

2. Sources of Diesel Fuel in Germany.

Note: Whenever a production process is mentioned, such as Fischer-Tropsch synthesis, or hydrogenation, the reader is referred to the reports on these various processes prepared by the U. S. Naval Technical Mission in Europe.

2. Sources of Diesel Fuel in Germany. (Cont'd)

(a) Natural Petroleum Distillates.

Crude oil was obtained from the Polish, Rumanian, Austrian and German fields, to serve as a base for the German fuels and lubricants industry. Although the quantity of these oils was continually decreasing under the impact of Allied air and land offensives, a surprisingly large amount was still on hand almost up to the end of hostilities.

(b) Synthetic Distillate known as Kogasin II.

The high-boiling fractions distilled from the Fischer-Tropsch low pressure, low temperature, catalytic process for obtaining hydrocarbons from solid fuels has the following typical analysis (1945) and was used as blending product for the preparation of Diesel fuels:

<u>DISTILLATION</u>			
Gravity	.76		
Color	15 Saybolt	I.B.P.	192°C
Odor	Sickly-Characteristic of F.T. products.	200°C	3.5 percent
		210°C	17 percent
Cetane No.	90 and better	250°C	82 percent
Bromine No.	13.8	260°C	91 percent
Iodine No.	13	270°C	95 percent
Aromatics	Nil	E.P.	276°C
Unsaturation	15 - 20 percent	Recovery	97 percent
Flash Point (PM)	195°F		
Fire Point	215°F		
Ash Content	Nil		
Comradson Carbon	Nil		
Viscosity	2.8 centiskokes @ 68°F		
Sulfur	.01 percent		
Aniline Point	90°C		

(c) Synthetic Distillate known as Kogasin I.

The lighter fractions distilled in the Fischer Tropsch process, with boiling range below 225 degrees centigrade, known as Kogasin I, and with a cetane number from 35 to 60, according to the cut, have also been used as one ingredient in various mixtures, for the production of Diesel fuels. Some work, mentioned below has been done to improve their suitability.

TABLE 1.

TABULATION OF DIESEL FUEL SPECIFICATIONS

Kriegsmarine		Sonder		Kriegsmarine	
Wehrmacht		Diesel		Kraftstoff	
Diesel		Kraftstoff		K ₁	
Kraftstoff		Kraftstoff		Mineral oil; F.T. Synthesis; Hydrogenation	
Kraftstoff		Kraftstoff		Ignite Oil	
Appearance		The fuel must be clear, free from all solid matter.		.88 Max.	
Gravity @ 15°C		.810 to .865		.90 Max.	
Viscosity Engler @ 20°C		1.1° to 2°		For U-Boats to 2.6°	
Pour Point		Winter: -30° C Max.		Must flow freely and without separation @ 0°C	
Filtering ability		Summer: -10° C Max.		No such specifications	
Flash point P.M.		Winter: 200 cc min in 60 Sec @ -25° C		55°C Min	
Neutralisation No		Summer: " " " " @ -50 C		1.5% Max	
Acid Corrosion		55°C min		Acidity Zero	
Water		1 mg Max		1.3% Max	
Ash		Not over 4 mg of weight reduction		1% Max	
Sulphur		1% Max		8% Max	
Corrosion Carbon		.05% Max		1% Max	
Lower Heat Value		Or 2% coke and gum by the Hagemann Hammerich method		No specifications	
Ignitability		15 Cetane Min.		(In practice 50 - 55)	
Volatility		80% Min distilled at 360°C, 95% Min @ 350°C		60% Min, distilled @ 350°C	
Compatibility		All Diesel fuels must mix together without precipitation			

NOTES:

1. The Kriegsmarine specified also an "Emulsibility Test" which was the following: 10°C of the Diesel fuel was shaken in a 50cc closed tube with 10cc of water for 30 seconds. There must be no emulsion and the separation of oil and water should start within a minute after the shaking. After 1/2 hour separation must be complete (with in 1cc of mixture). Then 1cc of a 10/10 NaOH solution is added and the fuel and water are shaken again 1/2 minute. The coloring of the liquid within the next 24 hours must be at the utmost a very pale pink. If too dark the entire test is repeated with sea water.

2. All Kriegsmarine Diesel Fuels, called "PREIBOEL", except. SDK2 (Sonder Diesel Kraftstoff 2) which is actually a "Tractor Distillate", had to be colored to a minimum of 4 - 5 Oswald. For oils which were too light in color a mixture of 13 mg of Sulan brown R and 1 mg of Japan black were added per 1 kg of fuel (colored made by I.G. Farben-Industrie).

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(d) Distillates obtained from the Low-Temperature Carbonisation of Coal and Lignite (Schwelteer).

Low-temperature carbonization of lignite produces about 3 percent of an oil containing as much as 20 percent of "creosote" and, according to the refining process, varying in cetane rating from 38 to 48. Its composition makes it a rather poor diesel fuel, and it is not generally used without further treatment.

(e) Distillates from the Hydrogenation Process.

The oil obtained from the hydrogenation of coal, coal tar and lignite constitutes a good diesel fuel, whether it is the middle oil from the sump phase, or the residue of distillation from the gas phase. Typical analysis of these hydrogenation diesel fuels cover a wide variety according to their boiling range:

Gravity	.850 to .885
Aniline Point	31 to 53°C
Aromatics and Unsaturation	38 to 49 percent
Boiling Index**	255 to 265
Cetane Rating	30 to 45
Pour Point	Below -35°C and as low as -70°C
Viscosity E @ 20°C	1.45 to 1.81°
They are used either pure or mixed with Kogasin II.	

** The Germans refer to "Boiling Index" as the sum divided by ten of the temperatures at which 10 percent, 20 percent, 30 percent, etc., of the liquid have distilled, including the end point, but not the initial boiling point. Some also divide by nine the sum of the 10 percent, 20 percent, etc., fractions but exclusive of both I.B.P. and E.P.

(f) Oils from High-Temperature Carbonization of Coal.

In the Ruhr where large quantities of coal are coked for the metallurgical industry, a tar-oil is available, of high gravity and low ignitability which is not suitable as diesel fuel for high-speed engines. It can however, be processed and mixed with other products, as will be described below.

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(g) Shale Oil.

The distillation of shale yields about 3.5 percent of an oil suitable as a Diesel fuel after further treatment and mixed with other products, in a manner similar to the treatment of coal tar mentioned above. This will be described further. A typical analysis of shale oil, such as produced at Dotternhausen (near Rottweil) is:

DISTILLATION

Gravity	.916		
Cetane Rating	35		
Neutralization Index	0	I.B.P.	124°C
Ash	.02 percent	10 percent	240°C
Water	.09 percent	20 percent	250°C
Sulphur	4.4 percent	50 percent	282°C
Saponification No.	2.63	70 percent	315°C
Conradson Carbon	.15 percent	90 percent	340°C
Asphalt	0.06 percent	E.P.	371°C
		Recovery	96 percent