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FINAL REPORT No. 86
ITEM Nos. 22, 31

OILS AND FATS INDUSTRY

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BRITISH INTELLIGENCE OBJECTIVES
SUB-COMMITTEE

REC'D MAY 1946
TIIC L.F. & L. S-C.

LONDON - H.M. STATIONERY OFFICE

OILS AND FATS INDUSTRY

Reported By:

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CIOS Black List Item Nos 22 and 31

BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE
32, Bryanston Square, W.1.

[1945]
51 p. diagr.

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Personnel of Team

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L.G. Russell)
C.E. Harvey)

FRITZ MÜLLER

Pressenfabrik, Esslingen - Neckar

This firm, which works in conjunction with Hansa Mühle who sell plant for the extraction of soya bean and other seeds, manufactures oil milling machinery and also hydraulic metal stamping presses and presses of various types for tabletting foodstuffs etc. Müller stated that the general tendency of oil milling in Germany is two-stage expelling followed by extraction.

He mentioned that they are designing a new expeller which would handle an input of 150 tons of material a day; he stated that apart from the increase in size it was on conventional lines. His present large expellers which handle 48 - 72 tons a day differ from the pre-war expellers in that they have a slotted bar cage in the first worm section instead of a perforated cage. In these expellers copra could be expelled down to about 25% oil content after the first operation and down to about 13% oil after the second stage. Apart from these changes there were no new developments in the design of their oil milling plant.

The steel used for the expeller cage bars and worm segments is supplied by Vohwinkel, Altena; a copy of the specification has been requested.

Müller also manufactures expellers for treating the acidified pulp used in the preparation of the artificial fibre Zellwolle.

REPORT NO.2

Target No:	F.I.A.T. Main
Full Title:	Gesellschaft für Wärmetechnik m.b.H., Frankfurt
Location:	Target not found
Date of Investigation:	23rd August 1945
By:	B.I.O.S. Trip No.979.

We were not able to trace this target but visited two other targets having similar names:-

(1) "Gewa" Gesellschaft für Wärmewirtschaftliche Anlagen m.b.H. Frankfurt-am-Main, Rankestrasse 8. Ing. H. Heinslein.

(2) W.G.F. Wärmetechnische Gesellschaft Frankfurt-am-Main, G.m.b.H. Kurfürstenstrasse 60.

Both factories had been destroyed. "Gewa" had never manufactured oil milling or oil extraction plant but made central heating plants and industrial heating plants including installations for textile mills and cable works.

No contact was made at target (2) which appeared to have been only a small factory.

REPORT NO.3

Target No:	HQ.21 A.G.
Full Title:	Harburger Eisen- und Bronzewerke A.G.
Location:	Saeve-Str. (off Werderstr.) Harburg.
Condition of target:	65% Operable
Department in which damage located:	Foundry, store, workshop buildings (machines in good condition)
Employees:	
	Pre-war 400 - 450
	War-time 600
	Now employed 200
Personalities:	
	R. Burdewick, Fabr. Director
	Mr Schwartz Engineer-Extraction (designer)
	Mr Halke Engineer - Refinery (designer)
Date of investigation:	30th August 1945
By:	B.I.O.S. Trip No.979.

HARBURGER EISEN- UND BRONZEWERKE A.-G.

This firm manufactures oil milling machinery including the Hildebrandt continuous extractor, oil refining plant, oil hydrogenation plant, plant for margarine, " Fauth" plant for recovering oil from animal offal and plant for making rubber tyres. It is part of the Krupp concern who made expellers at Magdeburg but as Magdeburg is now in the Russian zone it is intended to transfer manufacture to Harburg. At present they are making spare parts for the Krupp expellers but later on hope to manufacture the complete machine in three sizes with inputs of 15, 20 and 50 tons per 24 hrs. respectively. They do not appear to have made any recent advances in oil milling machinery, and stated that there was little fundamental change in design of their expellers.

Meal for extraction in Hildebrandt extractors should not contain more than 15 - 17% of oil and the oil content is reduced by extraction to less than 1%. The solvent losses were stated to be 0.4 - 0.5%. The bronze sieves with 0.5 mm. slots used at the top and bottom of the Hildebrandt extractors are made by Femspalt-Messing-Rima - Siebe, von Louis Hermann, Dresden.

REPORT NO.4

Target No:	H.Q. 21 A.G.
Full Title:	Hermann Bauermeister, Maschinenfabrik und Muhlenbauanstalt G.m.b.H.
Location:	Friedensallee 44, Hamburg.
Condition of target:	80% Operable
Department in which damage located:	Joiners shop and stores
Employees:	Pre-war 150 War-time 90 Now employed 80
Personalities:	Hermann Bauermeister - Director
Date of investigation:	30th August 1945.
By:	B.I.O.S. Trip No.979.

This firm manufactures roller mills, disintegrators and kibblers, etc.

Their equipment appeared to be in good condition but we found nothing new in the way of oil milling machinery.

REPORT NO.5

Target No:	H.Q. 21 A.G.
Full Title:	Mühlenbau- & Industrie Aktien-Gesellschaft (M.I.A.G.), Manufacturers of vegetable oil milling machinery and extraction machinery
Location:	Ernst Amme Str., Brunswick.
Condition of target:	60% Operable
Employees:	Pre-war 3,000 War-time 6,000
Personalities:	Dr Ing. Heinz Gehle - Director R. Schmidt - Chief of milling dept.
Date of investigation:	27th August 1945
By:	B.I.O.S. Trip No.979.

MÜHLENBAU- & INDUSTRIE AKTIEN-GESELLSCHAFT (M.I.A.G.)

This firm manufactures oil milling and extraction machinery, flour milling machinery, and machines for cement works. Production during the war was on a relatively small scale and there have been no recent improvements in oil milling plant.

The M.I.A.G. continuous extractor has been operated in Germany on a commercial scale by Noury & Van de Lande Emmerich and we were told that the plant has been exported to South America and Mexico. The extractor was stated to be capable of dealing with 30 tons of seed in 24 hours; for high outputs the tendency would be to increase the number of units and not the size of the plant. Diagrams of the extractor taken from a paper "Neue Wege in der Extraktion von Ölfrüchten" by Dr Ing Heinz Gehle ("Fette & Seifen", Vol.8, 1940) which gives a description of the plant are attached. After grinding and flaking the expelled seed is fed into cells formed by the main body of the extractor and moving perforated plates and is moved countercurrent to the solvent which is sprayed in on the opposite side of the extractor so that the final treatment is given with fresh solvent. The miscella is filtered through jute and cotton filter bags before evaporation; these bags are dried with open steam once a day, cleansed by hand and replaced.

Solvent loss in the extraction process was stated to be about 1%. The main advantage claimed over other extraction plants such as the Hildebrandt plant was ease of cleaning, and it was stated that this could be carried out without shutting down the plant.

Although at present all seeds other than soya beans are expelled before extraction there are indications in the above paper that consideration is being given to the direct extraction (without expelling) of seeds other than soya beans. Soya beans are readily obtained in a suitable form for extraction by rolling but other seeds need special treatments in order to get them into a satisfactory condition. Dr Gehle gives a brief description of a high output M.I.A.G. conditioner which has been developed for this purpose. In this plant the seed passes under controlled moisture and air-flow conditions between stream-lined radiators heated by steam or hot air. Reference is also made to the advantages of washing seed before conditioning; it is

claimed that this assists in the swelling of the grain during conditioning and that it avoids the presence of fine dust in the miscella.

The M.I.A.G. also manufactures a low pressure expeller for a seed input of about 60 tons per 24 hours. Usually expelling is done in two stages. The same expeller is used for the first and for the second stage with possible variations in the worm assembly and the spacings of the expeller cage.

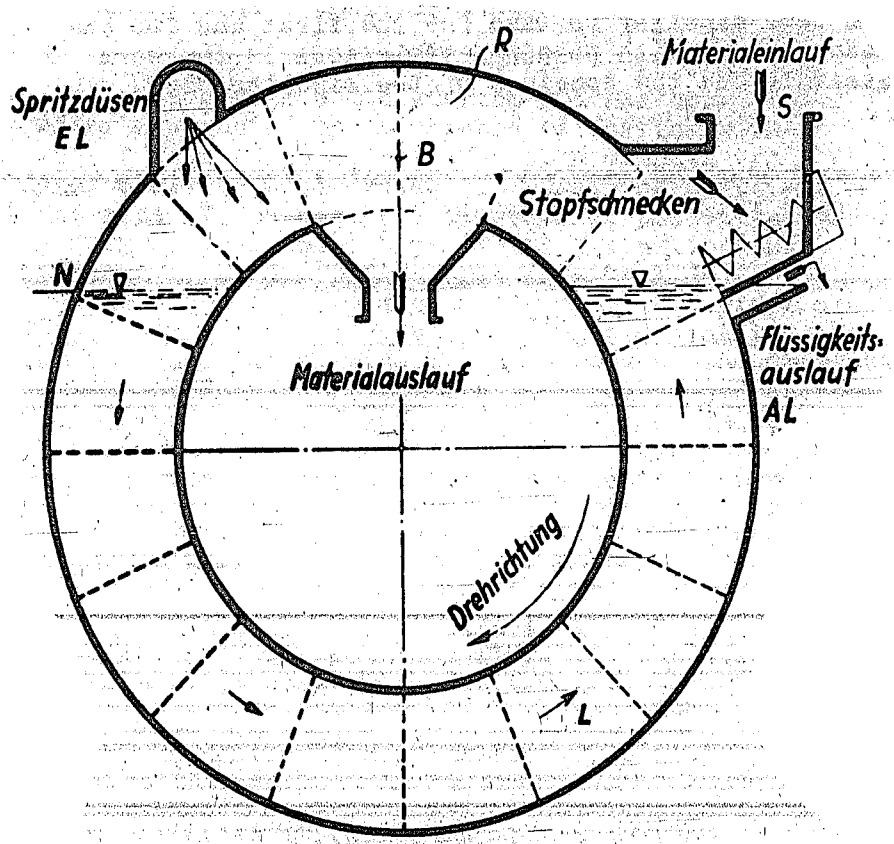


Abb. 1. N = Flüssigkeitsspiegel, EL = Eintritt des Lösungsmittels, AL = Auslauf des Lösungsmittels

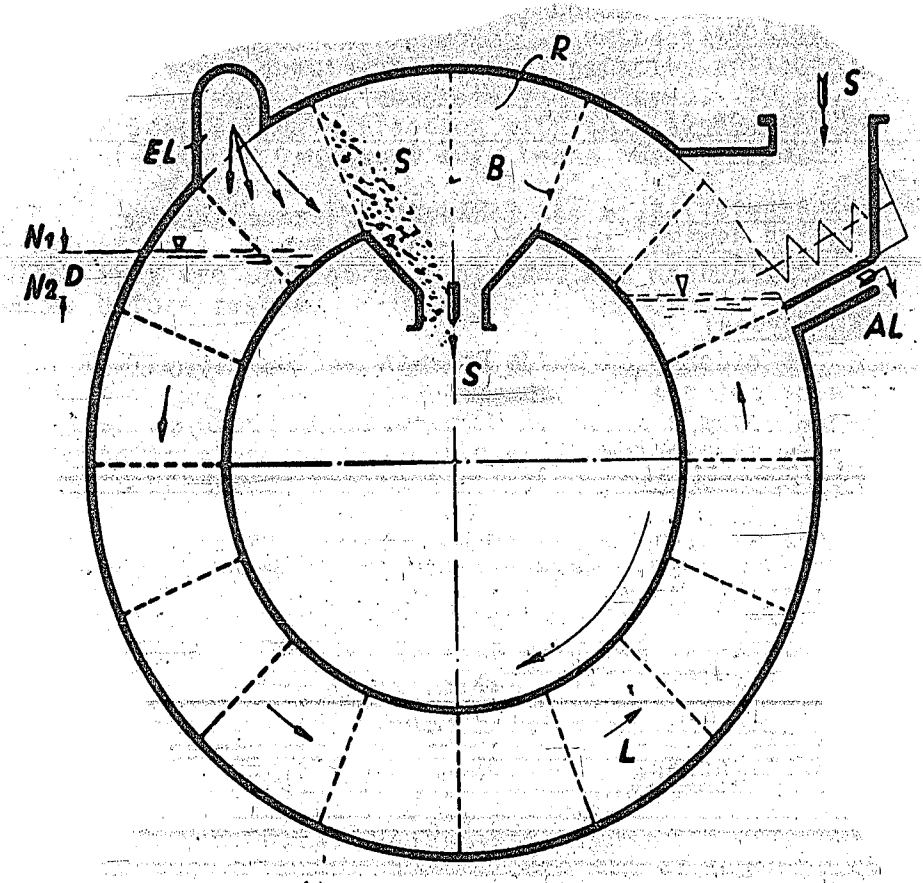


Abb. 3. $D = N_1—N_2$, $L =$ Weg des Lösungsmittels
$S =$ Saat, $B =$ gelochte Bleche, $R =$ Ringkörper

REPORT NO.6

Target No:	H.Q. 21 A.G.
Full Title:	Hansa Mühle A.-G.
Location:	Neuhof, Kohlbrand-Str.146, Hamburg.
Condition of target:	30% Operable
Department in which damage located:	Expelling and extractor department
Employees:	Pre-war 350 War-time 350 Now employeed 150
Personalities:	Ing. Kruse (Plant manager) Ing. Müller Chem. Dr. Mayer.
Date of investigation:	28th August 1945
By:	B.I.O.S. Trip No.979.

HANSA MÜHLE A.-G.

This firm designs the Hansa Mühle or Bollman extractor but plants are built by outside firms. The oil expelling plant and Hansa Mühle extraction plants used at the factory, 4 units with total capacity of 1,000 tons seed per day, had been completely destroyed. The solvent loss during extraction with this type of plant was stated to be 0.6% when soya beans were treated.

Bag filters are used for the miscella before evaporation. These operate for about one day, after which they are steamed out, cleaned and washed with water before re-use.

The oil refinery plant which is capable of dealing with 30 tons of oil per day and the lecithin plant which produces 24 tons of lecithin a month were not damaged although the building in which they were housed needed some repair.

Fat splitting is carried out at this factory in high pressure plant at 24 atmospheres; the capacity of the plant which is made of stainless steel and fitted with stirring gear is 18 tons a day. No catalyst is employed and it was stated that 92 - 95% split is obtained in about 4 hours. The fatty acids are distilled in a continuous Lurgi still with an output of 10 - 12 tons per day.

Crude lecithin mainly from rape oil is refined at this factory by washing with acetone, the output being 24 tons a month. Deodorised oil is added to the extract before the acetone is distilled off. In the extraction of the crude rape lecithin 5 - 6 washings are required as compared with 2 - 3 washings for soya lecithin. Westphalia centrifuges are used for the extraction of the crude lecithin from the oil.

REPORT NO.7

Target No:	C22/473
Full Title:	F.Thörl, Vereinigte Harburger Ölfabriken A.-G.
Location:	Schloss Strasse, Harburg
Condition of target:	Crushing plant - 95% Operable Refining plant - 30% " Extraction plant 75% "
Department in which damage located:	Crushing, refining and extraction plants
Employees:	Pre-war 1,000 War-time 500 Now employed 600
Personalities:	R. Neef - Director W. Paschke - Engineer J.D. von Mikusch - Chemist.
Date of investigation:	29th August 1945.
By:	B.I.O.S. Trip No.979.

F. THÖRL, VEREINIGTE HARBURGER ÖLFABRIKEN A.-G.

This factory, which is one of the Unilever group, has plant capacity for expelling and extracting about 500 tons of seed per day. There are 12 first-stage expellers in which the oil content of rape seed, which constitutes most of the oil seed available at present, is reduced to about 28%, 10 second-stage expellers in which it is reduced to 22 - 24% and 18 third-stage expellers in which it is reduced to 18%.

After expelling the meal is taken away in barges to the extractors but before this is done the fine particles are removed by sieving. This avoids the difficulties which occur when fine dust is present in the extraction process and it also helps to prevent caking during transit in the barges.

There are two groups of 8 extraction vessels each of 3-tons seed capacity. The meal is extracted by a batch countercurrent treatment, three vessels being placed into line.

There are 70 hydraulic presses which were used for linseed etc. and which had a total output of 400 tons per day.

Zellwolle (artificial wool) filter cloth and filter paper were being used in the filter presses but the former material was stated to be inferior to cotton filter cloth.

In refining the oil neutralisation is carried out with 5% or 20% caustic soda according to the free fatty acid content of the oil and Tonsil earth is employed for bleaching. Six 30-ton iron vessels are employed for these processes. Deodorisation with steam at 180°C. and vacuum is carried out in iron vessels. Four vessels remain undamaged whilst another four, which were salvaged, are being repaired and re-installed.

Nothing new in the plant or processes employed for oil milling and oil refining was encountered.

During the inspection of the works we were shown plant employed for the following processes:-

(1) The treatment of castor seed meal to render it suitable for cattle feed

The meal is treated with aqueous alkali and the liquid partly removed by spreading the paste on moving bands made of felt. The liquid containing protein which filters through is used for the manufacture of glue. The remaining meal is spray dried.

It was however stated that the process was not a paying proposition.

(2) The extraction of carotene from carrots

The carrots are cleaned, mashed and digested with a small amount of caustic soda and then with edible oil such as hazel nut oil. The moisture is removed in a vacuum drier and the oil is expelled from the dried material. Any residual oil remaining after expelling is extracted with benzine. The residue may be used in the manufacture of ersatz coffee.

(3) The extraction of carotene from palm oil

The oil is saponified with alcoholic soda, the proportions used being:-

1 part oil

2 parts alcoholic soda

2 parts water.

The soap is then given five benzine washes, each equal in volume to one-third of the soap solution. The extract is then boiled down to 25% strength and edible oil is added before the removal of the remaining solvent. The plant was capable of treating 4 - 5 tons of palm oil a day. The extract prepared from an oil containing 1,000 I.U. was stated to contain approximately 30,000 I.U.

(4) Recovery of lecithin from oil

All the oil, mainly rape oil, processed in the factory, is treated for the recovery of lecithin. 2% of water is added to the warm oil which is centrifuged to remove the sludge which is then extracted with acetone in the normal manner. The oil is again treated with 2%

of water and re-centrifuged but the sludge is not used for lecithin recovery - it is split and sold as acid oil.

(5) Fat splitting

High pressure splitting of oils is carried out in stainless steel autoclaves of 3 - 3½-ton capacity in two (three occasionally) stages according to the free fatty acid content of the oil. The pressures employed are 12, 25 and 40 atmos. for each autoclave respectively. Zinc oxide is employed as catalyst at the lowest pressure but no catalyst is employed at the higher pressures. Oils are split to the extent of about 92%, eight hours being required for a single treatment and 14 hours for a double treatment. The crude glycerine is given a barium treatment and concentrated to 88% strength.

Twitchell splitting is carried out in a tile-lined vessel, the capacity of the plant being 45 tons a day.

(6) Fatty acid distillation

This is carried out by a batch process in a cast iron still which has an output of 20 tons per day; the still is operated at 5 mm. pressure. The vapour pipe is made of Sicromal metal (composition unknown) and the condensers are water-cooled jacketed aluminium vessels. Cooling water at 0°C. is employed. Volkmar Haenig (Heidenau near Dresden) are the makers of the still.

REPORT NO.8

Target No:	HQ. 21 A.G.
Full Title:	Harburger Oelwerke, Brinckmann & Mergell
Location:	Harburg
Condition of target:	50% Operable
Department in which damage located:	Refinery and oil extraction plant
Employees:	Pre-war 1,000 War-time 700 Now employed 400
Personalities:	Mr A.Mergell - Director Mr W. Platt - Assistant manager Mr Hildebrandt, the inventor of the Hildebrandt continuous extraction plant is chief engineer. Away at time of inspection.
Date of investigation:	31st August 1945.
By:	B.I.O.S. Trip No.979.

HARBURGER OELWERKE, BRINCKMANN & MERGELL

This is a well arranged factory in which there are 5 Hildebrandt continuous extractors (1,000 mm. diam.) in working order, each capable of handling 3 tons of expeller cake or 4½ tons of soya beans per hour. There are also six smaller units (800 mm. diam.) in a rather badly damaged building. Hildebrandt is the chief engineer at this factory but he was away at the time of our visit. In 1938 and 1939 all seed was extracted except copra which was expelled twice in Andersen expellers to an oil content of 15 - 16% and then processed in Anglo-American presses. All seeds were pre-expelled before extraction except soya beans which were roughly broken. Soya beans were extracted in one plant up to 1941 and a small quantity of sunflower seed. At present only rape seed is available.

No work was being carried out at the time of our inspection but the oil milling plant is capable of handling 500 tons of seed per day. Only grinders and flaking rolls (no 5 high Anglo-American rolls) were used. Pressing is carried out in Krupp and Andersen expellers the former, which is used for the first pressing, having an input of 40 - 50 tons per 24 hrs. The solvent normally employed in extraction is benzine having a boiling range of 60 - 85°C. and the solvent requirements are 4 - 5 tons per day.

In extraction plant dealing with 3 tons of expeller cake per hour or 4½ tons of soya beans the solvent requirements per hour are 5,000 litres and 6 - 7,000 litres respectively.

When linseed oil was available it was first expelled cold to about 25% oil content, then warmed (50 - 60°C.) and expelled to 12% oil content and finally extracted to less than 1% of oil. The oil from the first expelling which was bright and free from "break" (lecithin substances) was sold for stand oil. The extracted oil which was much darker in colour was used for making boiled linseed oil.

All oil is treated for recovery of lecithin (for use in margarine) which is obtained by acetone extraction on conventional lines. The drying of the lecithin is carried out in tin-lined driers.

The oil refinery which was badly damaged handled about 300 tons of refined and deodorised oil per day, and the hydrogenating plant had capacity for about 100 tons per day. The oils were bleached but not neutralised before hardening. In the bleaching treatment 0.5% of phosphoric acid was added with the bleaching earth to the oil at 60 - 70°C., and after bleaching it was neutralised with chalk. It was claimed that the phosphoric acid incidentally helped to activate the bleaching earth. The oils were neutralised after hardening.

High free acidity oils were treated in a Wecker still and it was claimed that this process paid with oils having free fatty acid contents over 5%. The free fatty acid removal during distillation was stated to be 90% and it was claimed that catalyst poisons are also removed.

We were shown two hydraulic cake pressing machines which had been used to save meal bags. These machines, which each had an output of 3 tons per hour, compressed meal into cakes, each weighing 5 kilos. The practice was discontinued when there was a demand for mixed feeding stuffs.

Hydrogen was produced electrolytically in two BAMAG units. It was stated that some "heavy water" was formed in the process, and that the weak caustic solution in the cells was removed about once a year by the I.G. Farben, who recovered the "heavy water".

REPORT NO.9

Target No:	HQ. 21 A.G. "Opportunity"
Full Title:	Holtz & Willemsen
Location:	Friemersheimer Strasse, Uerdingen. 2nd factory at Langestrasse.
Condition of target:	No serious damage
Employees:	Pre-war 600 War-time 220
Personalities:	Mr E. Holtz)) partners Mr Willemsen)
Date of investigation:	6th September 1945
By:	B.I.O.S. Trip No.979 with Dr K.S. Markley Mr W.H. Goss.

HOLTZ & WILLEMSEN

The first of these factories is equipped with oil milling plant, refinery plant for technical linseed and soap oils and stand oil plant. The second factory has refinery plant for edible oils, fatty acid distillation plant, hydrogenation plant and plant for margarine manufacture.

The expelling and pressing plant which was operating on 2,000 tons rape seed a month has a total capacity of 5 - 6,000 tons a month. Before the war they also expelled and pressed copra and groundnuts and a small amount of linseed obtained from the Baltic region was treated during the war.

Expelling of rape seed is carried out at 50-60°C. mainly with Krupp and Muller expellers, but some Reinartz (Neuss) expellers are also in use. The seed is expelled twice before pressing, the oil content of the expelled seed being 23 - 24% oil. Pressing is carried out in cage presses after the meal from the expellers has been rolled. The expeller oil is better for refining than the pressed oil as it contains no slime but usually the two oils are mixed off. The seed after pressing containing 8% oil is sent for extraction to the Boley factories which are nearby.

Before the war most linseed was first expelled cold for special oil to be used in varnish and white lead paints - about 5% of oil was removed in this treatment. The seed was then heated and pressed for oil of second quality.

The refinery for technical oils was not operating: normally they refined 30 tons of linseed and soap oils per day with alkali and fullers earth treatment. Cold pressed oils (10 tons a day), do not require neutralisation with alkali.

The stand oil plant was a gas heated Sommer kettle, worked under CO_2.

The refinery for edible oils has a capacity of 80 - 100 tons of deodorised oil a day. Neutralisation and vacuum bleaching were carried out in separate vessels. There were eight deodorisers each of 10-ton capacity. Deodorisation is carried out with steam and vacuum for 11 hours at 160°C.

The free fatty acid content of rape oil after the neutralisation process was stated to be 0.06% and that of the bleached and deodorised oil 0.03%.

Oils containing more than 7% free fatty acids are treated in a Wecker still made by BAMAG, having a capacity of about 45 tons a day for rape seed oil containing say 10 - 12% free fatty acid. The distillation reduces the free fatty acid content to about 1 - 2%. For acid oils from soap stock the still has a capacity of about 12 tons a day. The still is operated at 250 - 260°C. and 12 - 13 mm. pressure; wet steam is injected through jets into the oil which is normally in the still for about 15 mins.

Oil hydrogenation plant is also available, the source of hydrogen being 2 BAMAG cells each with an output of 40 cubic metres of hydrogen per hour. The plant has capacity for hydrogenating 20 - 25 tons of oil per day to a melting point of 30 - 32°C. Nickel formate is used as catalyst, the reason given for this choice of catalyst being that it is very easy to reduce. The hydrogenation vessels are not fitted with stirring gear but the gas is circulated.

There did not appear to be any unusual features in the layour of the margarine plant which had capacity for 50 tons a day. The margarine was made from 60% hardened rape oil and 40% unhardened rape oil and contained 20% water. Tegomul, an emulsifier, carotene (not available at the time we were there) and potato starch, are also added. The starch is a compulsory addition which affords an easy means of differentiating between margarine and butter.

Margarine which was being manufactured during our inspection was satisfactory in respect of texture and taste.

REPORT NO.10

Target No:	HQ. 21 A.G. and "Opportunity"
Full Title:	Deutsche Rizinus-Oelfabrik, Boley & Co. Vereinigte Uerdingen Oelwerke, Alberdingk & Boley.
Location:	Uerdingen, near Adolf Hitler bridge.
Condition of target:	One factory (linseed mill) badly damaged
Department in damage located:	Linseed mill building

Employees:

	Factory (a)	Factory (b)
Pre-war	70	60
War-time	40	20

Personalities:	Dr Boley
Date of investigation:	6th September 1945
By:	B.I.O.S. Trip No.979 and Dr K.S. Markley Mr W.H. Goss.

DEUTSCHE RIZINUS-OELFABRIK, BOLEY & CO.

VEREINIGTE UERDINGEN OELWERKE, ALBERDINGK & BOLEY

This castor oil mill which is the only one in Germany is equipped with a Hansa Mühle extraction plant. This plant was bought for castor seed but as none is available at present it is being used for extracting rape meal (8 - 10% oil content) from Holtz & Willemsen's factory which is nearby.

The extractor which is described as a 100 ton per day plant - based on soyabean - normally dealt with 70 - 80 tons of castor seed a day and is now handling 50 - 70 tons of rape meal.

Castor seed having an oil content of 45 - 47% was pressed once in cage presses before extraction, the oil content of the cake obtained being 15 - 18%. Extraction reduced the oil content to about 1%.

During the war castor cake was used for fertilisers and we were told that the protein was sometimes extracted for human consumption (soup extracts). The extraction was carried out by:-

E.T.O. Works - Richard Grebner, Karlsruhe.

F.I.N.O. " - Andernach-on-Rhine.

The pressed castor oil which was of very good quality was kept separate from the extracted oil and only needed filtering with a little filter aid.

Benzine having a boiling range of 65 - 85°C. is the preferred solvent for the extraction plant. The solvent loss amounts to 0.6 - 0.7% when working with castor seed and 1% with the rape seed cake. Recently it has sometimes been necessary to use benzol, boiling point 87°C. for extraction and with this solvent losses have been at least doubled. The plant was operating during our inspection and we noted that the building was practically free from the smell of solvent.

The resulting meal was cooled in a Büttner Werke A.-G. (Oerdingen) machine in which the meal gravitated down over circular rotating trays.

REPORT NO.11

Target No:	F.I.A.T. Main.
Full Title:	L. Schmitt, Tech.Hochschule, Darmstadt.
Location:	Hochschule, Darmstadt.
Condition of target:	Almost completely destroyed.
Date of Investigation:	22nd August 1945.
By:	B.I.O.S. Trip No.979.

This target was listed as "Investigation of research into production of synthetic and other fats".

Professor Schmitt was away when we visited Darmstadt but enquiry elicited the information that he was mainly interested in agricultural research and only lectured occasionally at the Institute of Technology. His assistant Dr Breitweise did not know of any research which had been carried out at the Institute on the production of synthetic fats. We finally contacted Professor Clemens Schöpf of the organic chemistry department. He knew of no research on the production of synthetic fats except his own work on their synthesis in the living organism.

REPORT NO.12

Target No:	C22/459
Full Title:	Deutsche Fettsäure Werke. Märkische Seifen Industrie.
Location:	Witten/Ruhr
Condition of target:	75% Operable
Department in which damage located:	Repair shops, stores and Toilet Soap plant
Employees:	Pre-war 1,000 War-time 900 Now employed 600
Personalities:	Dr K.H. Imhausen, Director and part owner Dr Prosch, Technical Manager Dr Döphe, Salesman.
Date of investigation:	3rd September 1945.
By:	B.I.O.S. Trip No.979 with Dr K.S. Markley Mr W.H. Goss.

DEUTSCHE FETTSÄURE WERKE
MÄRKISCHE SEIFEN INDUSTRIE

The Märkische Seifen Industrie, which is adjoining the Deutsche Fettsäure Werke and I.G. each own half shares in the above company which manufactures fatty acids by oxidation of gatsch from the Fischer Tropsch process. The plant can deal with 40,000 tons of raw material a year. The Märkische Seifen Industrie also has a plant for the conversion of the fatty acids to synthetic fats by esterification with glycerine, plant for making margarine with a possible output of 600 tons per month, and soapmaking plant.

During the war the Reich bought about 80% of the total synthetic fats for the army and navy.

There are three other factories in Germany which have produced synthetic fatty acids; Oppau (Ludwigshafen) which is capable of dealing with 20,000 tons of raw material a year, Heydebrech with the same capacity, and a new factory at Magdeburg with a capacity of 12,000 tons which has never worked and which we were told has been dismantled by the Russians. This plant, which was to operate at 25 atmospheres pressure, cost 30 million marks; the Deutsche Fettsaure Werke which is operated at atmospheric pressure cost 12 million marks. We were told here and during a visit to Henkel & Cie that the Deutsche Fettsäure Werke was the only factory which had been operated successfully on a commercial basis and they are the only firm which has made synthetic fats commercially - no margarine has however been manufactured since March of this year.

Raw Materials

About 90% of the material produced in the Fischer Tropsch process (iron catalyst) consists of gatsch, olefins and a low boiling fraction "Kogaryin". Of this mixture the gatsch employed for fatty acid manufacture amounts to 30 - 35%.

About 150 - 200 tons of fatty acids per month was the maximum used for the production of synthetic fats and margarine. All material used for the manufacture of edible products must be made from Fischer Tropsch material. Material made in coal hydrogenation plants cannot be employed because it contains aromatic materials. Fatty acids of chain length C_{10} - C_{18}

(55 - 60% of total fatty acids obtained) are used for edible purposes as compared with the C_8 - C_{22} acids (60 - 65% of total fatty acids) used for soapmaking. The fatty acids of low molecular weight obtained in the first runnings on distillation are used after esterification in plastics. During the war they were employed in the manufacture of waterproof material known as Igelit.

Process and Plant for the Manufacture of Fatty Acids

A flow sheet of the process is attached. The oxidation of the gatsch by air is carried out at 110°C. and atmospheric pressure in the presence of 0.2% potassium permanganate as catalyst. The reaction is continued until the mixture contains about 33 - 35% fatty acids; the remaining non-oxidised material after separation from the fatty acid is returned to process. The overall yield of fatty acids is about 80%.

The reaction is carried out in vessels made of aluminium and fitted with stainless steel (V2A) tops since the action of the fatty acids is more severe in the vapour state. The vessels are fitted with a heating coil at the bottom and a cooling coil in the middle which is necessary because of the exothermic nature of the reaction. In carrying out the process the gatsch is first heated to 110°C. to get rid of the water and then cooled to 105°C. The air under a pressure sufficient to overcome the head of liquid in the reactor is passed through an aluminium distributor at the bottom of the vessel which has approximately 1,000 small holes of about 1/16" diameter. Aluminium has been found to be better than steel - it appears to have an accelerating effect on the reaction.

There are 36 reaction vessels in this factory, 8 with a capacity of 20 tons and 28 with a capacity of 10 tons. The large reactors have a diameter of 2.3 metres whilst the smaller reactors have a diameter of 1.8 metres.

Four reactors are working with two condensing systems in which low molecular weight acids (formic and acetic) are washed out with direct water and the higher volatile materials are condensed by indirect water cooling. The condensing plant is made of stainless steel - the pipes used are of aluminium.

The reaction mixture is saponified with soda ash and caustic soda in 35 ton iron pans in which the first separation of unsaponifiable matter occurs over a period of about 10 hours. Most of the remaining unsaponifiable is then removed from the soap by heating under pressure and distillation. The soap is first pumped into autoclaves at 20 atmospheres pressure when further separation of unsaponifiable occurs. The remainder is then removed by means of a gas fired pipe still from which the soap mixture is flashed into an expansion chamber through a reducing valve. The soap powder is removed from the bottom of the chamber by means of a screw, water being added at this stage.

The soap is then split with sulphuric acid and the fatty acids are distilled in four stills fitted with fractionating columns about 20 ft. high which are fitted internally with long strips of metal situated close together. The vacuum used for the main fractions is 2 - 4 mm.

The still temperatures are as follows:-

1st still - 1st runnings	150 - 160°C.
2nd still) main	240°C.
3rd still) fraction	280 - 290°C.
4th still - pitch	320°C.

The amounts of the various fractions obtained are:-

1st runnings	12% (C_4 - C_{10} acids)
Main fractions (2 stills)	65% (C_9 - C_{20} acids)
From pitch	14% (C_{20} - C_{28} acids)
Pitch	9%

The still containers are made of silicon iron, the columns of V2A steel and the pipe lines of aluminium. Steam is used for heating the first still and high pressure water 140 - 170 atmos. for the other three stills. Oil or glycerine is employed in the cooling

units because the water available is too hard for use.

The unsaponifiable matter present in the main fraction after distillation is 1.3%. Separation of the unsaponifiable from the soap by means of solvents has been tried but the method was not satisfactory as the unsaponifiable was not reduced below 4%.

The fatty acids obtained by the method in use at present have the strong odour characteristic of synthetic fatty acids and no economical method has yet been found for getting rid of it. The Märkische Seifen Industrie were using 20% of the synthetic acids in soap at the time of our inspection and claimed that 50% could be employed.

Synthetic Fats and Margarine

As already mentioned fatty acids of chain length C_{10} - C_{18}, amounting to 55 - 60% of the total fatty acids obtained by the above process, are used for the manufacture of synthetic fats. The glycerine is obtained by splitting non-edible fats.

The esterification is carried out in V2A stainless steel vessels (3 ton and 6 ton capacity) fitted with vertical water-cooled tube condensers to prevent loss of fatty acids and glycerine; the condensers are packed with raschig rings. The catalyst used is zinc and a slight excess of fatty acid (about 1%) is present at the commencement of the esterification. The reaction takes about 8 hrs. the temperature being gradually increased from 120 - 180°C. The glyceride obtained contains about 0.7% free fatty acid, which is subsequently removed in the neutralising and deodorising processes, and has a hydroxyl number of about 8. The fatty acid in the glyceride is neutralised with caustic soda and then the glyceride is bleached (in the same vessel) at atmospheric pressure with bleaching earth and carbon. It is subsequently deodorised, in iron vessels with superheated steam at 200°C. and 2 - 3 mm. pressure: 200 kilos of steam are used for 3 tons of fat.

The average melting point of the fat obtained is 35°C. and the iodine value of the fat is 10 - 13.

The fat may be given a slight hydrogenation treatment to improve its colour but this is not general practice.

We examined a sample of margarine made entirely with synthetic fats together with the usual additions of salt, carotene, diacetyl and 20% water; no lecithin is needed as the fat emulsifies readily. The sample was 6 months old. The consistency of the margarine was satisfactory but it had a taste which was described as "sharp" and "burnt" and it left a dry feeling in the mouth.

It was claimed that margarine from synthetic fats has very good keeping properties, the reason given being that it contains no protein material and is therefore a poor nutrient material for bacteria: samples have been kept for 1 year.

It was also claimed that synthetic fats are utilized in the body at least as well as natural fats. Work on this subject was carried out on animals and human beings by Prof. Flössner, Reichgesundheit Ambt., Berlin (now at Salzhemmendorf nr. Ebye, Hanover) and was published in "Die Ernährung".

Synthetic fats were also stated to be more suitable for diabetics than natural fats, the explanation given being that while diabetics burn the even number carbon chains in natural fats to give acetone, the odd number carbon chains present in synthetic fats in addition to even number chains, are burnt to propionic acid and finally give carbon dioxide and water.

Ethyl esters of various fatty acids have apparently been used to the extent of 10% in margarine during war-time in Germany for reasons of fat economy. We were informed that margarine containing ethyl esters of synthetic fatty acids was not satisfactory; the product was difficult material to deodorise and deodorisation could only be achieved at comparatively low temperatures which resulted in a fat with not very satisfactory taste. The esters also tended to split readily in the margarine, giving rise to bad keeping properties. It is interesting to note that the odour of the synthetic fats is very much better than that of fatty acids obtained from them.

The capacity of the Margarine plant at the Märkische factory was stated to be 600 tons per month.

Costs

We were informed that the cost of synthetic acids as made by the Deutsche Fettsäure Werke was 70 marks per 100 kilos whilst that of the acids made by the I.G. at Oppau was 120 marks per 100 kilos. The cost of fatty acids from natural oils during the war was stated to be 140 marks per kilo. Dr Imhausen said that before the war synthetic acids and natural fatty acids were on approximately the same price level. One of the factors that has helped in reducing the cost of synthetic acids is that the first runnings from the distillation plant are now utilized and have a value of 70 marks per 100 kilos.

This picture was rather more optimistic than that given us by Dr Henkel at Düsseldorf. The cost of the synthetic acids depends on the price of the gatsch used as raw material - during the war this was 30 marks per 100 kilos. Dr Henkel stated that if the gatsch was regarded as a by-product of the Fischer Tropsch process then synthetic acids come into the picture. Normally however synthetic acids for soapmaking would cost twice as much as natural soapmaking oils in Germany and on the world market perhaps three times as much.

Soap and Glycerine Plant

We were given the following figures for the capacity per month of various soap products made by the Märkische Seifen Industrie:-

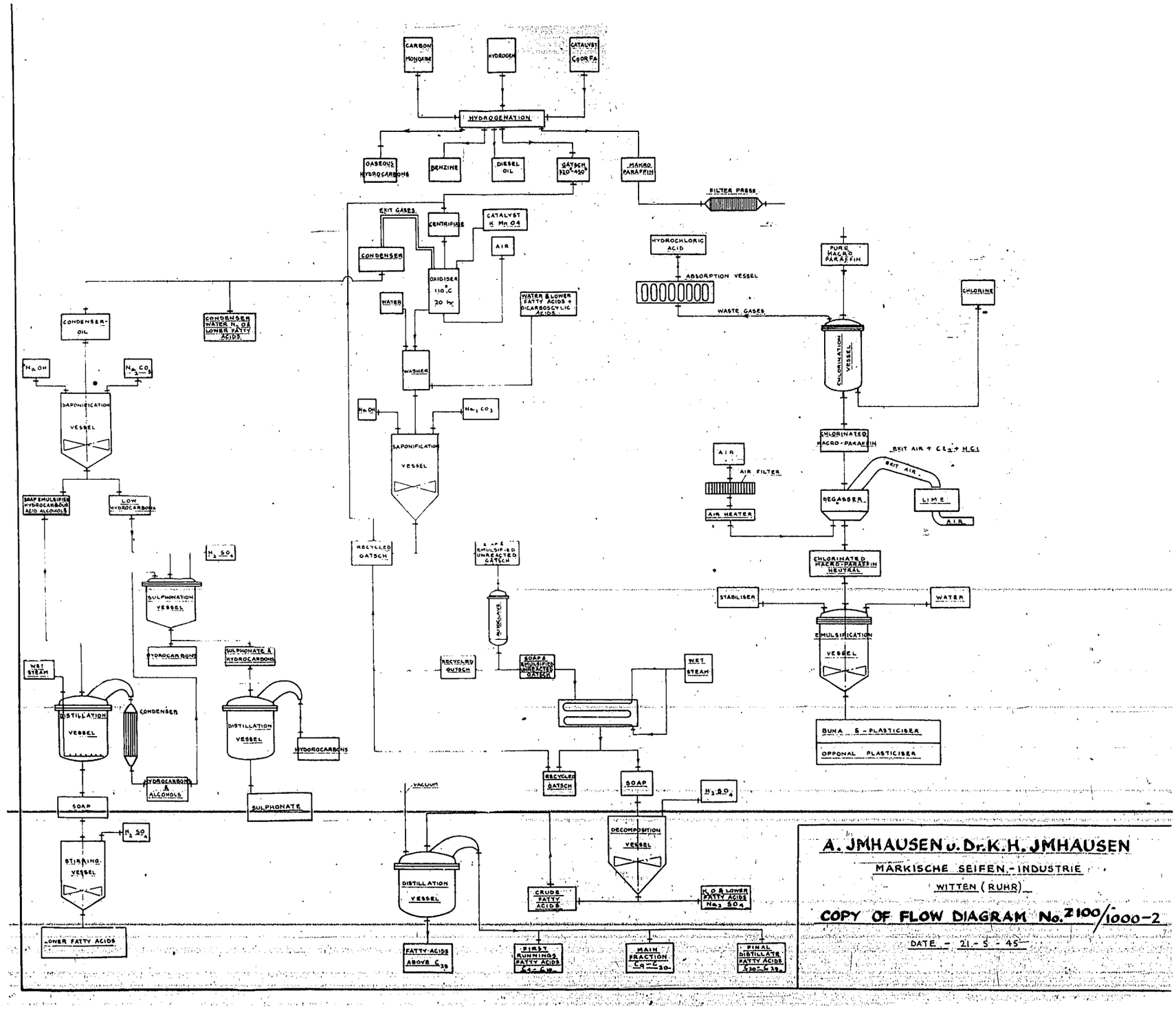
Soap powder (Krause blown)	1,000 tons
Toilet soap	500 "
Household soap	300 "

Soft soap - several hundred tons.

100 tons of glycerine per month can be distilled.

At the time of our visit a genuine soap tablet was being made for miners who apparently suffered from dermatitis when they used the soap kaolin mixtures made in Germany during the war. This soap, made from a charge containing 20% synthetic acids, was preserved with sodium thiosulphate and contained a tannin preparation known as "Dermolan" which it is claimed prevents dermatitis.

A very light unfilled floating soap prepared by aerating at 3 atmospheres pressure in a closed crutcher at 90 - 95°C. and then water cooling was also being manufactured:- it is understood that this soap is for young children.



A. JMHAUSEN u. Dr. K. H. JMHAUSEN

MARKISCHE SEIFEN.-INDUSTRIE

WITTEN (RUHR)

COPY OF FLOW DIAGRAM No. Z 100/1000-2

DATE - 21.-5.-45-

REPORT No.13

Target No:	C22/196
Full Title:	O.X.O. G.m.b.H. Ruhr Chemie A.-G.
Location:	Oberhausen-Holten
Condition of target:	95% Operable
Department in which damage located:	Practically none - plant not yet finished
Employees:	Pre-war - War-time - Needed 100
Personalities:	Prof. Martin, Director of Ruhr Chemie A.-G. Dr Meyer, Manager Fischer-Tropsch plant, Ruhr Chemie. Dr Landgraf, Chemist.
Date of investigation:	4th September 1945.
By:	B.I.O.S. Trip No.979 with Dr K.S. Markley Mr W.H. Goss.

O.X.O. G.m.b.H.

Ruhr Chemie A.-G.

This firm manufactures fatty alcohols by treating olefin products obtained from the Fischer Tropsch process with carbon monoxide and hydrogen under high pressure. The main portion of the alcohols obtained are sulphated to obtain non-soapy detergents. Fatty acids can be made from the alcohols by a further oxidation process but as the value of the alcohols is much higher than that of the acids this would not be an economical proposition. The process is not therefore likely to be of much interest to the food industry. Fatty acids for the production of synthetic glycerides are made by the direct oxidation of "gatsch" from the Fischer Tropsch process by air (see report on Deutsche Fettsäure Werke).

Ruhr Chemie, I.G. and Henkels each have shares in the O.X.O. process. The general scheme is that the olefins used in the process would be produced by Ruhr Chemie in adjoining plant, the alcohols would be prepared by the O.X.O. G.m.b.H., and the sulphation carried out by Henkel & Cie.

The pilot plant used in developing the O.X.O. plant, which is now partly destroyed, produced 1,000 tons of alcohol per year, the production plant, the erection of which is not quite complete, will be capable of producing 10,000 tons per year, or if it is made continuous by changing the contruction of the converters, 15,000 tons per year.

The main alcohols made by the O.X.O. process have chain lengths ranging from C_{11} to C_{18}. As the unsaturated bond of the olefins may be in various positions in the hydrocarbon chain it seems likely that they will contain branch chain alcohols which may not be as good as straight chain primary alcohols for the manufacture of sulphated detergents. Preliminary tests on a small sample of sulphated detergent obtained from Ruhr Chemie indicate however that it is likely to prove a satisfactory product. A proportion of lower alcohols are produced in the process and these are used for other purposes, i.e. in plasticisers.

In peace time the O.X.O. plant would cost 9 million marks - it would require about 100 men for its operation. It is the only commercial plant of its kind in Germany.

Raw materials

The raw materials used in the O.X.O. process are olefins obtained directly or indirectly by cracking from the Fischer Tropsch process. The Fischer Tropsch fraction which is cracked to obtain olefins is the Paraffin gatsch fraction which includes gatsch and higher melting point waxes. 50% of the Fischer Tropsch products are suitable for the O.X.O. process or a little more when high paraffin fractions are included.

The Fischer Tropsch process at Ruhr Chemie is operated with a cobalt catalyst at 195°C. - the plant is built to stand 15 atmos. pressure. The process employing an iron catalyst would give a higher yield of olefins but it requires a higher temperature (230°C.) and pressure (50 atmos.). Ruhr Chemie are experimenting on the direct production of a high percentage of olefins in the Fischer Tropsch process so as to avoid the necessity for cracking. They operate three processes:-

(1) At atmospheric pressure which gives about 10% olefins directly:

(2) At 10 atmospheres pressure which gives say 10 - 20% olefins:

and

(3) A recirculating process which gives about 50% olefins.

The recirculating process is operated at 10 atmospheres and to increase the yield of olefins the ratio of hydrogen to CO present is cut down to 1/1. Difficulty was experienced due to the formation of carbon on the cobalt catalyst but this was largely overcome by increasing the speed of the gas stream. The outgoing gases are re-used in the low pressure plant.

Before they pass to the O.X.O. plant the olefins obtained from the Fischer Tropsch process are distilled to obtain three fractions of the following chain length:-

$C_{11} - C_{13}$

$C_{13} - C_{16}$

and $C_{16} - C_{18}$

This is carried out in distillation towers which are 45 metres high and 2.5 metres diameter. Each still contains 50 slotted plates. One tower is worked at normal pressure and the other at a vacuum of 60 mm. pressure. These fractions go to different converters but they may be mixed after conversion to alcohols.

O.X.O. plant and process

The O.X.O. plant consists of 16 reactors (estimated to be about 30 ft. high and to have an external diameter of 1'6") of 720 - 840 litres capacity. These reactors are fitted with cooling coils, as the reaction heat is very high, and stirring gear. They are made of steel of low chromium content and the reaction is carried out at 200 atmospheres pressure and 180°C. - at higher temperatures polymerisation occurs. The cobalt, manganese, thorium catalyst is added to the olefins in the form of a fine powder. Any volatile materials distilling during the operation are recovered in a condenser at the top of the tower. The water gas freed from impurities, employed as the source of CO is compressed to about 200 atmos. by compressors which are capable of giving 300 atmos.pressure. The hydrogen which is used in the ratio of 1 part to 2 of water gas is obtained from the fertiliser plant where a process for the fixation of atmospheric nitrogen is operated. The actual time of reaction is 20 - 30 mins. and the whole operation including filling and emptying takes about one hour.

The alcohols formed by the reaction are separated from the paraffins in stills working at 3 mm. pressure; they contain small amounts of paraffin but not sufficient to affect the emulsifying and detergent properties of the sulphated alcohols. We were shown samples of C_{13}, C_{17} and C_{18} alcohols which were very satisfactory as regards colour and the C_{17} and C_{18} alcohols were comparatively free from odour. The odour of the C_{13} alcohols was similar to that of synthetic fatty acids but was not so pronounced as in the case of the acids.

During this visit we were told that the overall capacity of the 8 Fischer Tropsch plants in Germany is 600,000 tons per year.

The firms which operated the process were:-

(1) Gewerkschaft Rheinpreuzen - Mörs

(2) Ruhr Chemie - Oberhausen Holten

(3) Krupp Treibstoff - Gelsenkirchen

(4) Gewerkschaft Victor - Rauzel

(5) Hirsch benzene - Dörtmund

(6) Essener Steinkohle - Kamen

(7) Wintershall - Lutzendorf Krefeld

(8) Braunkohle und Benzene - Swartzheide.

Costs

The cost of the olefins produced by Ruhr Chemie was stated to be 35 - 40 pfgs. per kilo and they are sold to O.X.O. G.m.b.H. at 45 pfgs. per kilo. The cost of the finished alcohols is 80 - 90 pfgs. per kilo.

REPORT NO.14

Target No:	C22/195
Full Title:	Henkel & Cie G.m.b.H.
Location:	Holthausen, Nr Düsseldorf
Condition of target:	100% Operable
Employees:	Pre-war 5,000 War-time 2,000
Personalities:	Dr Jost Henkel Mr Victor Funck (Chief Engineer)
Date of investigation:	5th September 1945.
By:	B.I.O.S. Trip No.979 with Dr K.S. Markley Mr W.H. Goss.

HENKEL & CIE

Holthausen, Düsseldorf.

The subject of this target was synthetic fatty acids for soap and manufacture of synthetic oils for human consumption. Neither of these products are made at Holthausen but Henkels have a half share in the Deutsche Fettsäure Werke who manufacture the synthetic acids and oils at Witten and the process employed is the subject of a separate report.

At Holthausen Henkel's are mainly concerned with the production of washing powders and cleaning powders of various types: the pre-war and war-time formulae for some of these products are given in Appendix I and II; no Persil has been made since the beginning of the war. In addition they manufacture a series of products (known as the P3 series) for cleaning dairy equipment, machines, and for dirty equipment on farms and in mechanics shops etc. These products contain ingredients such as soda ash, sodium silicate, wetting agents and bleaching agents (e.g. chloramine).

In normal times about 5,000 workpeople and staff are employed at this factory and at present 2,100. The peak capacity of the factory was estimated to be 25,000 tons per month and the normal output 20,000 tons. They are now producing only 2,500 tons a month but as the factory is practically undamaged still have the capacity for 22,000 tons under present conditions.

Dr Henkel estimated that their production capacity at Holthausen is approximately 44% of that of the total production in Germany. Their associated company at Genthin (near Magdeburg) has 21% of the total and Boehme Fettchemie (Chemnitz), who also manufacture wetting agents for textiles, 5%, making 70% in all. The estimated production of various products at Holthausen during September 1945 is given in Appendix II. It will be noted that the soap powder contains a product known as Relatin; this is a Tylose type product (methyl cellulose) and it is claimed that it helps to keep dirt in suspension during the washing operation. This soap powder is of standard quality for which a Government Specification was laid down at the beginning of the war.

Sulphonated and sulphated detergents handled by Henkel were made by two associated companies now in Russian territory, Mersolat at Lohne (I.G.) and Gardinol at Chemnitz (Henkel). No sulphated alcohols are being made at present but they were hoping that the I.G. would soon be in a position to make alcohols by hydrogenation. Henkel's have a third interest in O.X.O. G.m.b.H., Oberhausen, Holten, who have erected plant for making 10,000 tons a year of alcohols from Fischer Tropsch olefins by treatment at high pressure with carbon monoxide and hydrogen.

At Holthausen Henkel's have equipment for sulphating 150 tons of alcohol a month and another plant, not quite completed, capable of handling 200 tons of alcohol a month.

With regard to the use of synthetic acids in soap products Dr Henkel thought that the maximum amount which could be used was about 30% of the total fatty acids: 20 - 25% was used in soap powders.

The objection to the use of these acids is that they leave an objectionable odour on the skin although this odour is not noticed on washed clothes.

Dr Henkel stated that they had made many attempts to get rid of this odour by using special perfumes, redistilling the acids and taking special cuts during fractionation, but these attempts were not successful. By taking certain cuts some improvement was effected but this method was not economical.

As mentioned in our report on the Deutsche Fettsäure Werke, Dr Henkel thought that from the point of view of cost synthetic acids only come into the picture when the gatsch from which they are made was regarded as a by-product. Normally they would cost about double the price of natural soapmaking oils in Germany.

During a tour of the factory at Holthausen the following plant was inspected:-

(1) 10 Krause spraying towers each capable of making 10 tons of powder per hour.

(2) 2 Welter spraying towers for blowing sulphated alcohol powders at high concentration: capacity of each tower 5 - 6 tons per hour. The Krause towers, which have a rapidly rotating spraying device, are not suitable for dealing with these products as there is a danger of explosion occurring.

(3) Rotary furnace for the manufacture of sodium pyrophosphate from disodium phosphate.

(4) Plant for the manufacture of sodium silicate from silica and sodium sulphate. The gases from this plant contain 2½% of SO_2 which is converted into sulphuric acid in a plant capable of making 50 tons of acid a day.

(5) High pressure fat splitting plant: 8 plants each of 10-ton capacity (oil) made of stainless steel (Va-14); total output 200 tons per day. These plants operate at 20 atmos. pressure and the corresponding temperature; no catalyst is being used.

Before autoclaving the oils are given an acid treatment in brick-lined vessels with lead covered stirrers and lead or copper coils. The outgoing steam from this plant is used to concentrate the crude glycerine to 80%.

(6) Fatty acid Lurgi stills: There were four stills each one capable of distilling 100 tons of fatty acids in 24 hours. They are heated by steam at 600 lb. pressure and operated at 3 mm. pressure. The stills are made mainly of copper but it was stated that fatty acids of better colour are obtained with cast iron stills.

Two stills, with a common preheater and joined by an overflow, are worked together in a continuous manner, the pitch being removed alternately from each still.

(7) Distilling plant for synthetic fatty acids: In this plant four fractions and pitch can be obtained by a semi-continuous process in which the residual fatty acids after removal of the first fraction were pumped to the next still where a second fraction was removed and so on.

(8) Hydrogenation plant: This plant is used for hydrogenation of fatty acids and crude or refined oils. It consists of four units made of 4A stainless steel each having a capacity of 4 cubic metres. They are fitted with turbo stirrers and normally operated at 12 atmos. pressure but can be used up to 25 atmos. Nickel formate is used as catalyst. The fatty acids are distilled before hydrogenation but are not given any treatment after hydrogenation. We were told that the nickel content of the hydrogenated fatty acids was very low but we were shown a sample of hydrogenated fat which had a distinct greenish colour.

Electrolytic hydrogen is supplied from BAMAG cells; they are very compact units each giving 200 cubic metres of hydrogen per hour.

(9) Glycerine distillation plant: The main plant is a Lurgi still in which the distillate is cooled in three stages by water under pressure. There is also an older type plant with air-cooled condensers.

(10) Oil extraction plant: This consisted of 12 batch extraction vessels which would deal with 300 - 400 tons of seed (soya or P.K.O.) a day. It had not been operated during the war.

APPENDIX I

Pre-war Products

		Composition	Weight g.	Price Pfg.
1.	Persil	31.0% Fatty acids (33.7% soap) 11.1% Soda ash (calculated as anhydrous material) 14.3% Sodium pyrophosphate 7.0% Sodium perborate 3.0% Magnesium silicate 4.9% Sodium bicarbonate 26.0% Water (calculated)	250 500	30 56
2.	Henko - Bleach soda	48.1% Soda ash (calculated as anhydrous material) 8.5% Sodium silicate (solid) 43.4% Water (calculated)	300	13
3.	Sil	42.9% Soda ash (calculated as anhydrous material) 7.6% Sodium silicate (solid) 12.0% Sodium perborate 37.5% Water (calculated)	180	17
4.	Imi	65.6% Trisodium phosphate $12H_2O$ 5.2% Sodium silicate (solid) 25.3% Soda ash 3.9% Water	300	20
5.	Ata:			
	(a) Coarse	5.0% Soda ash 3.0% Ammonium sulphate Remainder - silica Hg	315	12
	(b) Fine	4.3% Soda ash 0.9% Sulphonate Remainder - silica H4	340	17
	(c) Extra fine	4.3% Soda ash 0.9% Sulphonate Remainder - silica H7	600	30

APPENDIX II

War-time Products

	Composition	Weight g.	Price Pfg.	Production during Sept. 1945
1. Washing powder				
(a) With Mersolat	5.5% Mersolat	250	20	2,000 tons
	40.0% Soda ash (calcd. as anhydrous material)	500	38	
	1.0% Sodium silicate (solid)			
	1.0% Relatin - Tylose type product			
	52.5% Water (calculated)			
(b) With soap	8.0% Fatty acids (8.8% soap)	250	20	
	40.0% Soda ash (calcd. as anhydrous material)	500	38	
	1.0% Sodium silicate			
	50.2% Water (containing about 0.8% of salt)			
2. Henko - Bleach soda	40.0 parts Soda ash (calcd.as anhydrous material)	300	13	800 tons
	4.0 parts Sodium silicate (solid)			
	54.0 parts Water (calcd.)			
3. Sil	37.0 parts Soda ash (calcd.as anhydrous material)	180	17	150-200 tons
	6.0 parts Technical percarbonate			
	6.0 parts Sodium silicate (solid)			
	~~20.0 parts Salt~~			
	11.0 parts Water			
4. Imi	2.8% Mersolat	300	20	400 tons
	45.0% Soda ash (calcd. as anhydrous material)			
	11.0% Sodium metasilicate $9H_2O$			
	15.0% Sodium sulphate			
	26.2% Water			

APPENDIX II (Contd.)

	Composition	Weight g.	Price Pfg.	Production during Sept. 1945
5. Ata:				
(a) Coarse	3.0% Soda ash 2.0% Ammonium sulphate Remainder - silica Hg	310	12	400 tons
(b) Fine	3.0% Soda ash 1.1% Mersolat Remainder - silica H4	340	17	
(c) Extra fine	3.0% Soda ash 1.1% Mersolat Remainder - silica H7	600	30	

6. Unit Ration Soap

The Unit Ration Soap (so-called Floating soap for children) weighs 16 g. and contains 10 g. of fatty acids of the following composition:-

60% Fatty acids (from offal fats and hardened fish oil)

20% Palm oil fatty acids

10% Residual distilled fatty acids

10% Rosin.

It is an unfilled soap costing 12 pfgs. per tablet.

3,000,000 tablets are produced per month.

P3 products - For cleaning dairy equipment, machines etc.- 300 tons a month.

No Persil since beginning of war.

REPORT NO.15

Target No:	H.Q. 21 A.G.
Full Title:	Hammer & Anderson (manufacturers of Emulgator P.E.O.)
Location:	Feldbrunnenstr. 56, Hamburg 13.
Personalities:	Mr Hammer - General representative
Date of investigation:	30th August 1945.
By:	B.I.O.S. Trip No.979.

Mr Hammer is the German representative for the firm of Emulsion A/S Raadhuspladsen 16^{B}, Copenhagen who manufacture Emulgator P.E.O. which is Paalsgard Emulsion oil. Manufacture was commenced in Germany about ten years ago. The plant was damaged by bombing; part of it is now at Gotha and part at Eisenach and permission for its re-erection has been refused.

Mr Hammer stated that the Emulgator is made preferably from soya oil but also from rape and sunflower oils. He was unable to give details of the process but it is thought that the oil is treated at high temperatures and blown with air before dilution with untreated oil. The product was used as an emulsifier in margarine but it has now been almost entirely replaced by other emulsifiers such as "Tegomuls" and "Tegin" made by Goldschmidt, Essen. Its main use before production was stopped was in the preparation of "Trenöl", a preparation for greasing bakers trays and Mr Hammer also claimed that it prevented spluttering of fats. Sales in 1940 and 1944 were approximately 500 tons per annum.

Pre-war Mr Hammer was the Hamburg representative of the "Denofa".

SUMMARY

The following is a summary of the information obtained during the foregoing investigations.

Oil-milling

In Germany the general tendency in oil-milling is double, or sometimes treble, expelling followed by solvent extraction whereby the oil content of the seed is reduced to 1% or lower. The expellers employed are of the low pressure type and nowhere were high pressure expellers observed. When presses were in use they were usually of the closed cage type and not the Anglo-American open presses. No new designs of expellers were seen during our investigations but Fritz Müller is developing a large machine having an output of 150 tons in 24 hours as compared with the 48 - 72 tons in 24 hours given by the largest expellers they manufacture at present.

Extraction by both batch and continuous processes were in operation the tendency being for the latter process to displace the former. The continuous plants mostly employed were the Hansa-Mühle and Hildebrandt systems but a third type, a rotary extractor, in which the seed is carried in perforated cells countercurrent to the solvent, is made by M.I.A.G., Brunswick. We did not see this type of extractor in use but a full description of the principles of operation is given in an article "Neue Wege in der Extraktions von Ölfrüchten", "Fette und Seifen", Vol.8, 1940.

Up to the present only soya beans have been extracted continuously on a commercial scale without pre-expelling and/or pressing, but information recorded in the above publication suggests that consideration has been given to the preparation of other seeds and fruits in a suitable condition for direct extraction by special pre-treatment in conditioners in which the material to be treated trickles between stream-lined radiators under carefully controlled conditions of moisture content and air flow.

Refining

In the refining of oils the neutralising, bleaching and deodorising operations were carried out on conventional lines.

Wecker stills were being employed in some factories for reducing the free fatty acid content of oils containing relatively high amounts of fatty acids (above 5%) and also for distilling fatty acids from acid oils obtained from soapstocks. In this type of continuous still the oil, in shallow layers, is submitted to steam distillation in vacuo for a relatively short period of time and it was claimed that the reduction in the free fatty acid content of oils containing 5 - 12% free fatty acids was of the order of 90%.

Hydrogenation

In the hydrogenation of oils and fatty acids nickel formate was the catalyst in general use the main reason given for its selection being the ease with which it can be reduced. Brinckmann & Mergell stated that rape oil and other oils are bleached but not neutralised before hardening, phosphoric acid being added before bleaching.

Fat splitting and Fatty Acid distillation

Batch autoclaving at pressures ranging from 12 - 40 atmospheres has largely replaced Twitchelling for fat splitting but there was no evidence that any attempt had been made to carry out the process in a continuous manner. A catalyst such as zinc oxide is only employed at the lowest pressure; at the higher pressures there is no advantage to be gained by the use of a catalyst. Plant for the distillation of fatty acids was usually made by BAMAG or Lurgi. In addition to the continuous Wecker still mentioned above, both Lurgi semi-continuous and fully-continuous systems were in operation at the factories visited; it is difficult to give an opinion as to which system is the more satisfactory and presumably local conditions will be the deciding factor.

Lecithin production

All edible oils are treated for lecithin recovery, one of the main uses for the lecithin at present being as an emulsifier in margarine. Very briefly, the process normally employed is addition of about 2% of moisture to the warm oil, centrifuging to remove the sludge containing the lecithin and subsequent extraction of the sludge with acetone. Apparently considerably greater volumes of solvent are required to extract lecithin from rape oil than from soya oil and the quality of the rape lecithin is much inferior to that of soya lecithin.

Carotene extraction

At Thörl's, plant was available for:

(a) the extraction of carotene from palm oil, and

(b) from carrots.

The carotene is used as a source of vitamin A in margarine. Carotene is obtained from palm oil by extracting a solution of palm oil soap with benzine and it was claimed that from an oil containing 1,000 I.U. a concentrate containing 30,000 I.U. could be obtained. An interesting feature of this process is the use of alcoholic alkali for the saponification of the palm oil, which presumably reduces the viscosity of the soap and facilitates the extraction process.

In the extraction of carotene from carrots the carrots are digested with a small amount of caustic soda and then with an edible oil. Moisture is removed in a vacuum drier and finally the oil is expelled from the dried material. Any residual oil remaining after the expelling treatment is extracted with benzine.

MARGARINE

No new plant or machinery was observed in the factories which were visited. The only edible oil available in any quantity for the manufacture of margarine was rape oil; one formula given to us consisted of 60% hardened rape oil, and 40% unhardened rape oil, the fat content of the margarine being 80%. Additions included carotene and an emulsifier such as lecithin or one of the Tegomul (monoglyceride) type.

During the war synthetic glycerides prepared from synthetic fatty acids were used to the extent of 100% of the fat in margarine and 80% of the margarine so produced was supplied to the German army and navy. The maximum production of synthetic glycerides used in margarine and cooking fats was however only 150 - 200 tons a month. We examined a sample of margarine made from 100% synthetic fats, which at the time was 6 months old, and although it was very much inferior to margarine as manufactured in this country in respect of taste, it would probably be quite acceptable in a country suffering from acute fat shortage. One of the most important

questions which has arisen regarding this product is that of its digestibility particularly as it contains glycerides of fatty acids having an odd number of carbon atoms; the occurrence of such glycerides in natural fats is extremely rare. Dr Imhausen assured us that synthetic fats had proved to be equally as digestible and harmless as natural fats but in our opinion this requires confirmation, particularly as any systemic effects might not become apparent for a considerable period of time.

It is interesting to note that the typical objectionable odour of synthetic acids is not noticeable in the synthetic fat, although it reappears when the fatty acids are regenerated from the fat.

During the war the ethyl esters of fatty acids, natural and synthetic, were used in margarine to the extent of 10% but we gathered that the products were not very acceptable as the esters tended to split in the margarine, giving rise to bad taste and odour. Difficulty was also experienced in the deodorising treatment during manufacture; this treatment could only be carried out at relatively low temperatures and the resulting fat was not very satisfactory as regards taste.

Synthetic acids, glycerides and alcohols

The production of synthetic acids by air oxidation of gatsch from the Fischer Tropsch process appears to have increased very considerably during the war. Four factories, capable of dealing with 93,000 tons of raw material per year have been erected, although it is understood that the Deutsche Fettsäure Werke, with capacity for 40,000 tons per year, is the only factory which has been operated with complete success on a commercial basis and it is also the only factory concerned in the manufacture of synthetic fats.

During our visit to Ruhr Chemie we were given a figure of 600,000 tons a year as the total output of the eight Fischer Tropsch plants in Germany. If the whole of the gatsch (approximately 30%) from this production were diverted to the use of synthetic glycerides it may be calculated, on the basis that the yield of fatty acids would be 80% and that 55 - 60% of these acids would be suitable for synthetic glyceride manufacture, that the potential supply of fatty acids for edible purposes would be about 83,000 tons per annum. It is difficult to give an accurate estimate of the cost of synthetic

glycerides as compared with that of natural products but it would appear that in Germany before the war they were on approximately the same price level. Only low grade natural products are being used in Germany as the source of material for soapmaking and for this purpose synthetic fatty acids are probably considerably more expensive than the natural products. In 1938 the fat recovered from carcases and slaughter-house waste by the 'Fauth' and other similar processes was valued at approximately 33 marks per 100 kilos whilst the cost given us for synthetic acids was 70 marks per 100 kilos.

The O.X.O. process for the manufacture, from Fischer Tropsch olefins, of fatty alcohols which are ultimately sulphated to give detergents, is an extremely interesting development especially in view of the fact that the cost of the alcohols is not a great deal more than that of the synthetic acids (80 - 90 marks per 100 kilos as compared with 70 marks per 100 kilos). Although up to the present the alcohols have only been made on a 1,000 tons a year scale in pilot plant, a commercial plant capable of producing 10,000 tons a year is practically ready for operation at Ruhr Chemie; by making the process a continuous one this could probably be increased to 15,000 tons a year.