coal power plant equipped to recover 5-6,000 barrels per day of liquid hydrocarbons from coking the brown coal prior to burning. Total electric capacity was 220,000 KW of which 40,000 KW were used in the plant and the remainder fed to the power net. The liquid products consisted of some 3,000 barrels per day of tar and light oil for hydrogenation elsewhere, approximately 1,100 barrels per day of finished (45 to 50 cetane number) diesel oil, and about 1,200 barrels per day of fuel oil. The location is on the Leipzig-Borna highway, and just south of the village of Espenhain.

The plant was built during the period 1936-40 as a war project of the German Reich at a cost of 430,000,000 Reich marks, including the strip mine from which the coal is obtained. It was to produce power for aluminum manufacture at a plant about 50 miles east of Munich and to provide liquid fuels. The plant is completely modern in every respect, by German standards, and includes a unique application of the Edeleanu extraction and dewaxing process for the production of a diesel fuel and a hard wax of low oil content, of high quality, from brown coal tar.

DESCRIPTION OF PLANT

A schematic flow diagram and material balance is shown for the plant in Figure I. About 6,000,000 metric tons per year of raw brown coal was dried and pressed, producing about 3,000,000 tons of briquets. The briquetting plant, with 37 plunger type presses, was stated to be the largest in Germany. The briquets were charged to a typical Lurgi "Schwelerei" (low-temperature carbonization plant) from which 1,500,000 tons of coke was produced yearly. Of this amount, 900,000 tons were burned at the power house and 600,0(tons were distributed to various hydrogenation plants for hydrogen production. The other products from the Schwelerei were 400,000 cubic meters per year of phenolic water, 360,000 tons of tar and light oil, and 1,000,000,000 cubic meters of hydrogen sulfide-containing gas. This gas was treated for

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A. G. SACHSISCHE WERKE-ESPENHAIN
ESPENHAIN, KREIS BORNA, GERMANY

Reported by:

G. S. BAYS, JR.
J. P. JONES
B. L. MACKUSICK

On behalf of the

U.S. Technical Intelligence Industrial Committee

CIOS Target No. 30/241
Fuels and Lubricants

30 July 1945

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

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A. G. SACHSISCHE WERKE-ESPENHAIN

Bays, K. S., Jones, Mackusick

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COMBINED INTELLIGENCE OBJECTIVES SUB-COMMITTEE

Naphthas and Light Oils were refined in a discontinuous plant with bubble cap columns for the production of benzol toluol and solvents.

PRODUCTS.

The main products of wartime working were:-

Marine Oil - a mixture of 70% anthracene oil and 30% of drained naphthalene oil, of which 10-12,000 tons a month from all works was supplied to the Navy as a fuel. Sometimes this was mixed with a heavy oil fraction from the Bottrop hydrogenation plant and sometimes with pitch, but there seems to have been no standard pitch-creosote mixture.

Flame Thrower Oil. This was a mixture of pitch and anthracene oil with heavy naphtha and benzole, with apparently no fixed specification. Roughly, the proportions were 50 - 35 and 15, in the order given.

Diesel Oil. This seems to have been a drained naphthalene oil produced in small and irregular quantities up to 2,000 tons a month.

Benzole Wash Oil. To the usual quality distilling over 200°C. and 90% at 300. This was a regular production for the Ruhr coke ovens.

Road Tar. This production had diminished very considerably in wartime and nearly all the tar distilled had been to pitch and oils.

Pitch. Half of the production went for briquettes and the other half to Bottrop-Welheim for hydrogenation. A separate inspection was made of this plant by another party.

Anthracene. Production was about 400 tons a month, used for carbon black manufacture.

Naphthalene. About 5-6,000 tons of hot pressed naphthalene a month went to I.G. Leverkusen. About 1,200 tons a month of refined naphthalene went to the Deutsche-Hydrierwerke at Rotleben bei Dessau for the manufacture of tetralin.

Phenol. About 300 tons a month, chiefly used for plastic manufacture.

Cresols. Production 5-600 tons a month, chiefly for disinfectants.

Special Products. It was known that a large number of pure compounds have been separated from tar oils by this concern, and have been offered for sale for many years. Dr. Kraft was questioned

in regard to these developments, and it was found that production was on a much smaller scale than had been expected. The one exception mentioned was acenaphthene, 7-8 tons a month of which was produced during winter months.

The bulk of the pure compounds were separated on a semi-technical scale in a laboratory which contained a number of stills and oil distillation equipment of some 10-20 gallons capacity; one still of about 100 gallons capacity was available. We were informed that there was no continuous production of pure compounds, but that batches (200g. to 200kg.) were produced from time to time as required. The smaller quantities were prepared in their ordinary laboratories. Samples of the substances separated were found and included such substances as 1.6.-, 2.3.-, 2.6- and 2.7-dimethylnaphthalenes, 2.4 and 2.6 lutidenes, 2.4.6.- collidene, etc.

The laboratory and pilot plant building were in complete disorder and there was no record to be found.

GESELLSCHAFT FUR TEERVERWERTUNG m.b.H.
DUISBERG - MEIDERICH.

INTRODUCTION

The Company distills at the following works about three quarters of the tar produced at the Ruhr Coke Ovens:-

Meiderich	350,000	tons per annum
Castrop-Rauxel	400,000	" " "
Bochum-Gerte	50,000	" " "
Allsdorf-Aachen	35,000	" " "

The Head Office is at Meiderich and this works refine the primary products from Rauxel as well as its own production:-

Dr. Moehrle	General Manager
Dr. Kraft	Tar and Oils
Dr. Wille	Phenol and Benzole
Dr. Kruber	Research

Only Dr. Kraft was in Duisberg and interrogated.

PLANT

The Plant is well laid out and equipped with good handling facilities for tar and products. The only technically new feature was a continuous vacuum distillation plant, erected about 1941, with a capacity of 35,000 tons a year.

Tar Stills of two sizes about 18t. and 50t. working capacity, fire heated and under vacuum without columns. The larger stills are preferred to the small stills. The oils from the tar stills are redistilled under vacuum, in oil stills of the same sizes with Raschig ring columns.

Continuous Tar Stills. A plant for distilling dehydrated coke oven tar was found on sites 126/T1 and 128/Tp4 near the works boundary. Unlike the rest of the plant it was not seriously damaged. Official photographs were taken. Two bundles of documents and drawings were handed to C.I.O.S. The description below is based on an examination of the plant itself, on the drawings and documents mentioned above, and on information obtained from Dr. Kraft, Assistant Director of Teerverwertung G m.b.H.

Dehydrated and topped tar passes from one of two lagged storage tanks to a steam driven reciprocating pump, which delivers it to a gas fired pipe still. A drawing indicates stand by electrically driven centrifugals; the pump house was under water and could not be examined. The stock leaves the pipe still at 360°C. and enters the base of the first column through an expansion valve, the downstream pressure being about 60 mms. of mercury. Four columns are installed in series. The largest is

2.5 metres diameter and about 10 metres height, packed with Raschig rings to an undetermined depth. Liquid bottomsare drawn off at the base of each to coolers and receivers; gaseous products pass off overhead and are piped to the base of the next column. The liquid outflows from the successive columns are pitch, anthracene oil, wash oil, naphthalene oil, lighter fractions (including carbolic oil) passing overhead from the last unit. The last two columns are provided with steam heated reboilers. From the last column the overheads pass to a condenser. The uncondensed gases are then washed with oil whilst still under vacuum, and pass to the vacuum pumps.

The reflux control of each column was by dephlegmator direct to the head of the column and appears to have given trouble. The control of one column by its dephlegmaton unbalanced the feed to the following column and adjustment to give constant products from the column is said to have been difficult.

Dr. Kraft said that the daily throughput representing about one tenth of the total works capacity, is about 100-120 tons daily. Heat and labour economy and increased oil yield (a few per cent. of the tar) characterise the plant. Operation was very sensitive to small changes in the quality of the tar. The quality of the resulting pitch could be regulated.

The plant was spaciously laid out and the drawings indicate a large measure of automatic recording. It was stated that operation required only two men. The plant was originally put to work in July, 1941, but a fire caused by electrical short circuiting interrupted operation until the autumn of 1942 when working was resumed until the final shut-down in November, 1944.

The plant was to a design by V.f.T. and reports and investigations on a continuous process were found going up to 1939, but later files had been removed. There is said to be some arrangement between V.f.T. and Koppers regarding continuous plant and the pooling of ideas, but Koppers, according to a report by Mr. Neumann, were not impressed by the V.f.T. design.

Naphthalene plant was of normal type, crystallising pans, draining table and presses giving 79°C.m.p. Alternatively, the unpressed salts were washed and distilled to refined naphthalene.

Anthracene plant consisted of vertical water jacketted cylinders with internal scrapers producing 28-30% anthracene. Some was re-crystallised at Rauxel to give 40% anthracene.

Tar Acid plant was of normal type, caustioisers and rotary filters for the production of caustic and discontimuous washing and gassing of the carbolate. The refining plant was discontinuous, the condensers said to be silver plated. The refining plant also worked up crude tar acids washed from liquor at coke ovens, e.g. Nordstern.

GESELLSCHAFT FUR TEERVERWERTUNG m.b.H.

DUISBERG - MEIDERICH

PERSONNEL OF INVESTIGATING TEAMS:-

8th April, 1945

Mr. R.A. Acton Taylor,	British,	Ministry of Fuel & Power
Dr. C.M. Cawley,	British,	Ministry of Fuel & Power
Dr. H. Hollings,	British,	Ministry of Fuel & Power
Mr. R.N. Quirk,	British,	Ministry of Fuel & Power
Mr. J.H.G. Plant,	British,	Ministry of Fuel & Power
Mr. Baldeschweiler,	U.S.	Petroleum Administration for War.

9th April, 1945

Mr. R.A. Acton Taylor,	British,	Ministry of Fuel & Power
Dr. C.C. Hall,	British,	Ministry of Fuel & Power
Mr. R.N. Quirk,	British,	Ministry of Fuel & Power
Mr. Walker,	British,	Ministry of Supply

19th April, 1945

Mr. H.H. Bates,	British,	Ministry of Fuel & Power

GESELLSCHAFT FUR TEERVERWERTUNG m.b.H.

DUISBERG - MEIDERICH

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GESELLSCHAFT FUR TEERVERWERTUNG G.m.b.H. DUISBURG - MEIDERICH

Reported by

Major H.H. Bates, British

on behalf of the

British Ministry of Fuel and Power

C.I.O.S. Target No. 30/7.04

Fuels and Lubricants

4th June, 1945

COMBINED INTELLIGENCE OBJECTIVES SUB-COMMITTEE

G-2 Division, SHAEF (Rear), APO.413

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Gesellschaft Fur Teerverwertung G.M.B.H. Duisburg-Meiderich

Bates, H H.

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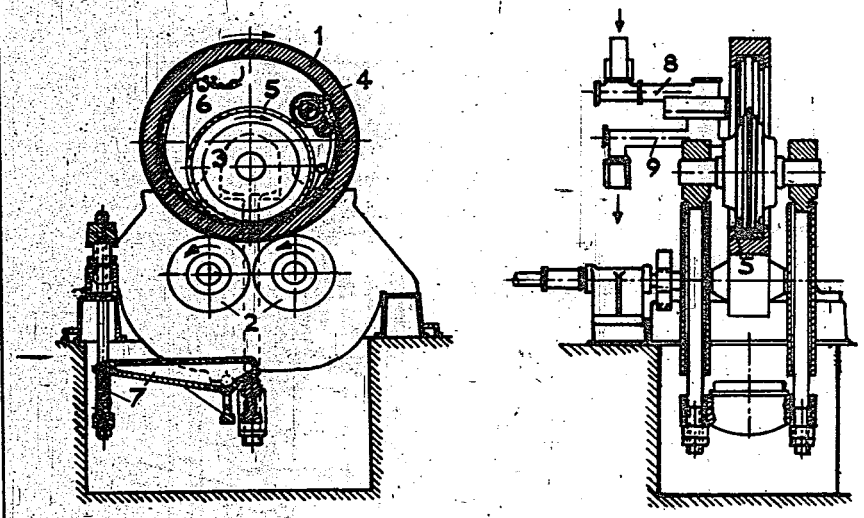
COMBINED INTELLIGENCE OBJECTIVES SUB-COMMITTEE



1 Rotating ring
2 Driving rollers
3 Rotating roll
4 Dry coal projector
5 Briquette moulds
6 Mechanism for detaching briquettes
7 Tension device for roll
8 Dry coal feed
9 Conveyor for excess coal

FIG. 4. KRUPP RING-ROLL PRESS FOR BRIQUETTING BROWN COAL.

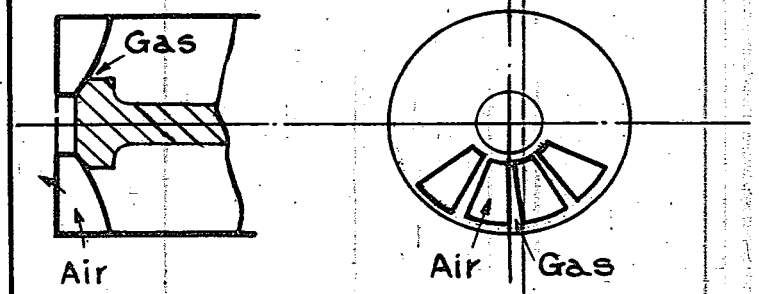
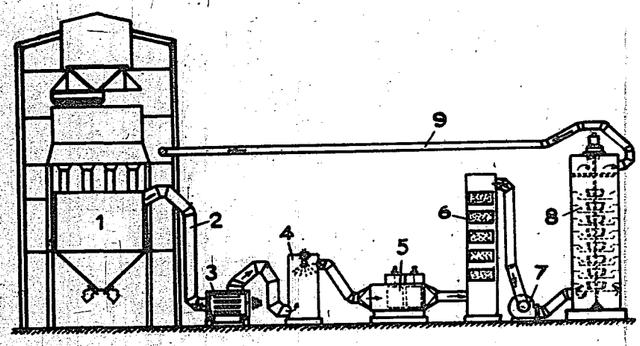


FIG.5
PRINCIPLE OF BALCKE-BOCHUM BURNER.

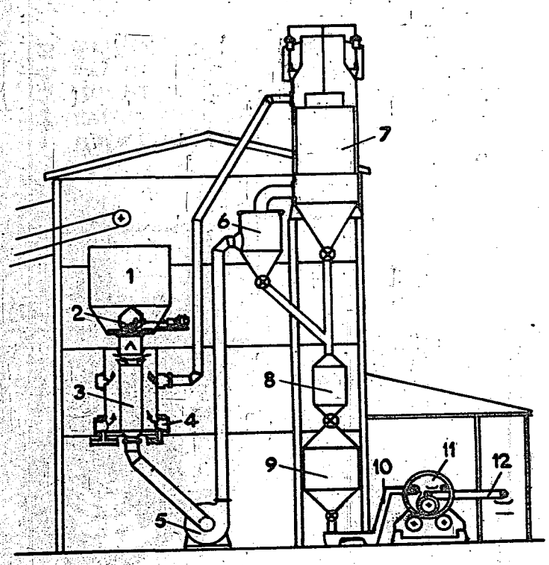
ELEVATION OF A LURGI DIRECT-HEATING CARBONISATION



1 Carbonising oven
2 Hot gas main
3 Dust separator
4 Primary cooler
5 Electrostatic precipitator
6 Tubular cooler
7 Exhauster
8 Light spirit scrubber
9 Cold gas main for return of circulating gases

FIGURE 2.

PLANT FOR THE PRODUCTION OF LOW TEMPERATURE TAR BY THE LURGI DIRECT-HEATING CARBONISATION PROCESS.



1 Raw coal hopper
2 Coal feed
3 Coal drying chamber
4 Combustion chamber for drying chamber
5 Combined pulveriser and fan
6 Coarse dust separator
7 Electrostatic dust separator
8 Coal dust cooler
9 Dust storage hopper
10 Dust feeding mechanism
11 Ring-roll press
12 Briquette conveyor

FIG. 3. BROWN COAL BRIQUETTING PLANT FOR THE PRODUCTION OF LUMP COKE (LURGI-KRUPP PROCESS.)

Briquette Analyses

	Moisture %	Ash in dry fuel %
Household	11	20.1
Industrial	15	20.9

Tar	E	M
Sp. Gr.	-	0.948
Water %	1.6	0.2
Dust %	0.24	-
Setting Point °C	-	- 3
Flash Point	-	107.
Tar Acids Vol. %	-	17.5

36/233/0 B.P.CO.LTD. 15/10/45

1 Coal hopper
2 Drying zone
3 Carbonising zone
4 Coke cooling zone
5 Coal charging car
6 Coke discharging mechanism
7 Coke discharging bockets
8 Circulating fan for drying zone
9 Combustion chamber for drying zone
10 Combustion chamber for carbonising zone
11 Admission of purified circulating gas →
12 Offtake for mixture of circulating gas and carbonisation gas
13 Offtake for waste gas from drying zone

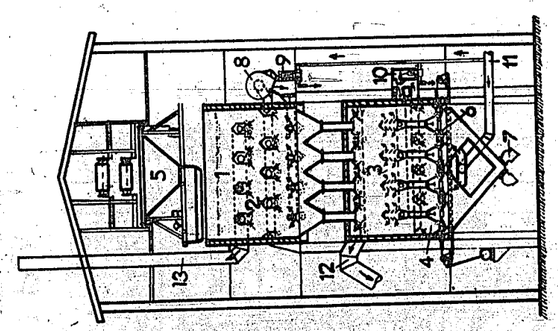


FIGURE 1.

ELEVATION OF A LURGI DIRECT-HEATING CARBONISATION PLANT.

4. Boiler Plant

A brief visit was paid to the adjoining power house in which the boilers used wet brown coal and briquettes on old type moving inclined grates and also on newer V-shaped grates. Still newer boilers (two units) were fired with pulverised brown coal; each produced 20 tons of steam per hour.

5. Drawings and Documents

The following drawings and documents were obtained and despatched to London:

Drawing No. L.S. 1867 b
Drawing No. 22385
Laboratoriumsbericht dated 30th Jan. 1945.

ABSTRACT FROM LABORATORY REPORT: DEUTSCHE ERDÖL A.G.

Dated 30th Jan., 1945

Raw Coal and Briquettes

Material	Low Temperature Assay						At 15% Moisture	
	Moisture	Tar	Liquor	Coke Ash free	Ash	Gas + loss	Tar	Ash
Raw Coal	53.2	8.2	56.9	19.4	4.9	10.6	14.9	8.9
Ring-Briquettes	9.8	15.3	18.5	38.3	10.3	17.6	14.4	9.7
Ramsdorf	17.8	14.4	25.0	35.4	9.0	16.2	14.9	9.3
Works Coal (Calc.)	10.8	15.2	19.3	37.9	10.1	17.5	14.5	9.6

Desulphurisation of Gas

Inlet to first of 10 towers	12,000 mg. H_2S per cu. metre (dry)
Outlet from tenth tower	6,670 " " " " " "
Gas volume (dry) per 24 hours	1,340,000 cub. metres

Ammonia in liquor gm. per litre

Free	4.51
Fixed	2.87
Total	7.38

Gas Analysis

CO_2	15 - 18
$C_n H_m$	0.4 - 0.6
O_2	0.2
CO	5 - 14
H_2	11 - 14
CH_4	11 - 12
N_2	42 - 49

Density (calc.) 1.156 - 1.238
Calorific Value 1408 - 1888 Kcal/cu.m.

Description of plant:

Each shaft consists of three superimposed sections through which the briquettes pass successively. In the upper section the briquettes are predried down to a moisture content of not more than about 0.5 per cent. before entering the carbonising section. The bottom section of each shaft consists of a coke cooling zone and discharge arrangements.

The shafts are of rectangular section and consist of a steel shell 5 mm thick brick lined to a thickness of up to 327 mm in the carbonising zone, which is about 6 metres high and of cross section approx. 3 metres.

(Drawings Nos. L.S. 1867 b and 22385 were obtained.)

Method of Heating:

The plant is of the internally heated type in both drying and carbonisation sections. Heating is effected by the recirculation of gases produced in the carbonisation, these gases being first burned in combustion chambers adjacent to both sections.

The gas recirculated in the drying zone is purified gas whereas that used in the carbonisation zone is unpurified. It was stated that normally on plants of this type unpurified gas was circulated in both zones - the use of purified gas in the drying zone was said to be peculiar to the Regis plant, and the object was apparently to minimize troubles caused by condensation of sulphurous gases in the cooler sections of the plant.

The heating gases are circulated by means of blowers and enter the charge through a series of louvres across the section of the retort, those in the drying zone being of metal and those in the carbonisation zone of brick.

The circulating gases enter the drying zone at a temperature of about 220°C. and mix with steam evolved from the briquettes. Excess gas at this stage passes off to atmosphere (Satd at 66°C) at 60-80°C.

The temperature maintained in the carbonisation zone is from 600 - 700°C although if desired it can be increased to 900°C. for the production of coke of only 2 per cent. volatile matter. The coke normally produced contains 10-12 per cent. volatile matter. The temperature of the gas leaving the carbonising unit is 250°C.

Cooling and discharge of coke

The coke in the lower section of the shaft is cooled by the passage of the recirculating gases which become preheated prior to their combustion to provide heating gas. The coke is then discharged through a lock chamber fitted with a movable bell arrangement operated by lever.

The coke on discharge is transferred to vibrating metal screens of 6 mm mesh. As the coke from brown coal is particularly reactive water sprays for use when necessary are fitted above the screens.

The coke as discharged was said to contain 5 - 8 per cent. of dust below 6 mm in size.

Yields of products

The following were quoted as typical yields of products - per cent. of briquettes as charged

Coke	15% (VM 10 - 12%)
Tar	13% (94% of Fischer assay yield)

Gas

Surplus	160 Cu. metres per ton (plunger briquettes)
	280 Cu. metres per ton (Ring press briquettes)
Gas C.V.	1800 Cal./c.m.
Ash	20%

(see attached abstract from laboratory report)

The coke normally contained 2½% sulphur but was said to be free from tar and suitable for use in vehicle gas producers.

Tar and Spirit Recovery System

The layout of apparatus for recovery of tar and spirit is shown diagrammatically. The gas passes successively through a dust separator, a primary cooler, an electrostatic tar precipitator, a tubular cooler, booster and light oil absorption plant before going forward for recirculation.

The dust separator consists essentially of a drum in which a cage of horizontal metal bars rotates slowly. The bars dip into tar and the dust adheres to the bars. These separators are cleaned out by hand about twice per shift. The primary cooler is a direct spray cooler which cools the gas to 100°C.

The electrostatic precipitators are of two types horizontal and vertical and are operated at a maximum voltage of 60,000. The insulators carrying the electrodes are shielded in cylindrical shields which are heated by steam or electrically. The indirect coolers have horizontal tubes through which the cooling water passes. The washers for recovery of light spirit can be of two types either Feld or Weindel but only the latter type are fitted at Regis. Oil is sprayed into the top of a vertical column in which rotates a series of baskets packed with Raschig rings.

1. Drying, Crushing and Briquetting Plant

The brown coal arriving at the plant contains normally about 53% moisture, and is of size 0-6 mm. Prior to briquetting in the Krupp ring-roll presses it is dried to about 10% moisture by contact with combustion gases at a temperature of 900° - 1000°C. During the drying process the rapid evolution of steam causes a breakdown of the particles of coal which are thereby reduced in size, the dried coal containing approx. 50% below a screen of 9000 meshes per sqcm. (circa 240 B.S.I.).

The wet coal is carried on rubber belts and discharges into hoppers situated above the driers. The coal is fed into the driers from an enclosed feed table carrying four ploughs. The hot products of combustion of gas enter the bottom of the drier at about 900 - 1000°C. and then pass downwards in a C.I. pipe and leave the drier at a temperature not exceeding 400°C. Combustion of the heating gases is effected in a brick-faced chamber, the burner being a Balcke-Bochum. An attached sketch (Fig. 5) shows the principle of the chamber. The gases and dust are withdrawn from the drier by means of a fan and then pass to a coarse dust separator. Finer dust is removed by means of an electrostatic precipitator. The separated dried coal is cooled to 50°C. with cool waste gases and then goes to the briquetting presses.

The general layout of the plant is shown on an attached diagram. (Fig. 3.)

2. The Krupp Ring Roll Presses

The Krupp ring roll press is illustrated in the diagram attached (Fig. 4.). It consists essentially of two rotating rings of respectively 3300 and 1900 mm diameter mounted eccentrically. The outer and larger ring is driven by a pair of rollers electrically driven and rotates at a speed of up to 7 rpm but which is normally 5 rpm. Coal for briquetting, without any binder, is fed by means of a centrifugal feeder into the space between the rings and is subjected to a pressure of 2000 - 2400 kg/cm. The briquettes leave the press in continuous strip form but break into pieces about 4 inches long at positions where the strip is notched.

Each press has a capacity of about 10 tons per hour - 50 tons of briquettes per day per one r.p.m.

The power consumed was said to be 10 kWh per ton of briquettes and costs quoted were 11 marks per ton including all overheads and inclusive of the cost of raw coal at 6 marks per ton. The presses at Regis have been in operation for 7 years.

General:

As brown coal is particularly reactive and liable to form explosive mixtures with air precautions were taken throughout the whole of the drying and briquetting process to exclude air as far as possible from the fine coal. Conveyors were all of the enclosed type (Redler) and cool waste gases were kept in continuous circulation during operation of the plant.

In the event of any interruption of the process, or while shutting down, water in the amount necessary to keep the gas at the correct saturation value was introduced in order to prevent over-heating of the coal and in this way the coal was flushed out of the system. A separate conveyor was used for this purpose.

It was stated that 99.9 per cent. of the total brown coal dust was recovered but the remainder had caused considerable trouble. In order to keep the atmosphere as dust-free as possible fans were installed mainly along the carbonising benches. These delivered into high vertical pipes which discharged to atmosphere above the level of the buildings and hence removed the dust from the neighbourhood of the works.

3. Lurgi Spülgas L.T. carbonisation

The plant consists of ten units for the carbonisation at low temperatures of briquettes produced from local opencast coal. The plant had been erected about 7 years ago and had been extended in 1943. It was stated to have been in use up to six months ago producing about 1200 tons of coke per day. Each unit has a nominal capacity of 300 tons per day and consists of two separate shafts placed one on each side of central combustion chambers and gas inlet and offtake mains.

Two types of briquettes, both produced at the works, are used. One type made in a normal type plunger press and containing 15% moisture is treated normally in two units and produces coke used for power production and for general industrial use. The second type of briquette, containing 8-10% water, is produced in Krupp ring roll presses and is charged to the other 8 Spülgas units. The coke from this type of briquette provides what was described as a high class fuel for domestic use. The proportion of unbroken briquettes in the coke was reported to be high.

The diagrams attached (Figs. 1 and 2) show the arrangement of the Spülgas unit and the general layout of the plant for the recovery of the tar and light spirit.

DEUTSCHE ERDOL A.G., REGIS NEAR LEIPZIG BOHLEN

Table of Contents

PERSONNEL OF INVESTIGATING TEAM

Mr. H. Bardgett, British, Ministry of Fuel and Power

Mr. T.F. Hurley, British, Ministry of Fuel and Power

Dr. J.G. King, British, Ministry of Fuel and Power

Dr. E. Spivey, British, Ministry of Fuel and Power

Mr. L.L. Newman, U.S. Department of Interior, Bureau of Mines

C.I.O.S. TARGET OF OPPORTUNITY

DEUTSCHE ERDOL A.G. REGIS NEAR LEIPZIG BOHLEN

Visits made

9th May	Dr. J.G. King	11th May	Mr. T.F. Hurley
	Mr. H. Bardgett		Mr. L.L. Newman
	Dr. E. Spivey		Mr. H. Bardgett
			Dr. E. Spivey

Personnel:

Dir. Landwehr	(May 9th only)
Herr Simon	Superintendent
Herr Wolf	Engineer

INTRODUCTION

This plant is one built by Lurgi for the L.T. Carbonisation of soft brown coal and is on the list of plants mentioned in Note of C.I.O.S. - visit to Lurgi-Haus Frankfurt /M. on 12th/13th April, 1945, by Dr. Hollings, Mr. Plant and Mr. Quirk.

It consists of plant for

1. Drying (and crushing) of wet brown coal from local opencast workings.
2. Briquetting plant. Two types -
   (a) Normal plunger presses. (Not seen.)
   (b) Krupp ring roll presses.
3. Lurgi Spülgas L.T. Carbonisation units.
4. Boiler plant and power house for supplying power to the briquetting and carbonisation plant and to the local colliery.
5. Metasolvan Process for the refining of tar and Phenolsolvan process for recovery of phenols from liquor (not inspected).

The plant was undamaged but was not in operation. This was stated to be because the tar was normally supplied to a subsidiary company, Mineral Oel Werke at Rositz for hydrogenation and this company could no longer operate owing to war damage.

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REPORT ON

DEUTSCHE ERDOL A.G., REGIS, NEAR LEIPZIG BOHLEN

Reported By:

Mr. H. BARDGETT, British

on behalf of the

BRITISH MINISTRY OF FUEL AND POWER

and

U.S. TECHNICAL INDUSTRIAL INTELLIGENCE COMMITTEE

CIOS Target Number
30/225

Fuels and Lubricants

[1945]

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

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DEUTSCHE ERDOL A.G.

REGIS

Bardgett, H.

Egner in Beton und Eisen in 1937. He said that the research had been very extensive and that he had no reason to feel that either weather or moisture conditions in Germany had changed much during the war. Much additional work on other problems had been carried out, however, and a list of his various reports has been included with the documents. These reports are available upon request. Letters dated May 12 to Capt. M. G. Troomkin, A. C. (U. S. Strategic Air Force) and May 2, 1945, to Major Denars (British 6th Army) have also been included with the documents.

Prof. Graf appeared to be very anxious to continue his scientific researches and was particularly desirous of resuming contact with the personnel of the Forest Products Laboratories at Madison, Wisconsin, U. S. A. He was very cooperative.

E. L. Baldeschwieler

Documents taken from Professor Otto Graf, Dir. of Institut für die Material Prüfugen des Bauwesens, Techn. Hochschule Stuttgart

1. Letter dated 12 May 1945 to Capt. N. G. Froomkin A.C. . U. S. Strategic Air Force Air Technical Intelligence from Otto Graf.
2. Letter dated 4 May 1945 to Major L. F. Denaro, Royal Engineer, CAFT & Army Sp. U. S. Army, from Otto Graf.
3. Veröffentlichungen in Jahre 1942
4. " " " 1943
5. " " " 1944
6. Kurzgerichte-Holzbauwesen dated 17 Jan. 1945
7. Plan showing bomb-hits on the Institut during year 1943 and beginning of 1944.
8. Abstract of paper by Otto Graf and Karl Egner published in Beton und Eisen 1937.

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INTERVIEW WITH PROFESSOR OTTO GRAF, INSTITUT FÜR BAUFORSCHUNG UND MATERIAL PRÜFUNGEN DES BAUWESENS STUTTGART

Introduction

Mr. Potts of U.S.S.B.S. requested the writer, while on another assignment in the same territory, to look up Dr. Karl Egner of the Technische Hochschule, Stuttgart, and inquire if additional work had been carried out on determinations of moisture content of building materials, in particular wood in German houses.

Interview with Professor Otto Graf

Considerable difficulties were experienced in locating Dr. Egner. In the course of the search for his address, it was found that he was a pupil of Dr. Graf and worked under his direction. Consequently, the writer felt, after talking to Dr. Graf that an interview with Dr. Egner was no longer necessary. In fact, Dr. Egner was living in Essignen outside of Stuttgart, very ill of a stomach ailment, and is now probably in a sanatarium. The writer had two short interviews with Dr. Graf, the first on June 10 at his home, 30 Spitzerstrasse, Stuttgart, and the second on June 11 at his laboratory, 212 Cannstatterstrasse. At the first interview, Dr. Graf stated that he had a number of reports at his laboratory which he would place at the writer's disposal. These reports have been received and forwarded to the Documents Section, in accordance with the customary practice.

Prof. Graf is head of the Institut für Bauforschung und Material Prüfungen des Bauwesens. This institute, which is apparantly part of the Technische Hochschule, has been somewhat damaged by bombs, mostly fire bombs. Dr. Graf had a map showing the bomb hits, a copy of which has been obtained and included with the documents.

Regarding the work on moisture content of woods, Dr. Graf stated that no additional work had been carried out since the publication of the original article by Graf and

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INTERVIEW WITH PROF. OTTO GRAF

INSTITUT FUR BAUFORSCHUNG UND MATERIAL PRUFUNGEN DES BAUWESENS

STUTTGART

Reported by

E. L. BALDESCHWIELER

on behalf of
United States Technical Industrial Intelligence Committee

CIOS Target Nos. 21/127 & 22/163
Metallurgy & Miscellaneous Chemicals

6 July 1945

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

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PROF. — OTTO GRAF

INSTITUT FUR BAUFORSCHUNG UND MATERIAL PRUFUNGEN DES BAUWESENS

STUTTGART

Baldeschwieler, E. L.

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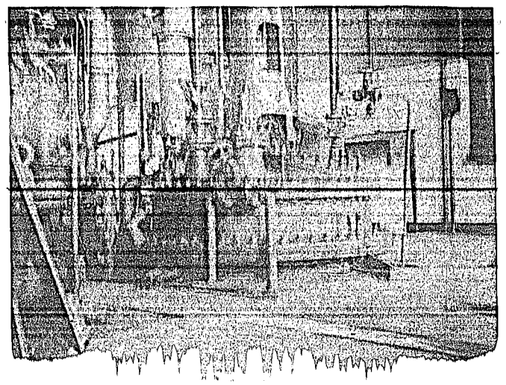
COMBINED INTELLIGENCE OBJECTIVES

SUB-COMMITTEE



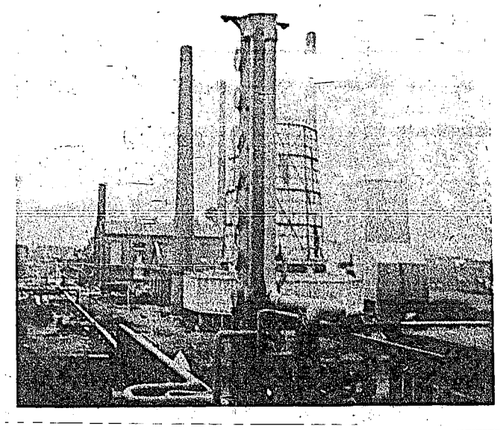


Fig. VI
Benzin stripping column

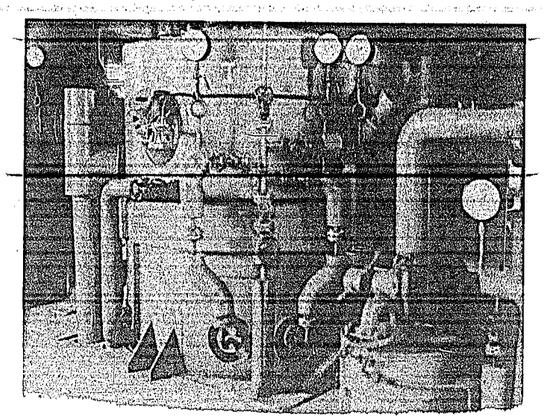
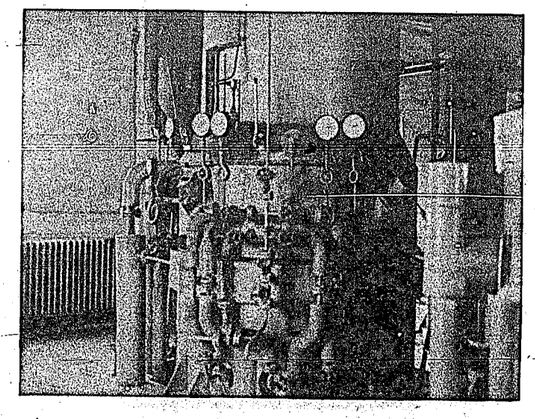


Fig. VII
Second vacuum still for
lube oil fractionation



VIII
Third vacuum still for
lube oil fractionation

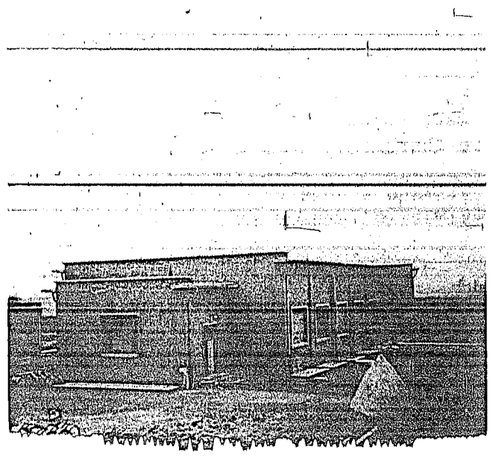


Fig. II
Synthetic lube plant

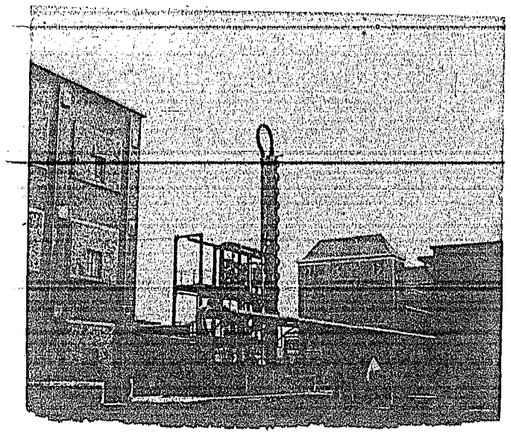


Fig. III
I-R: In-e oil plant, Benzin
[illegible] grease plant, laboratory

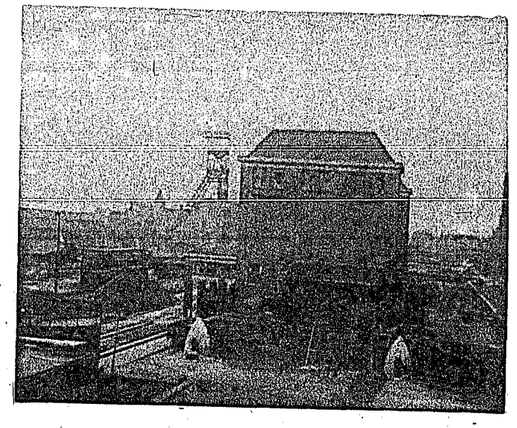


Fig. IV
Grease Plant

Characteristics of Separated Fatty Acids: Brown, amorphous, semi-colid acids.	I.V.	15
	N_D at 18°C	1.4995

Remarked: A high melting point soda base grease of the type usually employed for ball and roller bearings. It is made from a medium bodied engine oil of low V.I. and the isolated acids are without doubt derived from wool grease. The product has the appearance of having been prepared by fusion followed by some type of homogenising.

4. GENERAL PLANT CONDITIONS

The Rheinpreussen Plant (Schact I) at Homberg had suffered no bomb damage until Monday, March 5, 1945. Then three bombs were dropped south of the synthetic lube oil plant, damaging a small HCl gas holder and absorption tower, and breaking windows throughout the lube oil plant and laboratory. There was no apparent damage to equipment inside either of these buildings. Dr. Meusel expressed the opinion that these bombs had been dropped by a German plane by mistake.

At the time of the subject inspection no troops were quartered in the plant and there were no indications that equipment or files in the plant had been molested by Allied troops.

5. RECOMMENDATIONS

Unless the following steps have already been taken by other teems, they should be considered for further exploitation of this target:

1. The files of the Rheinpreussen main office at Homberg should be searched for copies of technical documents which had been evacuated from Moers by the Germans.

2. Dr. Meusel should be interrogated at length about all of his work, both at Homberg and Moers, in addition to his previous activities with Fischer at

Mulheim.

3. Dr. Kolbel and his records should be located and his activities at Moers, Homberg, and Stieppel should be thoroughly investigated.

4. Dr. Ullmann should be located and interrogated about his work on grease at Homberg and elsewhere.

5. Laboratory and plant samples of synthetic lubricating oils, greases, and other products at Homberg should be examined carefully with parties capable of identifying and describing them all, to clear up, among other things, the apparent discrepancy between claimed and measured quality of the lubricating oils.

1943	Cylinder Oil	Turbine Oil	Spindle Oil	Motor Oil	Grund Oil & Ruckol	Total
Aug.	-	-	12.152	354.950		347.102
Sept.	-	-	16.000	429.990	73.560	519.550
Oct.	135.370	28.100	37.600	152.090		353.160
Nov.	72.260	-	18.830	193.660		284.750
Dec.	83.330	14.220	-	200.210		298.260
1943 TOTAL:						1802.822
1944						
Jan.	94.400	26.570	11.440	161.910		294.320
Feb.	64.250	-	-	227.240		291.490
Mar.	98.750	21.530	17.490	150.300		288.070
Apl.	59.140	-	7.170	272.130		338.440
May	105.360	8.300	-	226.580		340.240
June	95.450	14.590	4.430	219.080		333.550
July	65.180	14.320	5.630	86.930		172.060
Aug.	Missing					
Sept.	26.840	-	-	209.050		235.890
Oct.	6.970	7.620	-	46.800		55.390
Later records missing.						
1944 TOTAL:						2349.450

3. GREASE MANUFACTURE

In part of an old building near the new laboratory, equipment for large scale grease manufacture is installed. This construction was started in 1942 but grease production in this plant was realised only for a couple of months during 1944, after which the needs for grease were supplied by other larger manufacturers, not further specified. However, experimental work on grease manufacture was stated to have been continuous at Homberg from 1942 to about a week before our arrival. All of this work was under the direction of Dr. Ullmann, who is supposed to have gone to Stieppel.

The large scale equipment consists of two steam heated grease kettles each of about 250 gal. capacity, a

milling machine, and miscellaneous tanks. Many drums of grease of varying appearance and consistency were standing around the plant, some showing considerable oil separation, but none being identified. There were no raw materials in evidence indicative of the types of grease being made.

Dr. Meusel claimed to be entirely ignorant of the details of the grease research and manufacture but believed the soaps of oxidised paraffin were used and that the oil was sometimes synthetic and sometimes natural. In the sample storage room of the laboratory were a large number of grease samples, and a partial inspection revealed a wide variety of consistencies and colors. All samples were marked only in code and could not be identified. A single sample was picked up more or less at random, but having the appearance of an ordinary cup grease. This sample was analyzed and tested by the Petroleum Board and their report is quoted below:

Identification:	MECH. 575	
Description:	Grease, unknown type from Homberg Plant, Target No. 30/5.05.	
Appearance:	Transparent, brown coloured rather lumpy grease. (About 5 kilos).	
Physical Tests:	Melting Point, I.P.	330F.
	Penetration (unworked).	165.
	" (worked).	240.
	Heat Test (120°C. for 1 hour).	Excellent, no separation and little change in consistency.
Analysis:	Sodium Soap.	17%.
	Free Fatty Acidity.	Nil.
	Free Alkalinity.	Nil.
	Water Content.	Trace.
Characteristics of Separated Mineral Oil:	Specific Gravity.	0.948
	Viscosity at 100F.	361"S.U. 78 c.s.
	Viscosity at 210F.	49" S.U. 7.0 c.s.

Summer grade: 12° Engler at 50°C
49% cylinder oil
51% turbine oil

Captured samples of motor oils which were supposed to have the above compositions were tested by the Petroleum Board and the results are quoted below:

	CIOS# 12 ~~6-0° Motor Oil~~	CIOS# 13 ~~Summer Motor Oil~~
I.B.Mech. No.	571	572
Sp. Gr.	0.939	0.938
Visc. 100°F.c.s.	136.4	187.1
Visc. 210°F.c.s.	11.35	13.66
K.V.I.	70.00	67.00
Neutr. Val.	< 0.05	< 0.05
Pour Pt.	- 10°F	-20°F
Flash Pt.closed	395°F	440°F
Coke No (Ramsbotham)	0.62	0.72

The BAM oxidation test was run on CIOS#13, Mech.No. [illegible] with the following results:

Ramsbotham coke:

Before oxidation ...	0.72
After oxidation ...	2.45
Increment	1.73

Viscosity-CS at 100°F

After oxidation ...	422.8

Ratio of viscosity before and after oxidation 2.26

(g) Plant capacity

The Homberg lube oil plant had a rated capacity of 10 tons per day and employed about 40 men and 40 women. It operated from the date of completion in 1942 or early 1943 until about October 1944 when the supply of Fischer-Tropsch middle oil from Moers was no longer

available. Dr. Meusel stated that I.G. makes lube oils from the products of destructive hydrogenation and that other Fischer-Tropsch plants synthesize lubricants by methods other than that used at Homberg. Dr. Meusel indicated that he had no knowledge of the nature of the other processes.

A record of production costs for 1943 and 1944 (Documents 17 and 29) found at the Rheinpreussen-Moers plant included production volumes and costs for the synthetic lubricating oil plant (Anlage IV) from which Table I below has been prepared. It will be seen that production averaged close to the rated capacity of 10 tons per day during most of the period of operation.

and that a large part of the total product was motor oil. The latter was apparently made to two different specifications ZdM6 and ZdM7, but the details of these specifications were not shown. However, monthly statements to "Arsyn" for 1944 characterize the lubricating oils as follows:

Oil.	Viscosity.
Spindle oil.	3.2/20
Turbine oil.	3.5/50
Motor oil Zdm 7.	9°E
Motor oil Zdm 6.	16-17°E
Steam Cylinder Oil	> 285

TABLE I.
Lubricating Oil Production
Plant IV - Tonnes.

1943	Cylinder Oil	Turbine Oil	Spindle Oil	Motor Oil	Grund Oil & Ruckol	Total
Jan.	34.230	53.870	10.770	9.100		107.970
Feb.	53.500	68.100	30.600	9.100		152.200
Mar.	33.230	17.250	37.770	67.859		155.449
Apl.	30.570	17.451	11.000	99.220		158.241
May	55.540	13.810	24.520	121.660		215.530
June	-	-	11.620	211.700	225.310	448.630
July	-	-	34.950	286.600	25.510	347.060

charge rate to these stills was 1000 liters per hour and the distribution of products was reported as follows: Overhead from the first still - 150 liters per hour of Diesel oil (fuel); overhead from the second still - 150 liters per hour of spindle oil; overhead from the third still - 200 liters per hour of turbine oil; bottoms from the third still - 500 liters per hour of steam cylinder oil.

(f) Properties of oil

The properties of these fractions were given as follows:

	Spindle Oil	Turbine Oil	Cylinder Oil
Flash point	160-170°C	220°C	285°C
Viscosity	1.5 Eng. at 50°C	3.0-3.5 Eng. at 50°C	6-9 Eng. at 100°C
Pole Height	2.0 - 2.2	2.5	2.7 - 2.8

The steam cylinder oil was reported to be satisfactory for use at temperatures up to 450°C, but this seems improbable.

Dr. Meusel indicated that the oils were equivalent to Pennsylvania stocks in respect to viscosity index, but this is not borne out by the pole height values. He also believed that the oils were highly resistant to oxidation and sludge formation. He did not have any standard test data to support this contention, but offered the following data from a modification of the B.A.M. test. One hundred cc of a motor oil blend of the synthetic fractions having an Engler viscosity of 8 - 10 at 50°C was blown at 172°C with 10 liters of air per hour. The tests given below were obtained on the oil before and after blowing.

	Before blowing	After blowing
Conradson carbon.	0.5	0.6
Neutralization No.	0.00	0.1 or less.

No sludge was precipitated by dilution with benzin either before or after blowing. The oil fractions are

sometimes subjected to a second contacting with 0.5 to 1.0% of bleaching earth but this improved only the appearance.

Captured samples of the primary stocks were tested by the Petroleum Board and the results are quoted below:

	CIOS# 14 Spindle Oil	CIOS# 15 Turbine Oil	CIOS# 11 Cylinder Oil
P.B.Mech. No.	568	569	570
Sp. Gr.	0.901	0.928	0.965
Visc.100°F.c.s.	16.11	43.89	1939
Visc.210°F.c.s.	3.21	5.49	52.39
K.V.I.	53.00	49.00	61.00
Neut. Val.	< 0.05	< 0.05	< 0.05
Pour Pt.	+ 25°F	-15°F	+ 25°F
Flash Pt. closed	340°F	395°F	525°F
Coke No (Ramsbotham)	0.17	0.24	0.11

The BAM oxidation test was run on CIOS sample 11, Mech. No. 570 with the following results:-

Ramsbotham Coke:

Before oxidation	...	1.15
After oxidation	...	4.46
Increment ...	...	3.31

Viscosity CS at 100°F.:

After oxidation	...	6520

Ratio of viscosity before and after oxidation ... 3.36

Dr. Meusel stated that motor oils were made by blending the cylinder oil and turbine oils, and include more or less spindle oil depending on flash point specifications. Typical compositions were reported to be as follows:

Winter grade: 8-9°Engler at 50°C
45% cylinder oil
47% turbine oil
8% spindle oil

accomplished batchwise in an unpacked tower about 1 meter in diameter and 10 meters high, located in the [illegible] (south) end of the building. The tower is made of cast iron and lined with enamel which combination of material is used for practically all vessels handling oil and HCl. Circulating pumps in similar service are all-porcelain, made by Hescho of Hermsdorf, Thuringia. Connecting lines are of cast iron unlined. During chlorination oil is circulated at the rate of 2 m3/hr downward through the tower with a cooler in the circulating line to hold the temperature at 80 to 100°C. Chlorine is admitted at the bottom of the tower through a single pipe with no special means for distribution. Each charge of oil consists of 2.[illegible] to [illegible].0 cu.meters and is brought to reaction temperature by a steam preheater. Chlorination is continued until the chlorine content reaches 20 to 25% by weight which requires 3 to 4 hours. Specific gravity is used as a guide to degree of chlorination. A greater degree of chlorination was stated to give a higher yield of heavy lube [illegible] somewhat poorer [illegible] viscosity index.

[illegible] Condensation

The condensation of the chlorinated oil with naphthalene was carried out in a battery of six batch reactors each about 1.5 meters in diameter and 2.5 meters high, made of cast iron, but with only four of the six being enamel lined. It was stated that no serious corrosion of the unlined reactors had been encountered, since the HCl in the system is completely anhydrous. Each reactor has an agitator comprising two cross arms at the bottom of a vertical shaft driven at 150 - 200 RPM. The upper part of one of the reactors is shown by Figure V.

The charge to each reactor consists of 500 - 600 liters of chlorinated oil, 200 - 250 liters of naphthalene, 800 liters of heavy synthetic benzin or Diesel oil (boiling range 130 - 230°C) and either 4 Kg. of metallic aluminum or 12 - 15 Kg. of $AlCl_3$. The naphthalene is free from phenols and nitrogen bases but is not specially distilled for this use. The heavy benzin is used merely as a diluent. The condensation is accomplished at 70 to

[illegible]

[illegible]

[illegible] with 40 - 50 Kg. [illegible] neutralize acidity [illegible]

[illegible] Stripping

The clarified oil is passed to a benzin stripping column shown in the center of Figure III and also in Figure IV. Preheating and reboiling are accomplished in separate exchangers heated by hot water from a gas fired pipe still with separate coils for the two circuits. It was stated that water for the reboiler was supplied at 240 - 250°C under a pressure of 60 - 80 atm.

(e) Distillation

After benzin stripping the lubricating oil is fractionated in a series of three vacuum stills, of which the second and third are shown in part by Figures VII and VIII respectively. This distillation system was built by Lurgi and its internal construction was unknown to Dr. Leusel. The same type of still was used extensively in Germany for fractionating non-mineral oils. All three stills were maintained at the same pressure of 3-5mm absolute by a steam jet vacuum pump. The oil temperatures in the successive stages were 150 - 170°C, 180 - 190°C and 270 - 350°C. A small unmeasured amount of open steam was admitted to each still. Only the third stage had a fractionating column, this consisting of a tower about 1 meter in diameter and 3 meters high packed with Raschig rings. It was stated that 200 - 300 liters per hour of distillate were pumped back as reflux and about 200 liters per hour withdrawn as overhead product. The normal

[illegible] AFT FISCHER

A letter in the files of the Rheinpreussen plant at [illegible] revealed the existence of a synthetic lubricating oil plant at [illegible] which was inspected on 9 March,194[illegible]. This was located in the Rheinpreussen plant identified as "Schacht I", in this report; Albert Meusel, a chemist, was found, and his superior, Herr Emil Kuppers "Leiter der Steinkohlen- ergwerke Rheinpreussen, [illegible] Bergwerkfeld Rhein land und der Gewerkschaft Neumühl." Dr. Meusel, who is not a technical man, explained that the synthesis plants, I and III, all at the plant [illegible] were built, and been exhausted many years ago and the [illegible] were dismantled. Several of the [illegible] are now in spare shops for other Rheinpreussen plants. Unit IV with its coke ovens, between Schacht one and two, was stated to be in operation cur[illegible] but the [illegible] any synthesis or research operations [illegible] head of Fischer, was also stated to [illegible]

Dr. Meusel is a chemist with degrees from Gottingen, Leipzig and Marburg. He worked with Franz Fischer at the Kohlenforschungs Institute (Mulheim) from 1935 to 1939 when he went to the Moers (Schacht V) plant of Rheinpreussen. There he claims he developed the synthetic lubricating oil process for which the plant was subsequently erected and operated at Homberg. However, Dr. Meusel also stated that this process was similar to that developed by Standard of New Jersey for making Paraflow, so there is some uncertainty about the degree of novelty in his process. Dr. Meusel stated that the General Director of Rheinpreussen, Heinrich Kost (previously arrested by C.I.C. near Moers) had instructed one man from each department to remain in the plant to "hinder" damaging of the plants by the Americans, and apparently Dr. Meusel and Herr Kuppers were designated for this purpose at Homberg.

Dr. Meusel stated that lubricating oil research had been under the direction of a Dr. Kolbel who, with all of his chemists and records, had been moved to Stieppel, near Bochum, about a week before our visit. Research on greases had been under the direction of Dr. Ullmann, who

had also moved to Stieppel. Dr. Meusel stated that about 4 chemists and 8 assistants were previously engaged in research on Fischer-Tropsch and lubricating oil synthesis in a laboratory at Stieppel. In addition, 5 chemists and 8 assistants had been sent to Stieppel. A new lube oil manufacturing plant had been planned for Stieppel but Meusel thought [illegible]

In the southwest corner of the Rheinpreussen plant (Schacht I) at Homberg new buildings to accommodate the laboratories and the lube oil synthesis plant had been erected in 1942. The laboratory is shown in Figure I (looking SE) and the lube oil plant in Figure II (looking S). Figure III (looking W) shows a corner of the lube oil plant on the left and corner of the laboratory on the right with one of the old buildings in the middle background and in which [illegible]. A closer view of [illegible] Figure II.

The laboratory building is arranged with private offices and laboratories along the side shown in Figure I and a large general laboratory occupying the remainder of the ground floor. The basement is devoted to utility services and stock and sample storage. The stocks of glassware and chemicals seemed quite large. There were several shelves filled with product samples, some obviously of a research nature, which would provide a basis for much further questioning of Dr. Meusel. No laboratory records of any kind were found in this building.

2. LUBRICATING OIL SYNTHESIS

The lubricating oil synthesis consists broadly in chlorinating a Fischer-Tropsch middle oil, reacting this with naphthalene in the presence of aluminum chloride as a catalyst, separating the sludge, neutralising, and fractionally distilling the lube oil product.

(a) Chlorination

The oil to be chlorinated is identified as heavy Kogasin and has a boiling range of 250 to 350°C, which was stated not to be critical and for which it was not necessary to fractionate sharply. Chlorination is

PERSONNEL OF INVESTIGATING TEAM:

H. V. ATWELL, Petroleum Administration for War

W. C. SCHROEDER, Bureau of Mines, U. S. Department of Interior

RESTRICTED

SUMMARY

A synthetic lubricating oil plant and laboratory at Schacht I of Rheinpreussen, south-east of Homberg, was inspected on 9th March, 1945. The informant here was Albert Peusel who had worked with Franz Fischer at Mulheim from 1935 to 1939 and then went to Rheinpreussen Schacht I, Moers, where he developed the process which he later put into operation at Homberg. The Homberg laboratory and plant were built in 1942. All laboratory experts and technical personnel, except Dr. Meusel, were [illegible] to Oberpral, near Bochum, about 1st March, 1941.

For the lubricating oil synthesis, Fischer-Tropsch middle oil, boiling range 250-350 C, is chlorinated at 90-100°C. to the extent of 20-25% chlorine by weight. Five volumes of chlorinated oil are reacted with 2 volumes of naphthalene at 70-100°C. in the presence of 2 volumes of Fischer Tropsch benzin and a small amount of $AlCl_3$ as catalyst. The sludge is withdrawn, the oil is neutralized with lime and bleaching earth, filtered and stripped free of benzin. Subsequent vacuum distillation yields spindle oil and turbine oil overhead, and cylinder stock as bottoms. The fractions are used as such, and are also blended to make motor oils. All products were stated to have a high viscosity index and great resistance to oxidation, but tests on captured samples do not support these claims.

The Homberg lubricating oil plant had a capacity of ten tons per day and operated until about October 1944, when middle oil from Moers was no longer available. Research on grease manufacture was also conducted in the Homberg laboratory and equipment for commercial production was installed in one of the old buildings at Schacht I. No significant information could be obtained about the nature of this work and large scale production was realized for only a couple of months in 1944.

The Homberg plant was never bombed before 5th March, 1945, when three bombs fell, perhaps accidentally from a German plane, causing only slight damage.

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REPORT ON INVESTIGATION OF SYNTHETIC LUBRICATING OIL PLANT RHEINPREUSSEN, HOMBERG

Reported by:

H. V. ATWELL U.S.
W. C. SCHROEDER U.S.

on behalf of the

U. S. Technical Industrial Intelligence Committee

CIOS Target Number 30/5.05
Fuels and Lubricants

15 May 1945

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

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ITEM NO. 30 COPY NO. 37

FILE NO. XXIV-9

SYNTHETIC LUBRICATING OIL PLANT
RHEINPREUSSEN, HOMBERG

Atwell + Schroeder

RESTRICTED

COMBINED INTELLIGENCE OBJECTIVES
SUB-COMMITTEE

"Lautmasse" and the like, at 120-150°C and regenerating the mass by treatment with steam or hot water at a higher temperature (175°C).

Brabag
B177992 IVc/12 o — Filed 6 Apr. 1937

Using for the Fischer Tropsch process a synthesis gas prepared from coal or coke and removing residual hydro-carbons from the synthesis gas by active charcoal or by contact with hot sulfuric acid or by cooling sufficiently to condense the hydrocarbons.

Brabag
B178085 IVC/12 o — Filed 14 Apr. 1937.

Diluting synthesis gas with reaction products so that the heat of reaction can be carried out as sensible heat of the mixture without excessive temperature rise.

Brabag
B175954 IVb/12e — Filed 23 Oct. 1936.

Desulfurizing synthesis gas by contact with an oxidizing agent such as a nitrite, chlorate, permanganate etc. on a support such as active carbon silica gel etc. at a temperature of about 80°C.

Krupp
K 147143 IVb/12g — Filed 5 July 1937.

Reactor for the Fischer-Tropsch process in which the cross section of the catalyst bed decreases from inlet to outlet according to the contraction in volume of the reacting gases.

Krupp
K148919 IVb/12g — Filed 20 Dec. 1937.

Carrying out Fischer-Tropsch synthesis (or other reactions with large heat effects) in a plurality of stages and introducing between stages sufficient cold charge gas to hold the desired temperature in the subsequent stage.

Ruhrchemie
R101215 IVd/12 o Filed 6 Jan. 1938.
Addition to R97521 IVc/12 o

Before discharging spent synthesis catalyst for reworking it is treated with inert gas such as steem at temperatures above 300°C and with a velocity of at least 1 meter per second to sweep out remaining oil and wax.

Ruhrchemie
R101219 IV/40a Filed 7 Jan. 1938.

In reworking cobalt synthesis catalysts the iron-thorium sludge is dissolved in acid and then treated with excess sodium carbonate at about 40-50°C to precipitate iron as hydroxide and keep thorium in solution as sodium thorium carbonate which is subsequently hydrolyzed to hydrocarbonate.

Ruhrchemie
R101354 IVd/12 o Filed 21 Jan. 1938.

Spent catalyst, after being freed from paraffin, is discharged and reworked by initial solution of active components in ammonium carbonate solution instead of acid. This is stated to facilitate elimination of impurities but details are not given.

Ruhrchemie
R101389 IVb/26d Filed 25 Jan. 1938.

Organic sulfur compounds in gases are converted to H_2S by heating the gas, preferably with added O_2 and steam rapidly to above 400°C and digesting at this temperature in the absence of a catalyst for a considerably longer time than required for heating. Final heating is preferably accomplished by partial combustion to prevent trouble due to deposition of solids on indirect heating surfaces.

Brabag
B.182409 IVd/12 o Filed 16 Mar. 1938.

In the hydrogenation of CO with a Co catalyst longer life is obtained if steem is added to the synthesis gas during initial operations according to the following schedule for example:

0 to 20 hrs.	2 - 2.5 vol.% steam
20 to 30-50 hrs.	0.7 - 1.5 vol.% steam
30-50 to 100-300 hrs.	0.1 - 0.2 " " "
After 300 hrs.	enough to make dewpoint 20-25°C.

Brabag Filed 27 Aug. 1938.
B184450 IVb/12g

Catalyst ovens or tubes are emptied of catalyst by suddenly applying a gas pressure of 5-20 atm, preferably after wetting the pressure side of the catalyst bed with a liquid.

Brabag Filed 29 May, 1937.
B178627 IV/26d
Addition to B175954 VI/26d

A catalyst containing an oxidizing salt such as sodium nitrite on a support such as active carbon is used for organic sulfur removal (as covered by 175954) and when spent for this purpose is used to convert organic sulfur to H_2S, which can be removed by well known methods.

Brabag Filed 24 June, 1937.
B178964 IVc/12 o

Using the relative CO_2 content or density of end gas in comparison with charge gas as a guide for adjusting operating conditions, particularly coolant supply.

Brabag
B179047 VI/26 d Filed 29 June, 1937.

Carrying out the catalytic removal of organic sulfur compounds from gases by plural stage operation with a higher temperature in the last stage than in the first.

Brabag Filed 14 Aug. 1937.
B179612

Synthesis gas from brown coal is freed from resin forming constituents, independent of desulfuring, by cracking in a cowper stove or adsorbing on active carbon, brown coal, coke, or bleaching earth.

Brabag Filed 8 Sept. 1937.
B179862

Oil from the Fischer Tropsch is neutralized by percolation through bleaching earth at about 150°C.

Brabag Filed 8 Sept. 1937.
B179863

Oil from Fischer Tropsch synthesis is neutralized by contacting with iron oxide in the form of gas purification "Masse" or

Ruhrchemie
R103714 IVd/12 o

Filed 7 Nov.1938.

Synthesis catalysts are regenerated in situ by removing paraffin and then treating at an elevated (not specified) temperature with hydrogen passed at high velocity, preferably 1000 cubic meters per hour per square meter cross section. The hydrogen can be recirculated if the CO and CO_2 content is kept below 2.5 gm per M^3 and H_2O less than 1 gm per M^3. Activity attained this way is stated to equal that of a reworked catalyst.

Braunkohle
B184414 IX/42i

Filed 23 Aug. 1938.

A thermocouple with the leads extending in opposite directions from the junction to avoid the problems of electrical insulation etc. associated with parallel leads. For measuring the temperature along the center of a vertical reaction tube the leads would pass through stuffing boxes at the top and bottom of the tube so that the junction could be raised or lowered as desired.

Brabag
B181705 IVd/12 o

Filed 31 Jan. 1938.

Addition to B 178085 IVc/12 O carrying out exothermic reactions such as Fischer-Tropsch synthesis with such a large percent of inert gas in the charge gas that the entire heat of reaction can be carried out as sensible heat of the effluent without harmful temperature rise. No data given.

Brabag
B181885 IVd/23b

Cracking heavy hydrocarbons over catalysts which serve at lower temperatures for the synthesis of hydrocarbons from Co and H_2. Such a catalyst which is spent for synthesis can be used for cracking. The oil to be cracked may be vaporized or atomized with H2. A cracking temperature of 300-350°C is suggested.

Brabag
B182020 IVd/12 o

Filed 19 Feb. 1938

Pretreating a synthesis catalyst with synthesis gas containing NH_3 for about 20 min. at 185°C. Longer catalyst life is stated to result.

Brabag
B182388 IVd/12 o

Filed 15 Mar. 1938.

Fresh catalyst, preferably blanketed with CO_2 when charged to the oven, is wet with synthesis product, at least in the top part of the oven, to minimize the tendency to excessive reaction and harmful overheating of the fresh catalyst when first put into service.

Brabag
B182389 IVd/12 o

Filed 15 Mar. 1938.

Extracting paraffin from synthesis catalyst by supplying vapors of a solvent, preferably synthesis oil, of such a boiling point that condensate therefrom is formed and flows down through the catalyst to extract the wax at a temperature above its melting point.

Brabag
B183662 IVd/23b

Filed 25 June 1938.

To avoid fog formation in condensing oil from synthesis oven effluent by spraying with water, vapors of the oil condensate, or of some oil miscible with the condensate, are combined with the effluent ahead of the water spray.

Ruhrchemie
R102874 IVb/12m

Filed 1 July, 1938.

In the reworking of spent synthesis catalysts the primary Na_2CO_3 precipitate containing Th and Fe is dissolved in H_2SO_4, Th is precipitated as thorium potassium sulfate by K_2SO_4, this is separated and washed and then converted to thorium hydrocarbonate by digestion with concentrated Na_2CO_3 solution.

Ruhrchemie
R102909 IVd/12 o

Filed 20 July, 1938.

Making relatively light products from the hydrogenation of CO by using a catalyst containing not more than 33% by weight of active metal and operating at relatively high temperatures (235-240°C with Co) and high space velocities (up to $9m^3$ synthesis gas per Kg Co per hr).

Ruhrchemie
R102756 IVd/23b

Filed 2 July, 1938.

The octane number of benzin from the hydrogenation of CO is improved (from 5 to 10 points) by passage over material of high surface area such as silica gel, active carbon, acid treated clay etc. at 180-200°C, apparently as a result of isomerization.

Ruhrchemie
R103371 IVb/12n

Filed 20 Sept. 1938.

The calcium impurity in cobalt nitrate solution prepared in reworking catalysts is precipitated by a soluble fluoride in the presence of added magnesium (nitrate). Any excess of soluble fluoride over that required to precipitate Ca will precipitate as MgF_2, thus leaving no fluoride in solution to precipitate inactive cobalt fluoride when Na_2CO_3 is added.

R-105297 IVd/120 Filed 24 May, 1939.

Increasing production of high molecular weight hydrocarbons by using a catalyst on a support of very low bulk density. Low temperatures (160-180°C) low space velocity (4 liters/hr/kg catalyst) elevated pressure (10-20 kg/sq.cm) and high cobalt content (over 100 gm. cobalt per liter of catalyst) are recommended with a catalyst support consisting of uncalcined magnesia or low density kieselguhr.

R 105508 IVd/120 Filed 24 June, 1939.

Process and apparatus whereby more uniform flow is mainteined through a bed of synthesis catalyst by supplying the synthesis gas through a valve or orifice causing a considerably greater pressure drop than the catalyst bed itself.

R 105615 IVd/23b Filed 7 July, 1939.

Preparation of high anti-knock fuels by heating a Fischer-Tropsch product with a small quantity, about 10%, of the bituminous components of hard coal or brown coal, freed from ash, and preferably under pressure and in the presence of a catalyst and hydrogen. Specifically a Pott-Brosch coal extract is mixed with Fischer-Tropsch product boiling from 200-250 C and passed over a molybdena catalyst with hydrogen at 480-500°C under 80 atm pressure, whereby 70 octane gasoline is obtained. The unconverted kogasin is recycled.

Braunkohle-Benzin A.G.
185 130 IVd/120 Filed 3 Nov. 1938.

Controlling the temperature in the catalytic hydrogenation of carbon monoxide by carrying out simultaneously over the same catalyst an endothermic reaction, specifically the catalytic cracking of alcohols and preferably of isobutyl alcohol.

Ruhrchemie
R-103450 IVd/120 Filed 1 Oct., 1938.

Reducing catalysts for hydrogenation of carbon monoxide with hydrogen containing less than 2.5 gms oxides of carbon and less than 1 gm water vapor per cubic meter to get faster reduction and a more active catalyst.

Ruhrchemie
R-103507 IVd/12m Filed 8 Oct., 1938.

In recovering thorium the iron content is minimized by dissolving the iron-thorium slurry with sulfuric acid, adding potassium sulfate to precipitate potassium thorium sulfate and decomposing the latter with sodium carbonate in the presence of

enough additional potassium sulfate to maintain the ratio of K to Na sulfate greater than 1:1. The potassium thorium sulfate is washed with saturated potassium sulfate until the wash liquor contains only traces of iron and then the double salt is "cooked" (under conditions not specified) with the sodium carbonate-potassium sulfate mixture to make thorium hydrocarbonate which contains less than 0.3 parts Fe_2O_3 per 100 parts ThO_2.

Improvement on R102874 IVd/12m.

Ruhrchemie
R103605 IVb/12m Filed 24 Oct., 1938.

Improvement on R103507 IVb/12m consisting in treating the washed potassium thorium sulfate with an excess of sodium carbonate to redissolve the initially formed thorium hydrocarbonate as alkali thorium double carbonate and heating this solution to 90°C whereby colloidal iron hydroxide is precipitated, together with a small amount of colbalt which may be recovered by recycling. Sulfuric acid is added to the solution to precipitate thorium hydrocarbonate (free from iron) which is filtered out and washed with water. HCl may be used for this precipitation and the solution may be cooled to precipitate alkali sulfate for reuse.

Ruhrchemie
R103713 IVd/12 o

Regenerating synthesis catalyst in situ by continuing hydrogenation after completing wax removal but with increasing temperature. For example treating for 2.5 hrs at 200°C with a mixture containing 25% N_2 and 75% H_2; raising the temperature to 350°C during the period of $\frac{1}{2}$ hr and treating at this temperature for $\frac{1}{2}$ hr; treating $\frac{1}{2}$ hr at 400°C and finally at 2 hrs at 450°C. Original activity is stated to be restored by this procedure.

Ruhrchemie
R103712 IVd/12 o Filed 7 Nov., 1938.

Used synthesis catalyst is subjected to oxidation under unspecified conditions except "elevated" temperature prior to regeneration with hydrogen, whereby the regeneration is said to proceed more rapidly and effectively.

Ruhrchemie
R103980 IVd/12 o Filed 6 Dec., 1938.

Kieselguhr to be used as a synthesis catalyst support is treated with a relatively volatile acid such as HCl or HNO_3 to remove inorganic impurities and is then oxidized below the sintering temperature to remove organic matter and the remaining traces of acids. Alternatively the metals may be removed as bicarbonates by blowing CO_2 through a suspension of Kieselguhr, after which the Kieselguhr is washed, dried, and calcined 1 hour at 550°C.

APPENDIX D.

ABSTRACTS OF PATENT APPLICATIONS

RELATING TO THE

Ruhrchemie
R-104584 IVd/120

Filed 20 Feb., 1939

To make products of lower molecular weight and higher olefin content the hydrogenation of CO is carried out with recycling of the product gas after separation of condensibles by cooling and charcoal absorption. With a cobalt catalyst at 200-230°C, a recycle ratio of 3:1 to 10:1 is preferred. A relatively high pressure, 3-10 atm., and high temperatures 200-230°C, can be used. The resulting gas and gasoline is stated to be about 75% olefinic and 55% of the product is in the C_2-C_4 range.

Ruhrchemie
R-104876 IVd/120

Filed 28 Mar., 1939

The hydrogenation of CO is carried out by passing synthesis gas into a suspension of finely divided catalyst in a suitable oil, preferably with mechanical agitation to distribute the gas, and simultaneously introducing a liquid such as water, which vaporizes under the reaction conditions to control the temperature. For example, 1270 gms of Co-ThO_2-MgO-Kieselgur catalyst containing 400 gms. Co is suspended in 15 litres of oil boiling from 240°-300°C. Synthesis gas containing 1 Co;$2H_2$ is introduced at a rate of 2.5 litres per gm Co per hour, and a pressure of 10 atm. is maintained in the reaction. The synthesis starts at 190°C and the temperature is gradually raised to 210°C as water is introduced to maintain this temperature. The contraction of synthesis gas amounts to 85% and the yield of liquid and solid hydrocarbons amounts to 172 gm/m^3. The liquid product contains 90% boiling up to 300°C and having an olefin content of 20%.

Ruhrchemie
R-104999 IVd/120

Filed 15 Apr., 1939

Preparation of synthesis catalysts by precipitating from sulfate instead of nitrate solution and activating by washing with alkali carbonate or hydroxide solution. For example, a catalyst containing 100 parts Co. 10 parts Mg O, 5 parts ThO_2 and 200 parts kieselguhr is prepared from a solution containing 40 gms/liter of Co in the form of sulfate. The precipitate obtained by addition of "soda" is washed first with water (1 liter per 25g Co) then with n/20 $(NH_4)_2CO_3$ (1 liter per 25g Co) and finally with water (1 liter per 25g Co).

8). Ascertaining the name of the Werke Commissar for Production (Rheinpreussen).

Re: Storage Places

Please be advised that for purposes of efficiency, the various storage places have been given individual account numbers. These are as follows:-

22030: All expenditures pertaining to shipments made to Alem, Stiepel, Mann.-Linden, Coswig, Hildesheim, Heilbronn, Bugstall. In the case of the last two cities only those expenditures which are not made for the laboratories, are to be considered.

22031: Shipping expenditures to Harderslaben and Harderslaben Nachterstedt.

22032: Expenditures for shipments to Bredelar.

Expenditures incurred for any other shipments, such as for laboratories, experimental stations, etc, shall, as heretofore, be entered under number 2203, next to the account of the consignee.
For example:
2203/490 for Laboratories
2203/491 for motor testing labs.
2203/600 for experimental stations.

Expenditures entered in accounts no. 2203-22032 should show the purpose of the individual shipment.

To the Rustungskommando
Essen - Bredency
Am Wiesental 10

February 24, 1945

Re New Location

Replying to your letter of the 10th inst. we herewith, give you a list of the new locations of our chemical plants.

The Alcohol & Acetone Plants will be moved to Bredolar in Sauerland. All necessary machines, apparatus and pipefittings have been forwarded there. The building order for this plant has been

given and is being carried out.

The Carburol Plant will be built in a larger scale in Hedersleben near Nachterstadt. The necessary machines, apparatus and pipe fittings have already arrived on the new location; the building order has been given and is being carried out.

For the Fischer Synthesis Plant we have a moving order to Alme in Sauerland. A great part of the machinery apparatus and pipe-fittings for it has arrived. A building order has not yet been given.

The Addresses to which we are moving are as follows:-

Dr. Hermann Häusser & Co., Bredolar

Paul Cullmann & Co., Hedersleben

Karl Henkel & Co., Alme

The Research Laboratories have been moved to Lüdenscheid. The order has been given as well.

The Experimental Plant for Research on Iron Catalysts has been moved to Bochum-Stiepel to the building of our Mine Gibraltar-Erbstollen. Here we also intend to erect a pilot plant. The order for the pilot plant has not yet been given.

Up to now 354 railway trucks have left to the new locations.

Steinkohlen Bergwerk
"Rheinpreussen"
Die Direktion

Gez. Kost

Operating Means:

H_2SO	5 tons per month
NaOH	5 tons per month

Power:

Water (15° C)	200	m^3/h
Current (500 V)	65	KWh
Steam (10 atm.)	2	t/h
Steam (2.5 ")	4.5	t/h

Fixed date suggestion:

Commencement of dismantling	1.11.44
End of dismantling	1.12.44
Commencement of construction	15.11.44
Commencement of assembly	15.12.44
End of assembly	15. 2.45

Assembly personnel required:
(not including building workers)

	15.12	1.1	15.1
A-Welders	7	10	15
E-Welders	3	5	15
Fitters	10	20	30
Assistants	20	40	60

Traffic:

Incoming: 3 tank wagons per month
Outgoing: 14 tank wagons per month
10 tank gas wagons.

4). Karburol Plant 3, Plant Bergkamen.

The plant is already dismantled partly, but the erection site is not yet known so that the dismantling work on this plant is also hindered owing to the change in the assembly site. Hoyerswerda/Lausitz is intended as the prospective locality.

5). Top Plant Taube 1 in Messinghausen.
Taube 2 in Muehlenbein.

These plants were inspected. They are two new twin plants with 3,000 tons per month raw material operating on 50% residue. The construction of the plants is very primitive (brick furnaces, small suspended roof, cooler and heat exchanges without compensation and without facility for switching off, no regulators, pumps in the open, steam supply from old locomotive boilers).

The date for starting was fixed at about 6 weeks ago, but neither of the two twin plants are ready for operation as yet. Considerable difficulties will presumably occur in the maintenance of the plant in the event of snow and severe cold.

The erection of Taube 1 in regard to A.R.P. is good, that of Taube 2 poor, as the latter is built into the centre of a circular stone quarry (crude oil tank with furnace).

Points to be clarified.

a) Karburol Plant2:

1). Fixing ultimate locality and ultimate despatch address.

2). Advising the Army Order Number by GbChem via DBHG to Still.

3). Works Commissar for Production.

b) Alcohol Plant:

1) Permit for dismantling from Geilenberg and the provision of labor.

2). Permit for re-assembly from Geilenberg and provision of labor.

3). Definite confirmation of the projected site Bredelar.

4). Despatch address for the new site.

5). Ascertaining name of the Trustee Administrator (DBHG?)

6). Ascertaining name of the Works Commissar for Construction and Erection (DBHG?)

7). Ascertaining the name of the assembly firm (Dr. Otto?)

The attention of the various service departments has repeatedly been called to the urgent necessity for the immediate dismantling of the Karburol and the alcohol plant because dismantling at a later date would be rendered doubtful owing to expected enemy action. The following points must be clarified immediately:

The fundamental permit for dismantling and/or reassembly and the provision of the corresponding number of workmen, furthermore the definite erection locality so that the individual apparatuses can be removed from the works one after the other and a bottleneck on the dismantling site avoided.

Draft for the Building Maturity Declaration.

for the decentralisation of the alcohol plant and acetone plant of the Fuel Works Rheinpreussen, Homberg/Niederrhein, to Bredelar (Sauerld).

Alcohol-Acetone Plant Rheinpreussen

Consisting of:

a) Polymerisation.
2 Stirring Plants.
2 Mixers.
4 Boilers
2 Coolers (100 m^2)
6 Pumps (each 3 m^3/h)
Various Small Tanks and Apparatuses.

b) Sulphuric acid regeneration.
2 Evaporators.
2 Re-evaporators.
1 Vacuum Condenser.
2 Vacuum Pumps.
Various small apparatuses.

c) Water Extraction from Alcohol.
1 Column 900 Ø x 15000
2 " 700 Ø x 7000
3 " 700 Ø x 4000
12 Condensers totalling 150 m^2
10 Pumps each 3 m/h
Various small apparatuses and tanks.

d) Acetone Plant.
1 Tube Furnace
3 Blowers
1 Evaporator
1 Distillation Column
4 Pumps
Various containers

e) Tank Store.
6 Tanks 2000 Ø x 8500
11 Tanks 1600 Ø x 6000

All above plant components are undamaged and in good condition.

Quota requirements:

Machine iron	35 tons
Construction iron	40 tons
NE metals	5 tons

Costs

for construction	RM 50,000.-
for assembly	RM 80,000.-

Capacity:

To be used:	25 tons per day cracking gas (30% Olefin content) = 7.5 tons per day Olefine from the Jakob II plant.
Product:	7 tons per day alcohol.
	1.2 tons per day acetone.
	7 tons per day liquid gas (for fuel purposes)
	Rest: Heating gas.

Labour:

12 Men
15 Women

Operating Means:

H_2SO	5 tons per month
NaOH	5 tons per month

2) Karburol Plant 1 (Jakob 11). Luetzgendorf.

Contractor: Wintershall A.G.

Trustee administration until completion: DBHG/Berlin.

Building supervision for buildings and power supply: DBHG/Berlin

Building supervision for apparatus components: The firm of Still/Recklinghausen

Works Commissar for Construction & Erection: Dr. Kox, DBHG/Berlin

Works Commissar for Production: Dr. Seifert, Wintershall A.A., Salzbergen.

Responsible for the Apparatus Section: Dr. Schmidt, Still/Recklinghausen.

Old Locality: Luetzgendorf.

New Locality: Bredelar

Despatch address for goods traffic: Bredelar, junction railway Zechitwerke.

Raw product to be used:

Mineral oil residue 60,000-75,000 tons per year = 5,000-6,250 tons per month = 240-300 tons per day = 10-12.5 tons per hour, 250 working-days.

Ultimate products:

Raw benzine	25%	= 60 - 75 tons per day.
Raw Diesel fuel	25%	= 60 - 75 tons per day.
Gas	12%	= 29 - 36 tons per day.
Heating Oil Residue	36%	= 86 -108 tons per day.
Loss	2%	= 5 - 6 tons per day.
	100%	=240 -300 tons per day.

Power requirements: Steam (10 atm) 30 tons per hour.
Water (15°C) 600 m³/h.
Current (220V) 600 KWH

The power supply is arranged in such a manner that the power for the alcohol plant of Rheinpreussen can be supplied by the cracking plant.

New Apparatuses for Feeding the "Gasol" to the Alcohol Plant:

1 Gasometer 300 m^3
2 Compressors (from Rheinpreussen)

Dates:

Commencement of dismantling: 16.10.44. End of dismantling: 30.11.44.
Commencement of Assembly: 15.11.44
Starting date : 18.1.45

3). Alcohol Plant Rheinpreussen.

A basic agreement was mde with the Wintershall A.G. to the effect that the alcohol plant is to be erected in conjunction with the Karburol Plant 1 (Luetzgenforf). The raw product to be used (7,200 - 9,000 tons per year cracking gas with 30% Olefin content = 12% of the quantity used for the Karburol Plant) is supplied by the latter so that it is advisable to set the alcohol plant up in the immediate vicinity of the Karburol Plant. The locality coming into consideration which is about 200 m away from the cracking plant (Bredelar Sauerland) was inspected very thoroughly. The gas is fed to the alcohol plant in a compressed state (smaller pipelines) for which a small gasometer (200 m^3) and 2 compressors are required; The latter will be provided by Rheinpreussen.

The steam required of 6,5 t/h (10 atm) as well as water (200 m³/h) and current (65 KWh, 500 V) will be taken from the power production of the Karburol Plant 2 which will be constructed on a correspondingly larger scale. In addition, a transformer 500 V, 65KWA must be procured because the cracking plant operates on 220 V.

It has been possible to convince the competent authorities of the GbChem (Dr. Altpeter and Dr. Sorg) as well as the Production Board (Dr. Romberg) of the necessity for immediate decentralisation of the alcohol plant.

In spite of the greatest efforts made it has not been possible to obtain a definite decision from Herr Geilenberg or Herr Leidreiter - a decision desired by Rheinpreussen - because a discussion did not take place on that day as these gentlemen were too busy. Herr Thelen is to try to obtain from Herr Leidreiter the official permit for dismantling and if possible for the assembly of the alcohol plant.

Raw product to be used: Lignite distillation tar or EGR tar

Capacity: 16,000 tons per year = 2,000 tons per month = 65 tons per day = 2.7 per hour with 250 working days.

Ultimate Products:

Raw benzine	25% = 16 tons per day.
Raw Diesel fuel	25% = 16 tons per day.
Gas	12% = 8 tons per day.
Heating oil residue	36% = 23.5 tons per day.
Loss	2% = 1.5 tons per day.
	100% = 65 tons per day.

Power requirements:

Steam (10 atm.)	10 tons per hour.
Water (15°C)	300 m³ per hour.
Current (500 V)	200 Kwh.

Commencement of dismantling 17.10.44. End of dismantling: 15.11.44 in Moers.

Commencement of dismantling 1.11.44 End of dismantling: 30.11.44 in Rauxel.

Commencement of work on the building site: 1.12.44
Commencement of assembly: 15.12.44
Starting date: 28. 2.45.
Date for beginning of operation: 15. 3.45.

} Provided the ultimate locality is announced immediately

Quota agent: The firm Still via DBHG/Berlin

Quota weight: 120 tons unalloyed.
22 tons alloyed.
50 tons tank.
0.5 tons NE

Condition of the old plant:

Apparatuses, scaffoldings, furnaces well preserved.
2 Tanks destroyed.
All measuring instruments and regulators damaged or in need of repair.
A few regulators are missing.
1 x 3000m³ Gasometer must be newly erected.
The boiler plant will be procured by the Olbau.

Personnel essential for assembly:

By 15.12.44.

5 E-Welders 5 A-Welders 10 Fitters 20 Assistants.

By 1.1.45.

10 E-Welders 10 A-Welders 20 Fitters 40 Assistants.

By 10.1.45

15 E-Welders 15 A-Welders 30 Fitters 60 Assistants.

Current (220 V) must be available on the building site by 15.12.44.

Traffic: Incoming: 6 trucks per day.
Outgoing: 5 trucks per day.

A.R.P.: Camouflage of the plants, bunker or galleries.

Cost of the plant: Will be decided later.

Report on the progress of dismantling (number of trucks despatched number of men employed, erection of the parts despatched, etc.) must be made very week to Head Engineer Weiss, DBHG.

Berlin-Charlottenburg 2
Knesebeckstr. 99: Tel. 31 80 21

Place where the parts to be despatched are warehoused:

Temporarily : Riebeck'sche Montanwerke Nachterstedt-Hoym

5)

Discussion and Inspection in Messinghausen and Bredelar.

Topic of discussion: Karburol Plant 1 (Jakob II and Alcohol Plant).

Present were:

Dr. Seifert, Wintershall A.G./Salzbergen

Dr. Schmidt, Still/Recklinghausen

Obering. Breitbach, Still/Recklinghausen

Obering. Weiss, DBJG/Berlin

O.T.-Stab, Building site, Messinghausen

Dir. Dr. Grimme, Rheinpreussen/Moers

Ing. Cullmann, Rheinpreussen/Moers

1) Karburol Plant (Jakob 9) Rheinpreussen.

The existing Karburol Plant Rheinpreussen is to be set up in combination with a new vaccum distillation. A few parts from the greatly damaged Viktor Rauxel Plant are to be taken to supplement the former. Provisions have been made to use as a raw product lignite distillation tar or BGR tar which is to be supplied by the Riebeck'schen Montanwerken Nachterstedt near Aschersleben. The originally intended locality of the plant in Miltisch-Roitschen near Meissen was, to begin with, changed for Frose (in the vicinity of Riebeck'schen Montanwerk), but this suggestion was turned down by the GbChem (Mr. Pfanndler) for A.R.P.-technical reasons because there is an exceptional accumulation of large-size industrial plants at the proposed locality (closed-down lignite mine). Dr. Gerich of GbChem has immediately gone in search of a new locality in the vicinity of Nachterstedt. As soon as a suitable locality has been found Dr. Gerish will advise us immediately. Special attention was called by Rheinpreussen and the firm Still to the fact that, owing to constant changes in the selection of the locality, the dismantling and assembling work has already been delayed by six weeks, as a result of which the demanded starting date (18.1.45) has been rendered doubtful.

The same conditions apply to the plants Karburol 1 and 3. In order to be able to carry out the dismantling work at an accelerated pace, however, it was agreed that until a final decision has been reached in regard to the locality the dismantled parts are to be sent for storage to the Riebeck'-schen Montanwerk. Dr. Pfaff (Riebeck'sche Montanwerke) declared his willingness to make suitable premises available for that purpose. The unloadking of the trucks will be supervised by our gang leader Tombrink. 12 men have been asked for by teleprinter from the O.T. through Dr. Sorg (GbChem) for the purpose of unloading. The unloading gang is to arrive at Nachterstedt on 31.10.44.

The temporary despatch address reads:
"Steinkolenbergwerk Rheinpreussen
i.Fa. Riebeck'sche Montanwerke,
Neues Schwelwerk,
Nachterstedt-Hoym".

In regard to the trucks which have already been despatched to Miltisch Reitschen, the goods yards there have been informed telegraphically that the trucks arriving are to be passed on to the new address.

Data for Karburol Plant 2.

Trustee administration until completion: Head Engineer Weiss of the DBHG/Berlin.

Building supervision for building and power supply: DBHG/Berlin.

Building supervision for apparatus components: Firm Still/Rechlinghausen.

Works Commissar for Construction & Erection: Dr. Kox, DBHG/Berlin.

Works Commissar for Production: ?

Responsible for the Apparatus Section: Dr. Schmidt, Still/Recklingh.

Old locality: Rheinpreussen/Meerbeck.

New locality: Will be decided later.

APPENDIX C

Documents Relating to
Relocating Moers Equipment

3)
Discussions in Berlin at the GbChem and Geilenbergstab on 25.10.44.

Topic of discussion: Karburol Plant 2 Rheinpreussen and Alcohol Plant Rheinpreussen.

Present were:

Dr. Altpeter, GbChem/Berlin.
Dr. Arnold " "
Dr. Sorg " "
Dr. Pflaundler " " (A.R.P. reporter)
Dr. Gerich " " (Reporter for the locality for erecting new plants).
Dr. Romberg, Production Board.
Dir. Dr. Grimme, Rheinpreussen/Moers.
Ing. Cullmann, Rheinpreussen/Moers.

4)
Discussion at the Riebeck'schen Montanwerken Concordia Nachterstedt on 26.10.44.

Topic of discussion: Karburol Plant 2 (Jakob 9).

Present were:

Dr. Pfaff, Concordia/Nachterstedt
Dr. Gerich, GbChem/Berlin
Dr. Seifert, Wintershall A.G./Salzbergen
Obering. Weiss, DBHG/Berlin
Dr. Schmidt, Still/Recklinghausen
Obering. Breitbach, Still/Recklinghausen
Dir. Dr. Grimme, Rheinpreussen/Moers
Ing. Cullmann, Rheinpreussen/Moers

far enough in the course of the report year so that the technical planning in all particulars could be completed. In addition to this the conversion of acetone to diacetone alcohol and the conversion of the latter to glycol D was brought sufficiently to conclusion so that planning for a technical plant could be taken up.

Two patents were applied for in the above avenues of effort from Dr. Schmitt's division.

Aside from the above, Dr. Schmitt, together with Diploma Engineer Dr. Beier, oversaw the education of the apprentices.

Dr. Campen

The avenues in which Dr. Campen worked were:

(a) Dicarbonxylic acid from perestol fatty acids, etc., etc.

(b) Nitrocarbonic acids from fatty acids and their conversion into amino acids.

Both of the above named problems, which are of importance for the complete synthetic production of artificial fibres, led to results of richest significance, which were described in different patent applications.

(c) Obtaining higher alcohols from olefines of the benzine and kogasin fractions, and a new and what appears to be especially economic way to the solution of the above problem was worked out, whereby there was also obtained valuable information for the recovery of lower alcohols.

(d) Isolation of olefines from synthesis product was further worked out in the laboratory and in the technical experimental plant. Dr. C. further supervised the extension of the laboratories which can be designated as complete in this report year.

Dr. C. was, in all of the above work, in which he showed great diligence and skill, assisted by Dr. Wollner, who could be promoted on the basis of his working out of the separation of olefines from kogasin.

Three patents were applied for in Dr. C.'s division.

Dr. Häusser

Dr. H. was primarily busy with the management of the alcohol plant which experienced a very considerable increase of production, as well as improvement in economies during the report year.

Aside from this Dr. H. worked in the laboratory on the isolation of amyl alcohol from the pentane fractions, the concentration of sulphuric acid by means of submerged burners, and the separation of new kinds of subsidiary products from the alcohol plant (octanesulphones).

Dr. H. has shown himself as a diligent plant manager, exhibiting independence. One patent came from his division.

Diploma Engineer Beier

He dedicated himself with the greatest zeal and scientific attention to all problems of the control laboratories. It should be especially noted that in spite of hindrances from sickness he carried out his work regularly.

Dr. Dannefelser

Dr. D. has conscientiously carried through his work as the division head of the test stands, including the direction of the benzin laboratory, and the control tests of final products. Also he has given useful service in the negotiations with the service and government authorities.

(Signed) GRIMME

4. Development of storage stable delay devices (contd)
(Parchlorit 7) *

5. " " membranes as a safety valve for flame throwing devices.

6. " " incendiary oil for filling flame throwing devices, and in combination with the above

7. " " ~~an aluminum alcoholate plant (see above)~~

8. " " burning tubes (Parchlorit 7) *

9. " " a chemical time igniter (see special application W 109820 XI/721, "Chemical time igniter").

A few additional assignments are yet to be expected.

(signed)
Wiedmann

* See application St 59425 IVb/78i, "Process for preparation of finely dispersed materials, of importance in pyrotechnics, from paraffin wax from the Fischer-Tropsch synthese".

Treibstoffwerk
27 September 1943

To: General Manager Kost,
General Offices

Herewith I send you a review of the productivity of the scientists in the principal laboratories in the past report year.

Dr. Wiedmann

Work of Dr. W. in the past year:

(A) Aluminum alcoholates and their decomposition in the most various ways. Technically useful products, especially thickeners, plastic masses and artificial materials were produced from the aluminum alcoholates and shown to be technically useful.

(b) Aluminum hydroxide and oxide: Intensive work was done on the production of the different modifications. Preparations were in part, taken up for their production on a semi-technical scale. Their usefulness as additives, as rubber filler, as catalysts, as a carrier for serums, as polishing means, and their usefulness for medical purposes was discussed and worked on in conjunction with numberous foreign firms.

(c) Production of ketones, especially acetone was worked on further, and during the report year the technical production of acetone was built up and is being carried forward at present.

(d) A series of developed projects of the Armed Forces (Army and Air Force) was worked upon and, in part, finished. In all of this work, Herr. Dr. W. proved himself to be extraordinarily valuable by reason of his fertility of ideas, his application to his work, and the pleasant way with which he did the work.

In the work mentioned above, he was supported with zeal and success by his assistant Dr. Josten.

Nine patents were applied for in respect to the work above mentioned from Dr. Wiedmann's division.

Dr. Schmitt

Aside from working upon any special current problems in the realm of organic chemistry, Dr. Schmitt was busy with the synthesis of polyvalent alcohols (glycerine substitutes). The work was carried

3. Preliminary Work on Synthetic Resins.

Preparation of methyl ester of ethyl-acrylic acid (beta-methyl gamma-keto-butanol). Preparation and purification of methylisopropenyl ketone and its polymerization products resembling plexigum. For the decolorizing of methylisopropenylketone before its polymerization experiments have been carried out which proved barium hydroxide and other weak alkalis to be suitable * see application St 60877 "Process for the purification of methylisopropenylketone". Furthermore, the preparation of cyclo-hexanone resin (AW-2-Resin), methylvinylketone, and others.

4. Development of the ketone resin "Emekal" from methylethylketone and formaldehyde, as well as the establishment of the process for a production of about 4 tonnes per month. Further improvement of the "Emekal" resin to an almost colorless and above all, hydrocarbon soluble resin type (for example Emekal 350) for the lacquer industry. See application St 60911, "Process for preparation of light colored, easily soluble synthetic resins".

5. Preparation of secondary butyl stearate as a plasticizer.

6. Preparation of aluminum alcoholates. Investigation of different catalysts for the reaction of aluminum with alcohols See application St 59625 IVc/120 and St 59626 IVc/120, "Process for the preparation of alcoholates of magnesium and aluminum".

Use of Aluminum Alcoholate (butyl and propyl) for:-

(a) pyrotechnic purposes (application St 59322 IVd/78d, "Use of metal-alcohol compounds for pyrotechnic purposes")
(b) carbon igniters (application St 59424 IVb/78d, "Process for improving the ignitability and combustion velocity of solid hydrocarbons").
(c) treatment of textile fibres (application St 60815 IVc/8k, "Process for improving textile fibres").
(d) lacquer technique and other purposes, especially the preparation of emulsions and suspensions with the aid of aluminum alcoholates")
(e) medicinal purposes (Professor Engelhardt, Tübingen, as well as Professor Frey, Düsseldorf)

7. Development of the carbonic acid addition products of aluminum alcoholates, particularly of the butyl compounds (application St 59783 IVd/12o, "Process for stabilization of metal alcoholates") Preparation of the material "Carbutal" or "Rh_5" and its use as a gelation medium for lacquers and protective coatings (application St 60358 IV/10b, "Process of thickening and solidifying liquid organic compounds") Likewise a proposal for medicinal use of carbutals (Professor Engelhardt, Tübingen; Professor Frey, Düsseldorf).

8. Development of an aluminum alcoholate plant for a production of about 30 tons per month (application St 61255 IV/12o, "Process for preparation of metal alcoholates; likewise St 59783 above).

9. Preparation of active aluminum hydroxide and oxide from aluminum alcoholates and their technical and medicinal application, as well as the development of an experimental plant for production of aluminum hydroxide and oxide.

10. Working out of a process for recovering pure aluminum from waste and remelted aluminum alloys (application St 61231 IVb/12m, "Process for separation of aluminum from aluminum alloys").

11. Preparation of a new gelatinizing material (Rh_6) from butyl (Butal) and our C_6 - C_9 fatty acids, and also the fatty acids from the Wittener process. Use of the aluminum salts of of these fatty acids for the purpose of "Wa Prüf 5 1c".

12. Development assignments of the "OKH., Wa Prüf 5".

1. Development of smoke tubes (Parchlorit 7)*
2. " " water resistant abrasive devices (Reibsätzen)
3. " " an igniter cartridge for oil (Parchlorit 7)*
4. " " storage stable delay devices

* See application St 59425 IVb/78i, "Process for preparation of finely dispersed materials, of importance in pyrotechnics, from paraffin wax from the Fischer-Tropsch synthese".

3) Production of ethers from alcohols and from olefines.

4) Production of the di-alkyl sulfates for alkylation.

5) Production of tertiary butyl alcohol.

6) Polymerisation of residue gas from the alcohol plant; production of products with high molecular weight.

7) Production of high molecular weight compounds from polymerisation of isobutylene.

8) Production of isobutylene by isomerisation of normal butylene.

9) Experiments on the reaction between olefines and aldehydes, especially formalin; production of glycols.

10) Chlorhydrins, olefine oxides and glycols from propylene and higher olefines -

(a) production of hydraulic liquids from glycols.

(b) polymerisation of olefine oxides.

(c) conversion of olefine oxides with paraffins to alcohols

11) Removal of CO_2 and H_2S from gases with aqueous ammonia.

12) Production of fuel for powdered coal motors from carbon monoxide.

(Signed) GRIMME

Treibstoffwerk, 15 January, 1942.

Projects carried out from 1940 to the present date and the projects under way at present.

Dehydrogenation of hydrocarbons, particularly propane and butane to propylene and butylene over Chromia-Alumina Catalysts developed for this purpose. About 60 catalysts have been developed, of which the following in particular appear to be highly active and technically useful:-

K-33b: A mixed catalyst containing 10% Cr_2O_3 on synthetic Dawsonite.

K-57 : A mixed catalyst containing 18% Cr_2O_3 and especially simple to prepare technically, since it is obtained directly by coprecipitation of aluminum chromate solution with ammonium bicarbonate. See (patent) applications St 59796 and St 61012 IVb/129g,"Process for Preparation of Active Aluminum Oxide-and Aluminum Oxide - Chrominum Oxide Mixed Catalysts".

K-58/K-61: A mixed catalyst of high activity and exceptional mechanical strength obtained by decomposition of aluminum secondary butylate with water followed by direct adsorption of chromic acid - see application St 59655 IVb/12m "Preparation and Use of Purest Hydroxides and Oxides of Aluminum and Magnesium", as well as addition application St 59894 "Process for Preparation of Activated Aluminum Oxide Catalysts".

2. Conversion of Ketones to Alcohols

A process has been developed for the thermal dehydrogenation of secondary alcohols, especially secondary butyl alcohol, to ketones, with the aid of a zinc catalyst (K-67) having a zinc content of 7-9%. The process has been put into use technically for the production of 30 tonnes per month of methylethylketone. In addition a process has been discovered for refining methylethylketone, which tends to turn yellow during storage, by distillation in the presence of calcium hydroxide.

12) Developed contracts of OKH, "Wa Prüf 5 1c":

(a) Development of smoke tubes (Parchlorit 7)
(b) Development of water stable friction devices (?) or grinding compounds (?).
(c) Development of an igniter cartridge for oil (Parchlorit 7).
(d) Development of storage stable retarded devices (Parchlorit 7).
(e) Development of a membrane as a safety valve for flame throwing devices.
(f) Development of incendiary oil for filling of flame throwing devices.
(g) Development of burning tubes (Parchlorit 7).
(h) Development of a chemical time igniter (translater's concept is that this is a delayed fuse of some sort). Refer to our files W 109 820 XI/72 at "Chemischer Zeitzünder".

Research Labpratory No. 2

1) Manufacture of esters of acetic, propionic, and butyric acids with propyl, butyl and amyl alcohols.

2) Separation of olefines and paraffins through treatment with slective solvents, in particular with SO_2.

3) Manufacture of esters of phthallic acid, and other dicarbonic acids (plasticisers, thickeners and glyptals.

4) Reaction between dicarbonic acids, in particular phthalic acid and alcoholates.

5) Investigation of the oxidation products, Parestol and Pantoxyl, in a comprehensive sense. For example, resins of the type of alkyd resins, soaps, washing media, salve basis for pharmacy and cosmetic purposes from fatty acids. Application of the oxy-acids as linseed oil substitutes, hydrogenation of the oxidation products to alcohols and esters.

6) Introduction of the sulphonic acid groups and nitro groups in the paraffin hydrocarbons.

7) Oxidation of the lower paraffins to dicarboxylic acids by means of nitric acid.

8) Dicarboxylic acids from Parestol or from paraffin or through the intermediary of the phenols from coke plants.

Research Laboratory No. 3

1) Conclusion of the theoretical work on secondary octyl acetate (trichloracetic acid and benzene sulphonic acid as catalyst, H_2S formation).

2) Development of the production of secondary octyl acetate into semi-technical operation; corrosion problem, filtration.

3) Production of esters of secondary alcohols of high and low molecular weight.

4) Tests of the additivity of fatty acids to different olefine double bonds (iso-olefines, cyclic compounds).

5) Addition of H_2CO_3 and HCN on olefines.

6) Production in the wet way of pure olefines by means of the esters of secondary monovalent and polyvalent alcohols.

7) Experiments on the composition of kogasins. Fractionation, determination of branch chains and the position of the double bond.

8) Production of fatty acid esters of secondary alcohols from the pure substances for determination of their properties.

9) Explanation of the reaction mechanism of resin formation from ketones, in particular methyl ethyl ketone and formaladehyde; principal reaction, subsidiary reactions influence of single reactions on the quality of the resin.

10) Further experiments regarding methylol compounds, in particular mono- and di- methylol acid-amides.

11) Production of tasteless triglycerol esters from synthetic fatty acids of the Fischer Tropsch synthesis and explanation of the carrier of the scratchy after taste. Esters of "Wittener" fatty acids.

Research Laboratory No. 4.

1) Purification of polymer benzin with phenolates.

2) Experiments in respect to the suitability of isopropyl alcohol as protection against freezing.

APPENDIX B.

TRANSLATIONS OF
DOCUMENTS RELATING TO
RESEARCH ACTIVITIES

The following is a rough translation of a manuscript by Dr. Grimme (said to be Director of the laboratory at Moers) dated January 15, 1942.

PROGRAM OF WORK FOR THE RESEARCH LABORATORIES

Research Laboratory No. 1

1) Dehydrogenation of hydrocarbons, in particular propane and butane to propylene and butylene, also the catalysts (chromoxide - aluminium oxide) developed therefor.

2) Conversion of alcohols to ketones.

3) Work with resins - preliminary.

(a) Manufacture of methylester of ethylacrylic acid
(b) Betamethyl gamma keto butanol
(c) Manufacture and purification of methylisopropenylketone and plexigum-like polymerisation products therefrom.

4) Development of the ketone resin, "Emekal", from methylethylketone and formaldehyde, also the working out of a process for a production of about 4 tons per month.

5) Manufacture of secondary butylstearate as plasticizer.

6) Manufacture of aluminium alcoholates. Experiments respecting different catalysts for the reaction of aluminium with alcohols. Application of butyl and propyl aluminium alcoholates for

(a) Pyrotechnical purposes
(b) Igniters for carbons
(c) The treatment of textile fibres
(d) For Lacquer technique and other purposes, especially the manufacture of emulsions.
(e) Medicinal purposes (Professor Engelhardt, Tübingen and Prof. Frey, Düsseldorf).

7) Development of the carbonic acid addition products of aluminium alcoholates, in particular of the butyl compounds.

8) Development of active aluminium hydroxide and oxide from aluminium alcoholates and their technical and medical application, also the development of an experimental unit for the production of above compounds.

9) Manufacture of a new gelation medium (Rh_6) out of butyl and our C_6 to C_9 fatty acids, also the Wittener-method-fatty acids. Application of the aluminium salts of these fatty acids for the purpose of "Wa Prüf 5 lc".

LIST OF SAMPLES
TAKEN FROM
RHEINPREUSSEN-MOERS PLANT

1. Milk can (not Jerrican) filled with benzin from tank car at Rheinpreussen. Container incorrectly named because sample was not transferred to a Jerrican at 21 Army Group Headquarters for shipment as requested. Sample taken from first tank car at Moers (Deutsche Reichsbahn - Essen - 508394) and the same as smaller sample 5. Composition uncertain. To be subjected to Engler distillation and determination of specific gravity and Bromine Addition No.

2. Milk can filled with Fischer-Tropsch catalyst. This to be sampled carefully under CO_2 for analysis and activity test and the balance sealed for future disposal.

3. One of two pieces of wax (from catalyst washing). To be subjected to vacuum fractionation and determination of of melting points.

4. Jerrican filled with illuminating oil from drums in box car at Moers (not "Benzene from second tank car"). Identity uncertain, although drum was marked "Leuchtol". To be tested like Sample 1.

5. Small can of Benzin from Rheinpreussen I. Sample taken from same tank car as Sample No. 1. Identity uncertain. To be subjected to Engler distillation, determination of specific gravity and Bromine addition No.

6. Can shift convertor catalyst Rheinpreussen. Supposed to be fresh catalyst (of unknown composition) for water-gas shift reaction. To be analysed.

7. Small can of benzin from Rheinpreussen II. Sample taken from second tank care (F.S. Italia Mo. 551033) in Moers plant. Identity uncertain, and no more sample available. To be tested like Sample 5.

8. Can rough purification catalyst for sulfur. Supposed to be "Luxmasse". To be analysed.

9. Can fine sulfur purification catalyst. Supposed to be Luxmasse plus sodium carbonate. To be analyzed.

10. Small can of Fischer-Tropsch catalyst. To be handled like Sample 2. Sample 10 came from same Kubel in Moers plant as Sample 2 but was taken with less precaution against oxidation.

CIOS TARGET 30/5106
RHEINPREUSSEN-HOMBERG.
MOERS-MEERBECK

CLASSIFICATION OF CAPTURED DOCUMENTS FOR STORAGE.

16 April, 1945

MIRS BAG	BUNDLE	DOCUMENTS
1477	A(2)	1,2,3,4,5,6,9,10,14,15,17,20,23,42,51,79, 82,88,89,16.
1477	B	11,21,24,25,29,30,32,33,34,35,36,37,38,39, 40,41,59,61,65,68,69,91,94.
1477	C	7,8,18,19,27,45,48,67,71,87,90,92,95,96,47.
1478	D	26,28,31,72,78,80.
1478	E	12,13,49,50,53,56,58,62,63,64,66,70,81,83, 84,85,86,93,98.
1478	F	22,97,101,102.
1478	G	46,57,60,76,77,103,104,105.
1478	H	43,44,52,54,79,99,100,55.
1478	I	75.
1481	Plans and Maps Nos. 1,2,3,4,5,6 and 7.	

Doc. No.	Class	Title	Micro films
94	B	Letter 8 July 1941 from Ruhrchemie to licensees regarding countercurrent operation of fine purification towers to increase catalyst life.	
95.	G	~~Miscellaneous documents relating to catalyst composition, catalyst handling and regeneration.~~	P
96.	G	Minutes of conferences at Holten July-Aug. 1936 on progress of new construction (Ruhrbenzin?)	
97	F	Miscellaneous documents relating to industrial relations, military service of personnel etc.	P
98.	F	Miscellaneous research programs and summaries including Pantoxyl etc.	C
99.	H	Data on reproducibility of octaine number determination and minutes of 1941 conferences on this subject.	P
100.	H	Fuel consumption test data for engine w 24 Engine and fuel unidentified (1940)	
101.	F	Cards from personnel files at Moers for technical employees and others who might be useful sources of information.	
102.	F	Documents relating to shipment of laboratory and plant equipment, stocks etc. to new locations 1944-1945.	P
103.	G	Chemical Testing Methods for the preparation of Fuels I Coking Industry. E. Merck, Verlag Chemie 1943.	P
104.	G	Publications of Vid. Eisenhüttenleute on Laboratory procedures for the coking industry.	P
105.	G	V.D.I. bulletin DIN 1952 (1943) on procedures for measurement of fluid flow with orifices etc.	P

PLOT PLANS AND DIAGRAMS SEPARATELY LISTED
ALL IN MIRS SACK # 1481

1. Plot plan of Synthetic Fuel Plant 1939
2. Plot plan of Coking Plant (undated).
3. Plot plan of Coking Plant (undated).
4. Plot plan of Coking Plant 1938.
5. Plot plan of Coking Plant 1938.
6. Plot plan of Synthetic Fuel plant colored to show dates of construction through 1943.
7. Flow diagram of Fischer-Tropsch process.

Doc. No.	Class	Title	Micro films
63.	E.	Laboratory subject classification for files etc.	
64.	E.	Original laboratory notes on conversion of Kogasin in lube oils with $AlCl_3$ (1934-1935)	
65.	B	Technology and Prospects of Oxygen Utilization Karwat, Brenn. Chemie 17, 141-149 (1936)	
66.	F	Diagram showing methods of converting coal and possible products therefrom (different from Doc 70)	C
67.	C	Note book containing miscellaneous calculations, partly on diesel fuel blends.	
68.	B	Notes on experiments on purification of synthesis gas with bleaching earth.	
69.	B	Misc. data on effect of active charcoal adsorption ahead of fine purification.	
70.	E	Diagram showing methods of converting coal and possible products therefrom (different from Doc 66)	C
71.	C	Misc. data on synthesis oven and charcoal absorber operation.	
72.	D	Paper by Grimme on recovering light hydrocarbons by charcoal absorption presented at second Chem. Eng. Congress, Berlin 1940.	
73.	C.	Experimental data on charcoal absorption and contact oven performance 1941-1942.	
74.	A	Monthly production estimates and reports for Arsy including some product tests, and related correspondence. Oct. 1941 to date.	P
75.	I	Correspondence and documents cleared through Arsyn regarding prevention and repair of bomb damage including hydrogenation plants.	C
76.	G.	Misc. documents on nomenclature and analytical methods.	
77.	G	Miscellaneous documents on physical and chemical properties.	
78.	D	Flow diagram of Diesel fuel refining process	
79.	H	Tech. Hochachule Stuttgart report on design of engine for testing Diesel or Otto cycle engine fuels.	C

Doc. No.	Class	Title	Micro films
80.	D	Experimental data on substitution of Kogasin for wash oil in benzol recovery. Sept. 1939.	
81.	E	Copies of patent applications filed by Ruhrchemie relating to Fischer-Tropsch from Dec. 1937 to July 1939.	
82.	A	Correspondence with Arsy re production of and specifications for benzin, diesel fuel etc.	P
83.	E	Letter 22 June 1944 re use of sodium-propyl-butyl sulfate in spinning bath for synthetic fibres.	
84.	E	Miscellaneous documents relating to preparation and use of higher alcohols, fatty acids, special waxes etc.	P
85.	E	Miscellaneous correspondence and data re production and use of "Pantoxyl" oxidized wax.	P
86.	E	Private report 3 Feb. 1942 on review of the Esthonian oil shale industry.	C
87.	C	Blank operating report forms used by Brabag.	
88.	A	Actual and prospective production of liquefied gas by all Fischer Tropsch Plants 1939-1940.	C
89.	A	Misc. notes on unidentified conference re F.T. synthesis plants' equipment and capacities (July 1939)	
90.	C	Diagram of sources of C_3 and C_4 hydrocarbon in connection with F.T. synthesis (cf 45)	
91.	B	Photos and description of Pintsch apparatus for charging coke to water gas generator and arranging gas cracker with latter.	
92.	C	Informal reports from Brabag (Ruhland) Jan 1938 on influence of synthesis gas and its impurities on catalyst capacity and life.	C
93.	E	Minutes of conferences of Fischer-Tropsch plant representatives on research and operating problems Nov 1936 to July 1939.	

Doc. No.	Class	Title	Micro films
31.	D	Diagram of Stabilization unit #1.	
32.	B	Drawing of combustion shaft of the cowper stove for gas cracking.	
33.	B	Drawing of slag washing plant.	
34.	B	Detail drawing of masonry on gas generator (1936).	
35.	B	Detail drawing of masonry in "Zundkammer" of gas generator (1941).	
36.	B	Detail drawing of masonry on gas generator (1941).	
37.	B	Detail drawing of masonry on "Zundkammer" of Gas generator	
38.	B	Drawing of fine Purification Plant.	
39.	B	Drawing of fine Purification Plant.	
40.	B	Drawing of fine Purification Plant.	
41.	B	Detail drawing of masonry on dust separator and connecting conduits of gas generator (1941)	
42.	A	Tabulations of equipment and capacities of all "Western" Fischer Tropsch plants Oct. 1939.	P
43.	H	Notes re apparatus for controlling feed of liquefied gas to engine and determining anti-knock value.	
44.	H	Data on relation between cetane and cetene numbers.	
45.	C	Graphs of unidentified variables in operation of second stage of F.T. including $C_2 + C_3$ content of gas 1943-1944 (Cf Doc 90).	
46.	G	Procedure for taking gas samples from ovens and for low temperature fractional distillation of these samples to determine composition (1944).	
47.	C	Blank form for reporting operating conditions and production data all Fischer-Tropsch plants.	
48.	C	Data pertaining to determining condensible hydro-carbons in gas.	

Doc. No.	Class	Title	Micro films
49.	E	Apperently unpublished thesis by W.Beir on a study of the solidification characteristics of mixed waxes.	
50.	E	Miscellaneous and relatively unimportant test data for synthesis, charcoal absorption, cracking and alcohol units.	
51.	A	Detailed calculations of costs of making diesel fuel and alcohols, and reworking synthesis catalysts including pertinent information on processes and quantities 1943-1944.	P
52.	H	Misc. Notes and graphs from engine test laboratory concerning relationships between FeCO and TeL (1939) Engine tests on fuel blends (1944)	P
53.	E.	Original laboratory notes on reactions of "Butal" with various organic acids.	
54.	H	Original notes and report on experiments for measuring vaporlocking tendency in lab. apparatus and in engines (1940)	
55.	H	I.G. report (1941) on reference fuels and accuracy of octane number determination.	C
56.	E	Miscellaneous data regarding wax oxidation in connection with "Parestol" manufacture.	P
57.	G	Miscellaneous analytical methods useful in connection with F.T. synthesis.	
58.	E	Charts representing course of oxidation of parafin wax by blowing with air.	
59.	B	Tests on Moers coal and ash therefrom (1938)	
60.	G	Collection of analytical methods applicable to Fischer-Tropsch operations and products.	P
61.	B	Misc. notes on fine purification experiments and regeneration of catalyst, also tests on shift converter catalyst.	
62.	E	Numbers and titles of patent applications filed by Rheinpreussen-Moers Sept. 1943 to Sept. 1944.	C

APPENDIX A

LIST OF CAPTURED DOCUMENTS

Doc. No.	Class	Title	Micro films
1.	A	Correspondence and accounts in connection with royalty payments to Ruhrchemie Late 1940 through 1944. (Book and loose sheets).	C
2	A	Rurchemie lincense with correspondence and accounts regarding royalty payments 1935 to July 1940	C
3.	A	Record of daily receipts of chemicals, desulfurizing catalysts, oil stocks etc., including weights and origin of shipments Jan. 1942 thru Oct. 1943.	C
4.	A	Daily production figures, primary products only 1943.	P
5.	A	Record of daily receipts of chemicals, desulfurizing catalysts, oil stocks etc., including weights and origin of shipments Nov. 1943 thru 1944.	
6.	A	Daily production figures, primary products only 1944.	P
7.	C	Synthesis catalyst shipments from Ruhrchemie July 1940 to October 1944.	C
8.	C	Raw material requirements for synthesis catalyst preparation from 1936 to date.	C
9.	A	Record of taxable benzin production 1943-1944.	
10.	A	Record of taxable benzal production 1943-1944	
11.	B	Misc. data on gas cracking operation	
12.	E	Construction schedules for improvements and expansion of Moers plant 1942-1943.	C
13.	E	Alcohol production figures in connection with royalty payments to Merck.	
14.	A	Monthly summaries of production, shipments and stocks, including by products, 1944	P

Doc. No.	Class	Title	Micro films
15.	A	Shipping records showing car numbers, weights consignees for all products in 1944.	
16.	A	Daily reports on production, shipment, and stocks including alcohols etc. Jan-July 1944 summarized by months.	C
17.	A	Monthly cost statements including summaries of production 1943 and 1944. Summary of costs for 1942.	P
18.	C	Calculations of conversions per stage and overall for synthesis ovens, 1941 and 1942.	
19.	C	Material and energy balance for gas production and synthesis units including graphs of daily production 1941-1942.	P
20.	A	Cost and production summary for July 1944, (Now combined with 17)	P
21.	B	Miscellaneous papers on gas composition.	
22.	F	Miscellaneous documents relating to Moers personnel and organization.	
23.	A	Daily report sheets for production, shipments and stocks, most of 1944.	P
24.	B	Drawing of complete plant for synthesis gas production at Moers (1938)	
25.	B	Koppers drawings and description of proposed enlargement of Moers water gas plant (1938)	P
26.	D	Complete set of drawings with engineering calculations for all parts of Wilke oil cracking unit and clay treating unit (1939)	P
27.	C	Drawing of special rail car carrying two Kubels for synthesis catalyst.	
28.	D	Diagrams and description of Moers charcoal absorption plant (1939)	
29.	B	Description and drawings of Rheinpreussen Grobreinigung unit built by Aug. Klonne.	
30.	B	Detail drawing of masonry in Zundkammer of gas generators (1942).	

APPENDIX A

LIST OF CAPTURED DOCUMENTS AND SAMPLES

The attached list differs from the original which was prepared in the field and returned with the documents, in the following respects:

1. The titles have been amplified to give a more accurate description of the contents of each document.

2. The documents have been further classified according to subjects as indicated on the following page, and the documents pertaining to each subject have been tied in bundles for convenient future reference. The letter following each document number indicates the subject classification.

3. Many documents have been recorded on microfilm with the cooperation of USSBS. Following the title of documents which have been microfilmed the letter "C" indicates a document completely microfilmed and "P" indicates partly microfilmed.

4. On the subject classification list on the following page the "Sack Number" indicates the MIRS sack in which the subject bundle in question has been placed for storage.

SUBJECT CLASSIFICATION OF DOCUMENTS

		Sack No.
A.	Plant Production and Cost Records, Shipping and Receiving Records	1477
B.	Synthesis Gas Production and Purification	1477
C.	Synthesis Operation including Catalyst Data	1477
D.	Primary Product Recovery and Refining	1478
E.	Research, Development, and By Products	1478
F.	Personnel and Organization	1478
G.	Methods of Test and Analysis except Engine Testing	1478
H.	Engine Testing of Fuels	1478
I.	Bomb Damage	1478

supervisor. They consisted of specialized units servicing:

1) Pit repairs
2) Transport installations
3) Coke oven plants
4) Power station installations
   a) furnaces
   b) machines
   c) transportation installations of every kind
5) Cooling towers
6) Steel construction
7) Electric installations
   a) high tension
   b) low tension.

Requests for services of the shocktroops were to be made to the central Ruhr committee. Debris were to be cleaned out before the arrival of the shock troops so that they could commence work immediately. All necessary repair material was to be on hand. The Stosstrupp supplied the small tools. On the other hand, the individual plants were obligated to have the balance of the machines put into working order, so that full production could be resumed, as soon as the shocktroops completed their repairs. The management of the plant was to inform the stosstrupp unit supervisor of the time the unit commenced and ended work. Furthermore the plant was to supply food and lodgings for these units

Seized records contain considerable information regarding personnel constituting the commission for the Ruhr area. Copies of the code used for reporting the location and extent of bomb damage in the various Arsyn plants were also obtained.

XV ACKNOWLEDGEMENTS

The writers are greatly indebted to Mr. C.Chilvers and associates of The Petroleum Board and to Dr. C.C.Hall and associates of The Fuel Research Station for making tests and analyses of the various samples brought back from Moers. Valuable assistance in reading and abstracting captured documents has been given by Messrs. J.H.Jones, A.R.Powell, W.W.Odell, and H.M.Weir. The cooperation of the U.S.S.B.S. in making available microfilm equipment for photographing many of the captured documents is also appreciated.

Stock	Loss in Tonnes
Crude (Synthetic)	680.3
Grund benzin	172.5
Kogasin-in-N-Diesel Fuel	2.0
Gatsch	11.3
Liquefied Gas	39.8
Kogasin	44.0
Total	949.9 tonnes

Enemy action on 2 Nov. 1944 destroyed 14 tons of Mixed Diesel fuel, and attacks on 2 Nov. and 21 Nov. 1944 destroyed, 103 tons of benzin, which was all the benzin on hand at that time. Of the remaining stocks, 110 tons of "Rohol" were shipped to Brabag and 11.85 tons of mixed Diesel fuel were shipped to Rheinpreussen Schacht IV. This left only 15.5 tons of light Kogasin in car Essen 508394 and 33 tonnes of intermediate oil (not further identified) in cars 551033, 597876, and 505655. There also remained 12.5 tonnes of hard paraffin, presumably that in the storage bin at the North end of the contact oven house, from which a sample was taken. (See page 74 for analytical results) Samples of the oil in cars 551033 and 508394 were also taken and results of the analysis of these samples will be found in the section relating to Kogasin, page 73.

For synthetic fuel plants in general the prevention and repair of bomb damage was organized by Arsyn and considerable correspondence on this subject, dating back to May 1940, was seized (Doc 75). Of the numerous parts of the plants for which protective measures were recommended, special importance seems to have been attached to the storage facilities for lead tetraethyl, and the handling of lead was forbidden unless adequate safe guards against bomb damage were provided. The vulnerability of pipe lines, particularly for water supply, was also a matter of great concern and covered by special instructions. Brabag issued a circular letter (5-12-44) recommending wherever practical, and giving directions for the substitution of canals for pipe lines to handle water supply and drainage in hydrogenation plants, including those which were to be partly underground. Leuna described means adopted for quick emptying of pressure vessels in case of attack. Stettin-Politz described the temporary use of hydrogenation vessels for oil cracking while repairs were being made on other parts of the plant required for hydrogen production. Stettin also recommended independent utility supplies to segments of the synthesis plant (decentralization) to minimize the danger of all production being stopped by a single attack. These recommendations (1 Dec. 1944) concluded with the following significant statement: "This conversion has not yet been undertaken because of an air attack which took place immediately after

the completion of the repairs necessitated for the reconstruction as outlined.----Furthermore this reconversion will require obtaining priority construction material from the Ministry of Reconstruction"

As far back as July 1, 1940, the Reich Economics Ministry ordered all fuel producing plants to reduce their stocks for the duration of the war. They were permitted to keep in stock:

Crude Oil a maximum of the amount needed for a monthly production. (Not subject to this rule were the plants in Ostmark, in the Bohemian protectorate and in the Eastern provinces).

Intermediate products a quantity not exceeding that which could be treated over a period of two months.

Finished products under no condition was any amount to be stored, but was to be shipped as soon as ready.

In May 1942, it was decided, in spite of the shortage of personnel, to create within each plant, a fire brigade, which would at all times be ready to step in in case of fire.

As air raid attacks on the Ruhr increased in intensity and the damage to synthetic oil plants became more serious, a committee met in Rauxel, in September 1944, to compare and discuss the extent of damage suffered by various synthetic oil plants. According to the Geilenberg plan, precautions and reconstruction measures, based on common experiences, would permit a much more speedy resumption of operations, and at the same time eliminate undue loss of time and waste of construction material. In order to make these experiences available to all plants, a commission, composed of 4 to 5 highly specialized technicians, was appointed. This commission, it was decided, would visit the individual plant immediately after the bombing and:

1) advise the management on measures to be taken for the necessary repairs and assist them in estimating the material and labor required;

2) Clear substitution parts for damaged units out of reserves which may be on hand in other synthetic plants.

This exchange of reserve units between the various plants, was expected to prove more efficacious and speedy than calling on the distribution center of the Geilenberg commission.

A Stosstrupp (Shocktroop) service was then created to assist individual plants in repairing damages caused by air attacks, in cases where local efforts would be inadequate. The Ruhr district Stosstrupp units were located in various cities and functioned under

TABLE XXIII

Equipment and Capacities
West German Fischer-Tropsch Plants
October 1939

Plant	Rhein-preussen	Essener Steinkohle	Hoesch Benzin	Krupp Treibstwk.	Ruhrbenzin	Gewerk. Victor
Synthesis Press ure	Atm.	Atm.	Middle	Atm. and "Pressure"	Atm. and "Pressure"	Atm.
Raw Material	H.t.coke & gas	H.t.coke & gas	H.t.coke	?	Coke	H.t.coke
Gas Producers	10*	10(Demag)	6 (Demag)	8	11	3(Demag) 4(Pintsch)
Output per unit M 3/hr	6000	9000				2
Gas Cracking Units	1	?	?	?	?	20000
Output M 3/hr	17000	-	-	-	-	32600
Ideal Gas Production M 3/hr	60000*	57500	36200	48000	63000	52
Number of ovens	96	96	68	72A-20P	52A-72P	41 1 stage
Stages	Optional	48 1 stage 48 2 stage	36 1 stage 32 optional	36 1 stage 36 optional 20 2 stage***	2 stage	11 2 stage 4 optional
Benzin Separation between stages	No**	Yes	No	No	No	Yes
Oil Cracking Unit	Carburol	Carburol	Carburol	Carburol	TVP & UOP	Carburol
Capacity, tons/day	65	125	125	100	100 & 90	50-60
Gas Polymerization Unit	None	None	None	Yes	UOP	Pintsch
Capacity, tons/year	-	-	-	14000	24000	9000

* As of 1 Jan 1940. ** Subsequently changed. *** Pressure ovens.

XIV. BOMBING DAMAGE AND DEFENSE MEASURES

Bombing of the Moers plant was stated to have occured on July 20, August 21, October 25, November 2,8,20,21 in 1944 and on February 23, 1945. The first attack, elsewhere referred to as the attack of July 19 since it started before midnight, practically ended the production of synthetic fuels, although partial repairs permitted small scale operation for a few days theafter. After another heavy bombing on October 25, 1944 attempts to repair the synthesis plant were discontinued and instrument and accessories which could be used elsewhere were moved.

In general the bomb damage in the synthesis plant was widespread and severe. Most of the equipment for charge gas production and purification and for product recovery was completely destroyed. The south end of the contact oven house was very badly damaged but many of the ovens in the remainder of the building looked as though they could be restored to operating condition if desired.

The first serious damage to the coke ovens was caused by the bombing of 25 Oct. 1944 and raids thereafter put the two older batteries permanently out of commission by 21 Nov. 1944. The third (newest) battery of coke ovens continued operation until the bombing of 28 February 1945, four days before the plant was captured. The mine operating machinery was badly damaged by bombing on an unspecified but presumably recent date.

The abrupt drop in actual production as a result of the July 19 raid is well shown by Table IX page 58.

The realization by the plant management that production could not be maintained is evidenced by the monthly forecasts of production submitted to Arsyn from which the following estimates of total liquid products are taken.

1944	Predicted tons, total liquid
June	4800
July	5200
Aug.	4200
Sept.	1200
Oct.	2400

No later forecasts have been found.

On 28 Nov. 1944, Rheinpreussen informed Arsyn that no further production could be expected from Moers.

The monthly statement to "arsyn" for July, 1944 reports the following losses of stocks due to enemy action during that month:

TABLE XXI

West Germany Fischer-Tropsch Plants
Estimated Capacity and Product Quality
July - Sept. 1940
Basis Maximum Diesel Fuel and Gatsch

	Essener Steinkohle	Hoesch (Mid.Pres.)	Krupp Treibstwk (Atm.& Mid) Pres.	Rhein-preussen	Ruhr-benzin	Hewk Victor
Total Primary Products: tons/mo.	4400	2750	4450	5200	5700	2500
Benzin: tons/mo.	3650	995	3200	3900	2200	1300
End boiling point °C	165	160	175	160	145	160
Octane Number	61-62	55-56	60-61	60	58-60	62
Vapor pressure, atm.	0.65	0.78	0.60	0.78	0.70	0.65
Diesel Fuel: tons/mo.	*	1100	1650	1950	1850	900
Boiling range, °C		130-280	-	160-310	145-280	150-310
% below 200°C		55-60	40-50	40	40-50	55
Cetane number		70	85-95	100	80-85	80-90
Solid point, °C		-23.5	21	-25	-25	-35
Flame point, °C		21	35	40	21	57
Gatsch: tons/mo.	*	450	405	360	-	175
% useful for oxidation		85	100	-	-	-
Liquefied Gas; tons/mo.	700	300	250	450	500	400
Wt. % C4		75	70	50	60-70	65

* Diesel oil and gatch not to be made because of lack of distillation facilities.

TABLE XXII

Estimated Capacity of Synthetic Fuel Plants
1940 - 1941*
Metric Tons per year

	Benzin	Liquefied Gas
Gelsenberg	200,000	40,000
Scholven	200,000	40,000
Rheinpreussen	50,000	10,000
Victor	27,000	5,000
Krupp	40,000	8,000
Hoesch	45,000	8,000
Essener Steinkohle	50,000	10,000
Rheinbraun (Wesseling)	100,000	16,000
Ruhrbenzin	60,000	16,000
Total	772,000	157,000

* Capacities for 1941 were expected to be the same except for Rheinbraun (Wesseling) which was to make 20,000 Tons benzin and 40,000 tons liquefied gas.

Most of the seized correspondence regarding shipments to these points excluding detailed lists of goods, are translated and reproduced in Appendix C, page 120.

No information could be obtained as to the new location of personnel from Moers, but in general they probably went with the equipment of the departments with which they were formerly associated.

XIII INFORMATION REGARDING OTHER SYNTHETIC FUEL PLANTS

At a meeting of Fischer-Tropsch plant operators in October 1939 tables were prepared to show the expected output and product quality for all plants in West Germany during most of 1940 (Doc.42). These estimates assumed maximum production of Diesel Fuel and gatsch, with the benefit of various improvements and expansions of plant facilities which were in prospect when the conference was held. Some of these data are summarized in Table XXI page 88. From other records it has been found that the Rheinpreussen expectation of making 100 cetane Diesel fuel with a solid point of -25°C was never realized which suggests that some of the other estimates may be likewise optimistic. The total output estimate for Rheinpreussen proved to be quite accurate and the magnitude of the other production figures does not seem unreasonable. The productive capacity of some of these plants may have been increased subsequent to 1940.

Somewhat earlier (Doc 88) an estimate was prepared for benzin and liquefied gas production by a larger group of plants, which is summarized in Table XXII page 89.

A summary of the type and capacity of equipment in the West German Fischer-Tropsch plants was included in Doc 42 and is condensed in Table XXIII page 90.

Other research and development activities were indicated by miscelleneous documents as follows:-

A letter dated 17 Jan.1945 from the Reichsamt fur Wirtschaftsausban, Berlin, discusses tests conducted at the Textile Engineering School, Krefeld, and directs further tests at I.G. relating to the suitability of di-aluminum-hydroxide, presumably made at Moers, for us as a "Druckverdickungsmittel" in textile dyeing.

A letter dated 15 Nov. 1944 from Märkische Seifen Industrie, Witten-Ruhr, conveys a complaint from their branch factory at Lahr/Baden regarding poor color of "Kontakt-Paraffin" (wax) furnished by Rheinpreussen-Moers.

A letter dated 23 Jan. 1945, from Chemisch-technisches Laboratorium von Hch. Norrenberg, Irmenach bei Iraben-Trarbach, inquires about experimental data on Rheinpreussen's salve base "Symalin".

Correspondence in August 1944 with Krup Treibstoffwerke Wanne-Eickel, explains that lack of manufacturing equipment at Moers makes it impossible for Rheinpreussen to furnish fatty acids to Schering A.G. Berlin, for use in insecticides.

Some correspondence and technical data on the preparation and uses of "Pantoxyl" were found, dated in 1941. This product appears to be an oxidized Fischer-Tropsh wax, useful as a thickening agent, emulsifying agent etc. Some data were also found relating to "Parestol" which appears to be a similar product.

Notes on a conference held at the Bergbauverein, 25 Nov. 1942 showed the following production of fatty acids from different Fischer Tropsch plants.

Rheinpreussen	about 4000 Kg	per month
Krupp	" 2000 "	" "
Rauxel	" 1800 "	" "
Essener Steinkohle	" 3000 "	" "
Hoesch	" 10000 "	" "
Ruhrchemie	Unknown	

The high production at Hoesch was attributed to the use of pressure synthesis there. Methods of recovering soaps of these acids were discussed. Apparently the soaps are used mainly locally as detergents.

XII. RELOCATION OF EQUIPMENT

A number of documents were found which reveal in part, where equipment from the synthesis plant and laboratories was shipped after further operations at Moers became impractical. The most recent statement was a letter from Director Kost to the Rustungskommando, Essen, 24 Feb. 1945, which is summarized below:-

The alcohol and acetone plants are going to Dr. Hermann Hauser and Co. in Bredolar in Sauerland; the Carburol plant to Paul Cullmann and Co. in Hedersleben near Nachterstädt; the Fischer Synthesis plant to Karl Henkel and Co. in Alme in Sauerland; the research laboratories to Lüdenscheid; and the experimental plant for research on iron catalysts to Bochum-Stiepel, in the building of the Rheinpreussen mine Gibraltar-Erbstollen.

A list dated 10 Feb. 1945 indicates that the equipment from the engine testing laboratory also went to Nachterstädt. What appear to be complete lists of the Alcohol plant equipment shipped to Bredolar and the synthesis equipment shipped to Alme were obtained. A long list of laboratory apparatus packed for shipment, presumably to Ludenscheid, was also found.

A memorandum dated 22 Jan. 1945, regarding accounting for the cost of such moving indicated that some equipment was also being shipped to Hannover-Linden, Coswig, Hildesheim, Heilbronn, and Burgstall. The last named destination is apparently near Neumühle northeast of Duisberg, (Rheinpreussen Gewerkschaft Neumühle) where some research laboratory was to be set up as indicated by letters of 24 Jan. 1945 and 26 Jan. 1945.

Bills of lading for material going to Coswig indicate that this came from the Moers hydrogen plant. Similar documents identify the shipments to Hannover-Linden as relating to "Einlagerung Aegier-Norday-Lager, Arbeitsstab Geilenberg".

A detached sheet dated 28 Feb. 1945 lists laboratory equipment and personal property of several individuals, including Dr. Grimme, as prepared for shipment to "Anlage Lachs", suggestive of a coded underground plant but actually not identified. A letter dated 7 Feb. 1945 from Lurgi Wärme, Baubüro Plauen, acknowledges the receipt of contact ovens Nos. 24 and 43. There is no apparent connection between this and the Scheduled shipment of synthesis equipment to Alme. A card from Stadtwerke Chemnitz, Gaswerk III, dated 10 Feb. 1945 acknowledges the receipt of two cars, contents not specified.

used for converting some solid to flake form. In the same room was direct driven horizontal drum about 4x4 ft. entirely enclosed in a heavy housing and built by C.G.Haubolt, Chemnitz. Being assembled in the opposite end of the building was a piece of apparatus which might have been a dryer. It comprised a vertical shaft about 10 ft tall carrying two squirrel cage fans about 6 ft in diameter. Surrounding the fan and spaced about 4 ft therefrom were fin-tube heaters and a frame to enclose the whole in a metal housing. Frame work for some kind of inclined conveyor extended from the floor to the top of the unit, and around the upper part of the fan was a helical structure of angle iron.

XL RESEARCH ACTIVITIES

Although it was stated that all collected laboratory records and reports had been moved to other (unknown) plants, and no evidence to the contrary was seen, a few miscellaneous documents were picked up which give some idea of the lines of research being followed at the Moers plant.

A document dated 15 Jan. 1942, signed by Dr. Grimme comprises the research program as of that date. The departmental documents from which this was compiled were also obtained and indicate that all of the work outlined was in progress and many of the items represented accomplishments rather than proposed future work. The outline submitted by Laboratory No.1 has been translated in full since it was considerably condensed in Dr. Grimme's summary. Also a letter dated 27 September, 1943 from Dr. Grimme to Director Kost was found, summarizing the research accomplishments during the preceding year. Translations of this, and of the above mentioned 1942 documents, are attached as Appendix B, page 108.

A complete picture of the reported research activities can not be conveyed by any further condensation of the outlines in question, but it can be said that the following broad lines of research appear to hold a prominent place in the programs:-

1. Development of dehydrogenation catalyst, including new alumina supports.

2. Conversion of alcohols to ketones and production of resinous products from the ketones.

3. Production of aluminum alcoholates and derivatives for a variety of uses.

4. Production of acids and esters thereof from Fischer-Tropsch wax.

5. Production of glycols and derivatives thereof.

6. Fundamental studies of reactions of fatty acids with olefins.

7. Production of higher alcohols from olefins in benzin and kogasin.

8. Research on pyrotechnics and other assigned problems in connection with the war effort.

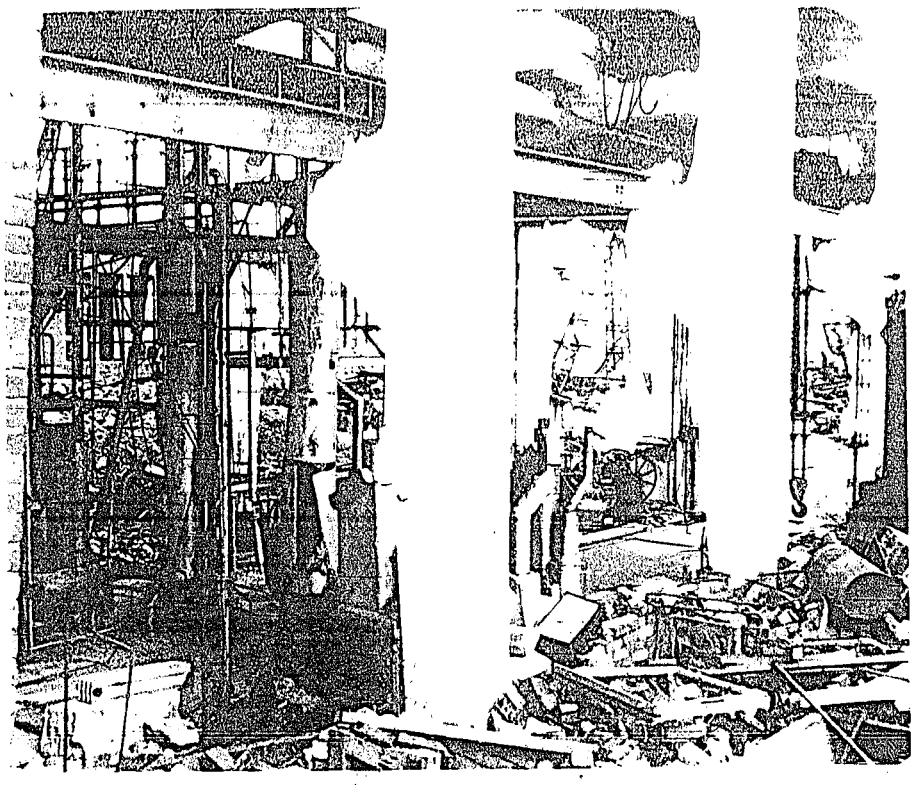

Figure 27.

V LABORATORY FACILITIES

The largest laboratory building (96) had apparently been used for general testing and analytical work. Although the upper part of the building had been badly damaged by bombing, the basement was intact and was well stocked with glassware and chemicals. One private laboratory in the basement had been left as used and all documents therein were examined carefully. In the basement corridors other miscellaneous collections of documents were found and examined. However, no formal research note books or reports were discovered, and the records of greatest value had evidently been shipped away. Two carloads of boxed laboratory equipment and chemicals were found on sidings in the plant but so far as they were examined they yielded no research records.

Building 97 was the automotive engine testing laboratory but no information could be obtained about the work done there except by inspection of the remaining equipment. Two small four cylinder engines were found on test stands without dynamometers. Two dynamometer stands were in the same room without engines. There was no chassis dynamometer. In another room were three stands which probably previously accommodated CFR or IG knock test engines. There was no indication of equipment for supercharged knock testing.

Building 120 and a new building southwest of it, which does not show on the aerial map, were stated to be used for research on lubricants and fats but the informants professed to be entirely ignorant of the details of the work carried out there. The personnel had been moved to an unknown destination about a month previously and no records were found in either building. Among the chemists engaged in this work were Drs. Kölbel, Ackerman, and Langheim.

Building 120 was used for small scale research but the only pieces of apparatus which had survived the bombing were four small heavily insulated units which seemed to involve thermo syphon circulation of a liquid downward through a vertical reactor by means of a heated external return line. A view "through" this laboratory is shown in Fig. 27, page 81.

In the adjacent new building operations were obviously on a larger scale but likewise difficult to identify from the remaining apparatus. The equipment included a batch still of approximately 100 gal. capacity surmounted by a fractionating column about 1ft. in diameter and 20 ft high. There was also a rotating drum about 3x3 ft. with a scraper which might have been

TABLE XX

Alcohol Shipments by Rheinpreussen in 1944

Metric Tons

Principal Consignees	BUTYL ALCOHOL DEGUSSA Buchhausen	BUTYL ALCOHOL DEGUSSA Frkfrt/M	ISO-PROPYL ALCOHOL DEGUSSA Mainz	ISO-PROPYL ALCOHOL I-G FARBEN Frkfrt/M	SEKTOL II PANKOWER Transport Berlin/P.	SEKTOL II Gebrueder 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	-	-	-	-