

VIII QUALITY AND DISTRIBUTION OF PRODUCTS

Interrogation at the Moers plant yielded very little information regarding product quality or distribution, but seized documents were somewhat more helpful. Product quality standards for synthetic fuel plants in West Germany were apparently worked out to meet Government requirements by the Arbeitsgemeinschaft fur Hydrierung, Synthese, and Schwelung, abbreviated "Arsyn", having headquarters in Berlin (NW 7 den Dorotheenstrasse 35111) and a branch office in Essen at the Krupp A. G. (Dr. - Ing Fritz Muller). Correspondence with, and reports to, this organization have yielded considerable information on product specifications and how they were met by Rheinpreussen.

The destinations of practically all shipments of stabilized benzin, Diesel fuel and Liquefied gas were apparently dictated by the "Zentralburo fur Mineralol GMBH". The address of this bureau was originally Berlin 1 Charlottenberg 9, Adolph Hitler-Platz 7/9, but on 26 August, 1943, "as a precautionary measure against catastrophe" it was changed to Dresden-Altstadt, Beustrasse 7. Although other records indicated shipments merely to "Zentralburo", one book was found (Doc 15) showing the exact destination of each carload or cylinder of such products shipped during 1944.

From the above sources most of the following information about specific products has been derived.

A. Liquefied Gas (Flussiggas; Treibgas)

Figures for prospective production of liquefied gas by all Fischer-Tropsch plants in West Germany were assembled at conferences held in August and October, 1939 (Doc 88) and are summarized in Table X page 60. Plants showing zero percent olefins presumably had polymerization units or were converting olefins to alcohols as at Rheinpreussen. The estimates contemplated setting aside 15000 tons of Treibgas per year in 1940 and 1941 for aviation engine factories but how this would be used is not stated.

The division of Rheinpreussen's primary production between alcohol manufacture and shipment for fuel in 1944 is shown by Table XI page 61.

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TABLE X

ESTIMATED PRODUCTION OF
LIQUEFIED GAS FOR MOTOR FUEL
BY SYNTHETIC FUEL PLANTS
(Metric Tons)

	<u>Last three</u> <u>Mos. 1939</u>	<u>Total</u> <u>Tons</u>	<u>1940</u> <u>% olefins</u>	<u>Total 1941</u>
Scholven	13,500	54,000	0	54,000
Gelsenberg	700	20,800	0	50,000
Victor Rauxel	350	2,800	50	2,800
Rheinpreussen	1,800	5,400	50	5,400
Ruhrbenzin	1,200	6,000	50	6,000
Krupp	900	4,300	50	4,500
Essener Steinkohle	1,350	5,400	50	5,400
Hoesch	1,500	4,800	40	5,000
Rheinbraun		<u>20,000</u>	0	<u>40,000</u>
Total		<u>123,500</u>		<u>170,000</u>

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TABLE XI

RHEINPREUSSEN PRODUCTION
AND DISTRIBUTION OF TREIBGAS
1944 - Metric Tons

1944 Month	Production	Distribution *	
		Zentralburo**	Alcohol Plant
Jan.	638,300	390,780	243,800
Feb.	680,400	440,132	189,000
Mar.	794,800	643,153	183,200
Apr.	801,300	591,556	187,300
May	722,700	518,029	230,900
June	689,800	462,848	216,900
July	227,700	135,438	68,300***

* Excluding small amounts used by Rheinpreussen plants

** Includes small amounts "fur Rechnung Benzol-Verband,
Bochum"

*** The total stock on hand (46,122 Tons) was destroyed
by the bombing of 19 July, 1944.

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The principal recipients of Rheinpreussen shipments in 1944, excluding companies getting relatively small quantities in cylinders, are shown by Table XII, page 63.

B. Grund Benzin

In recent years the great demand for Diesel fuel has apparently resulted in the lowering of its initial boiling point to the extent that only one benzin was made and shipped. This is sometimes referred to as stabilized benzin and presumably takes the alternative name of "grundbenzin" from its use as a base stock for blending in motor fuels. Data on the total shipments and principal properties of this benzin as made at Moers are given in Table XIII, page 64. The principal recipients of benzin shipments from Moers in 1944 are shown in Table XIV, page 65.

Although the Moers plant had facilities for adding lead tetra-ethyl to gasoline it was stated that no lead had been available there for the last two years. Seized correspondence indicates that this may have been in accordance with a government ruling that lead blending should not be done with any facilities which could not be made absolutely safe against bombing.

The necessity of reducing the benzin endpoint to around 160°C to make the required quantity of Diesel fuel introduced a serious problem of avoiding excess front and volatility which was a subject of prolonged discussion and repeated compromise.

C. Diesel Fuel

Seized documents 74 and 82 reveal that means for increasing Diesel fuel production began to be discussed seriously late in 1939 with particular consideration being given to lowering the initial boiling point to about 150°C and blending with aromatic stocks of similar boiling range from high temperature coking. It was foreseen that less gas oil would be available for cracking and the gasoline quality would be impaired accordingly. The reduction of benzin endpoint would necessitate some shifting of butanes from benzin to Troibgas which might require changes in pressure regulators etc. for use of the latter as motor fuel. The aromatic stock desired for blending was tar wash oil which would have to be replaced by heavy synthetic gas oil for benzol recovery and this introduced a number of operating problems.

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Table XII

PRINCIPAL RECIPIENTS OF RHEINPREUSSEN TREIBGAS SHIPMENTS, 1944
Metric Tons

<u>Principal Consignees</u>	<u>Matzerath Erkelenz</u>	<u>Hinkel Essen</u>	<u>Hilleke Essen</u>	<u>Benzol Verband Koblenz</u>	<u>Benzol Verband Frankfurt</u>	<u>Benzol Verband Stuttgart</u>	<u>Hugo Stinnes Mannheim</u>
January:	58.250	115.400	11.500	42.060	--	--	21.150
February:	119.900	192.600	12.800	--	41.450	20.500	19.650
March:	271.700	106.000	11.200	38.800	--	--	--
April:	197.400	171.200	6.600	22.500	21.000	--	83.090
May:	94.400	114.900	14.600	46.800	20.800	--	87.600
June:	30.900	37.000	--	--	--	--	42.500

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Table XIII

"Grundbenzin"
Monthly Shipments Reported to "Arsyn", 1943-1944

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
Quantity	2710	2451	2709	2647	2745	2558	2757	2715	2545	2794	2645	2607	2653	2537	2705	2661	2805	2218	720
Sp.Gr.	0.679	0.679	0.682	0.683	0.685	0.682	0.683	0.683	0.682	0.680	0.680	0.679	0.679	0.679	0.682	0.681	0.680	0.681	0.682
% off at 75°C	41	41	40	37	39	39	37	40	40	42	42	42	42	43	40	38	40	39	39
V.P. (Atm)	0.73	0.68	0.58	0.57	0.59	0.59	0.58	0.59	0.64	0.72	0.77	0.79	0.81	0.78	0.78	0.58	0.70	0.62	0.63
End B.P. °C	160	158	157	160	163	165	166	165	163	161	166	162	160	157	160	161	161	162	170
Octane No. (R.M.)	60	61.5	59	55	56*	54.3*	53.0	52.4*	55*	57	58	57.2*	57.1*	56.7*	54.7*	53.6*	55.2*	54.4*	55*

* M.M. instead of R.M.

** Winter grade on orders from Arsyn

Table XIV

RESTRICTEDPrincipal recipients of Grundbenzin Shipments from
Rheinpreussen - 1944 -

Jan:	WIFO Ebrach	WIFO Berlin	WIFO Derben	WIFO Fargo	Z.Holl. Gelsenk.	R.Mueser Bochum	NITAG Dortmund	Thyssen Duisbrg	Ruhrroel Bottrop
	102.150	205.700	253.200	353.100	101.500	134.100	157.450	105.300	350.300
Feb:	WIFO Ebrach	Benz.V. Stuttg.	WIFO Derben	Konstantin Bochum	Z.Holl. Gelsenk.	R.Mueser Bochum	Muller Gladb.	OLEX Regnsb.	Ruhrroel Bottrop
	143.800	125.000	456.100	110.000	197.100	132.500	117.400	347.400	209.700
March:	Rheinpr. Heilbr.	RAAB Karlsruhe	Gasolin Stuttg.	Konstantin Bochum	Rhenania Cologne	R.Mueser Bochum	Ebert Regnsb.	--	Ruhrroel Bottrop
	175.650	147.900	108.550	145.800	163.650	111.500	801.400		113.300
April:	NITAG Magdeb.	NITAG Neuss	Dr.Marks Cologne	Benzol V. Eickel	Betriebsgess. Dresden	--	--	--	Ruhrroel Bottrop
	533.150	144.900	107.600	305.000	397.000				201.550
May:	WIFO Amstotten	RAAB Duessel.	Strehmeyer Freib'rg	Rhenania Magdeburg				OLEX Regnsb.	
	407.500	101.100	122.75	199.000				368.100	
June:	NITAG Dortmund	Gasolin Frankfurt	Zentral- buero Vienna	D.Erdoel Fechel- brom	WIFO Heiligen- stadt	OLEX Danzig			
	166.350	108.800	550.600	697.000	268.000	145.000			
July:	WIFO,Derben	--	--	--	--	OLEX,Danzig			
	660.700					100.350			

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Apparently engine tests were conducted by Bosch at Stuttgart, and by the Rheinpreussen and Ruhrchemie laboratories to prove that Fischer-Tropsch oil boiling from 150° to 320°C could be used satisfactorily with current Diesel engines and injectors. However no exhaustive or recent engine test data pertinent to this problem have been found.

In the discussions of increased Diesel fuel production there were occasional references to the need for considerable quantities of propylene to be used in some undisclosed manner for the production of a pour point depressant. Chlorine was also needed for this project but it was stated that the chlorine supply problem had been solved. No evidence has been found as to the extent to which such a pour depressant was made or used.

The basis for the final decision as to diesel fuel specifications does not appear in available records. The quality, as well as the quantity, of the two grades of fuel finally shipped by Rheinpreussen is shown in Table XV and Table XVI. The SDK is believed to be entirely Kogasin but the combination of about 76 cetane number with a solid point of about -42°C (-44°F) indicates the use of a pour depressant. The mixed diesel fuel MOK contains a coal tar oil (Waschol) the specifications of which are unknown. Shipments in 1944 averaged 45% "Waschol" and 55% Kogasin.

A flow diagram (Doc 78) indicates that the Rheinpreussen diesel oil refining process involves mixing suitable fractions and proportions of Kogasin and tar oil and treating the mixture with weak acid followed by weak alkali after which the oil is centrifuged, contacted with bleaching earth and passed through a filter press. No verbal confirmation of the details of this process was obtained.

The principal recipients of Diesel fuel shipments from Moers in 1944 are shown by Tables XVII and XVIII, pages 69 and 70.

On 13 March 1942 Arsyn notified Fischer-Tropsch plants that the Luftwaffe would require unspecified quantities of Diesel fuel meeting the following specifications.

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Table XV

Synthetic Diesel Fuel (SDK)
 Monthly Shipment Reports to "Arsyn"
 1943 - 1944

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Month:	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	
Quantity:																			
Tonnes	506	346	396	420	510	429	601	439	487	510	856	679	533	563	533	745	529	684	
Tests:																			
Density	0.746	0.744	0.743	0.745	0.747	0.748	0.748	0.747	0.749	0.748	0.750	0.749	0.748	0.747	0.747	0.747	0.747	0.747	0.748
Filterability	<60 -35	<60 -35	<60 -40	<60 -35	<60 -20	<60 -35	<60 -25	<60 -35	<60 -35	<60 -35	<60 -35	<60 -35	<60 -35	<60 -35	<60 -35	<60 -35	<60 -35	<60 -35	<60 -35
Solid Point°C.	-41	-44	-49	-45	-43	-39	-38	-41	-41	-40	-40	-41.5	-41	-41	-41	-41	-41	-41	-41
Flame Point°C	27	30	26	29	32	40	37	30	43	40	44	49	42	46	47	46	48	48	48
Cetane No.	77	77	77	76	78	76	76	76	76	78	73	73	75	75	75	75	78	78	78
Boiling Range°C	156 -252	159 -244	158 -225	162 -246	155 -236	169 -240	167 -243	160 -234	164 -252	160 -250	165 -245	164 -247	165 -247	165 -240	165 -238	165 -250	165 -245	165 -247	165 -247

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TABLE XVI

Mixed Diesel Fuel (MDK)*
Monthly Shipment Reports to "Arsyn"
1943-1944

Month:	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	
Quantity:																				
Tonnes	934	908	962	955	875	550	479	763	679	403	297	480	299	319	454	397	593	440	104	
Tests:																				
Density	0.847	0.848	0.846	0.847	0.848	0.849	0.848	0.848	0.848	0.899	0.899	0.887	0.881	0.881	0.879	0.880	0.879	0.881	0.881	
Filter-																				
ability	<60	<60	<60	<60	<60	<60	<60	<60	<60	<60	<60	<60	<60	<60	<60	<60	<60	<60	<60	
Solid																				
Point	-32	-34	-35	-34	-32	-32	-33	-33	-35	-30	-26	-28	-25	-27	-29	-26	-30	-29	-25	
Flame																				
Point	57	58	61	61	62	61	63	62	61	65	65	61	62	62	63	59	62	62	68	
CetaneNo.	55	53	55	54	54	54	54	55	57	45	45	45	48	48	48	48	50	50	50	
Boiling																				
Range	170	171	170	171	171	171	171	171	170	170	170	170	170	170	170	170	170	171	170	
	-285	-280	-280	-285	-288	-286	-283	-284	-284	-295	-300	-302	-295	-295	-300	-305	-300	-320	-320	

* Designation changed to "NDK" Oct. 1943 and subsequent months

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TABLE XVII

PRINCIPAL RECIPIENTS OF SYNTHETIC DIESEL FUEL
SHIPMENTS FROM RHEINPREUSSEN, 1944

Main Consignees:	<u>Regensburg</u>	<u>Regensburg</u>	<u>Ebrach</u>	<u>Torgau</u>	<u>marine</u>	<u>Magdeburg</u>
OLES						
Kuno Ebert WIFO						
Rh.Ossag Kriegs-						
Benzol V.						
Tons:						
January	151.500	154.000	-	-	-	-
February	99.850	-	102.850	-	125.170	98.000
March	150.800	-	-	146.500	-	-
April	205.500	-	-	357.500	-	-
May	-	-	83.000	141.600	-	-
June	201.400	-	-	174.400	-	-
July	-	-	-	66.700	-	-

TABLE XVIIIPrincipal recipients of Mixed Diesel Fuel
Shipments from Rheinpreussen, 1944

Tons						
<u>Main Consignees</u>	<u>Rheinpr. Cologne</u>	<u>Rheinpr. Duisburg</u>	<u>Rheinpr. Moers</u>	<u>DAPG Wesel</u>	<u>DAPG Maggen</u>	<u>Bezol. V. Dortmund</u>
January:	34.200	100.500	-	-	-	-
February:	-	-	55.700	47.550	-	59.160
March:	-	67.320	77.700	-	-	51.260
April:	-	33.500	58.000	-	-	-
May:	-	122.250	71.500	-	48.400	-
June:	100.000	61.650	-	84.760	-	-
July:	-	97.500	-	-	10.000	-

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TABLE XIX

Principal Recipients of Kogasin Shipments from Rheinpreussen
1944 - Metric Tons

1944	Light Kogasin		Heavy Kogasin		I. G. Farben Ludwigshaven	I. G. Farben Ludwigshaven
	Chemische Werke, Huls.	Rubrchemie Holton	Rheinpreussen Anlage IV	Rubrchemie Holton		
January	105,036	385,550	345,520	53,600		11,950
February	198,130	213,660	268,110	151,250		17,130
March	263,840	64,970	355,860	-		9,500
April	236,840	300,660	340,940	-		17,250
May	251,900	212,490	306,370	-		-
June	155,560	316,540	307,050	64,030		16,880
July	79,940	13,800	86,040	-		-
August	No additional stock or shipments		None	-		-
September			22,500	-		-
			No additional stock or shipments			

Sp.Gr. at 20	Not below	0.740
Solid Point	Not over	-38°C
Flame Point	Not below	437°C
Viscosity	Not below	1.05 E at 20°C
Neut. No.	Not over	0.4
Cetane No. (HWA)	Not below	70
Initial boiling pt.	About	160°C
End boiling pt.	Not over	360°C

Rheinpreussen replied that they could meet this requirement by blending Mittelol with heavy benzin as follows:-

	<u>Mittelol</u>	<u>Schwerbenzin</u>	<u>1:1 Mixture</u>
Sp. Gr.	0.752	0.742	0.7465
B.P.A.	-26.5°C	-36.0(-42.)°C	-25.0(-32.0)°C
Solid Point	-29.0°C	-44.0°C	-45.0°C
Flame Point			45.0°C
Vis /20°C			1.07°E
Cetane No.			78

It will be noted that the "SDK" Diesel fuel shipped from Moers during the last year of operations also met these specifications. Unfortunately the designations of these shipments are not indicative of the extent to which such fuel was used by the Luftwaffe.

D. Kogasin

The distribution of shipments of light and heavy kogasin from Moers during 1944 is shown by Table XIX page 71. The heavy kogasin shipped to Rheinpreussen "Anlage IV", Homberg was used for the manufacture of synthetic lubricating oils and was stated to have a boiling range of about 250-350°C. The specifications and uses of the other shipments are unknown.

Two samples of oil were taken from tank car Essen 5-8394, which was reported in captured documents to contain light kogasin. These samples were identified as C105 No. 1 and C105 No. 5. Sample No. 1 was analysed by the Petroleum Board and No. 5 by the Fuel Research Station, with results as given below:-

	CIOS No.1 P.B.No.45/989 Mech 573	CIOS No.5
Specific Gravity /60°F	0.7609	0.757
Color	15 Saybolt	
Odor	Typical of F.T.	
Initial BP	192°C	195
200°	3.5%	3.0
210	17 %	17.5
220	35 %	37.0
230	53 %	55.0
240	69 %	71.5
250	82 %	84.5
260	91 %	92.0
270	95 %	95.5
End point	276°C	279
Recovery	97%	98.5
Residue	2%	1.5
Unsaturation	8.0%	10-11%
Aromatics	Nil	
Unsulphonatable	92%	
Bromine No.	13.8	10
An.Pt. before Sulphonation	83.0°C	
An.Pt. after Sulphonation	86.6%	
Cetane No.	86	

A sample taken from one of several drums marked "Leuchtol" in a box car awaiting shipment to Plant IV was identified as CIOS No. 4. This was tested by the Petroleum Board under their number 45/988 Mech 574 and was found to be identical with CIOS Sample No. 1.

A sample was taken from tank car FS Italia Mo 551033 which was reported in captured documents to contain intermediate product. This was identified as CIOS No. 7 and was analyzed by the Fuel Research Station with the following results:-

Sp.g at 20°C	0.685
Initial boiling pt.	42°C
50°C	3.0%
60	12.5
70	25.0
80	35.0
90	44.0
100	54.0
110	63.0
120	71.0
130	78.5

140	83.5 %
150	88.5
160	93.0
170	95.5
178	97.0
End point	178°C
Residue	1.7%
Loss	1.3%
Bromine No.	66
Olefin content	42%

E. Hard Paraffin and Gatsch

In 1944 "Hart Paraffin", recovered by washing of the synthesis catalyst with benzol, was shipped mainly to Norddeutsche Mineralölwerke, Stettin-Politz, but small shipments were made to other scattered plants. Monthly reports to Arsyn for 1943 characterize the Hart Paraffin as having a melting point above 65°C. Gatsch, recovered as bottoms from distillation of the synthetic crude oil, was shipped entirely to the Fettsäure-Werke, Witten. The use made of these waxes is unknown but it seems probable that they were in part oxidized to fatty acids for the production of soaps and other derivatives. Some of the work along this line conducted at Moers is discussed later under the subject of Research Activities.

A considerable stock (12 tons) of hard paraffin was left in the Moers plant and a sample was obtained. This wax is yellow in color, has a distinctive odor and was stated to have a melting point of 80-100°C. A sample was examined by the Petroleum Board with the following results:-

Melting point (ASTM Pet. Method)	90°C
Iodine No.	3½
Saponification value	1
Ash	0.13%
Water	3.0%

Examination of another portion of the same sample by the Fuel Research Station yielded the following information.

The sample was distilled under a pressure of approximately 1mm abs. and the observed boiling points were corrected to 760mm giving the following distillation record:-

Below 300°C	11.0%
300-330°C	0.3
330-350	0.7
350-375	1.2
375-400	2.1
400-425	1.9
425-450	4.9
Above 450	76.9
loss	<u>1.0</u>
	100.0

The total wax boiling above 300°C had a molecular weight of 430 and the fraction boiling above 450°C had a molecular weight of 530. The congealing points (Method IP 76-44T) were as follows:

Total wax	80-81°C
Above 300 C	87-88°C
Above 450 C	91°C