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ENCLOSURES
Copy No. *K* 67372
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MILITARY INTELLIGENCE DIVISION W. D. G. S.

MILITARY ATTACHE REPORT Germany
(Country reported on)

Subject: Examination of Enemy Oils and Fuels. I. G. No. 9525
(Brief descriptive title)

From: M. A. London Report No. 70242 Date 8 July, 1944.

Source and degree of reliability:

Air Ministry. A-2.

SUMMARY. - Here enter careful summary of report, containing substance succinctly stated; include important facts, names, places, dates, etc.

w/4 incls (A.I.2(g) reports new)

The attached A.I.2(g) Reports contain analyses of enemy oils and fuels, as follows:

Incl. 1 - Report No. 1588 describes a sample of soluble cutting oil.

Incl. 2 - Report No. 1591 describes a sample of K.I. Diesel Fuel.

Incl. 3 - Report No. 1592 describes samples of engine oil, engine coolant, and hydraulic fluid taken from a Ju. 88 shot down over Essex 24/3/44.

Incl. 4 - Report No. 1595 describes three samples of oil taken from a Ju. 88, and one sample each of hydraulic fluid and coolant.

MILTON M. TURNER,
Colonel, Air Corps,
Military Air Attache.

4 Incls. as above,
3 cyps. cc. w/Mr.

OMA, American Embassy, London. 8 July, 1944. Forwarded *NDM*

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4341-2385

21st June 1944

War Cabinet Technical Sub-Committee on Axis Oil 0026842

ENEMY OILS AND FUELS COMMITTEESample No. AIR 394 (received via United States Petroleum Attache,
London from A.F.H.Q.)

AIR 394 - No.997; Plain tinned can. No marking.

SOLUBLE CUTTING OILAnalysis by Shell Marketing Co.Ld., Fulham

Size of Sample	Approx. 1-gallon
Appearance	Clear dark red soluble oil. The oil produces a stable white slurry with water.
Water	2.0% wt. (approx.)
Alcohol (methyl)	3.0% wt. "
Free Acidity (mg.KOH/gm.)	4.0
Sulphur	2.25% wt.
Copper Strip Test	No stain
Sulphated Ash	2.94% wt. Essentially sodium sulphate
Unsaponifiable Matter	73.8% wt.

Properties of Unsaponifiable Matter

Appearance	Clear dark red spindle oil.
Specific Gravity	0.9095
Kinematic Viscosity @ 100°F	15.23 C.s.
210°F	3.03 "
Viscosity Index	37
Sulphur	1.15% wt.
Copper Strip Test	No stain

<u>Total Free & Combined Fatty Acids</u>	14.7% wt.
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Properties of Fatty Acids

Melting Point	Viscous liquid at room temperature
Iodine Value	15
Mean Molecular Weight	365
Refractive Index n _D 60°C	1.498
Sulphur	Present
Copper Strip Test	Slight stain
Nature of fatty acids	Probably naphthasulphonic acids

The values reported above for unsaponifiables and total acids are probably low due to the volatility of the spindle oil in the first case and to the solubility in water of the sulphonic acids in the latter case.

The above analysis indicates the following probable composition for the soluble oil:

Light Spindle Oil	75.0% wt.
Sodium naphthasulphonates	17.5% wt.
Free Fatty Acid	2.5% wt.
Methanol	3.0% wt.
Water	2.0% wt.

S.J.M.Auld
Chairman,
for the Enemy Oils and Fuels Committee

The Petroleum Board,
Shell-Mex House,
W.C.2.

ENCLOSURE

70242

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28th June 1944

War Cabinet Technical Sub-Committee on Axis Oil

ENEMY OILS AND FUELS COMMITTEE

Sample No. AIR 391

A.I. 2G. 1501

MINISTRY

K.I. DIESEL FUEL ex Mediterranean area

Analysis by The Petroleum Board, Vauxhall

Size of Sample	Approx.	4-gln. Jerrican
Specific Gravity		.870
Colour		1 - 1½ N.P.A.
Distillation - I.B.P.		211°C
Recovery at 250°C		12%
300°C		62½%
350°C		94%
F.B.P.		369°C
Total Recovery		98½%
Residue		1%
Flash Point, Closed		208°F
Viscosity, Redwood 1, @ 100°F		37"
Four Point		0°F
Cloud Point		16°F
Sulphur Content		0.08%
Conradson Carbon		Trace
Ash		Slight trace
Water		Nil
Neutralization Value (mg.KOH/gm.) ..		0.006
Diesel Index		47
Cetane Number		47
Sediment		Nil
Aniline Point		65.8°C
Condition		Good - clear and bright
Phenols		0.002%

Hydrocarbon Analysis

Aromatics	19.5%
Paraffins	58.0%
Naphthenes	19.0%
Unsaturateds	3.5%

This is a diesel fuel of average ignition quality. It is probably of petroleum origin but may contain some synthetic material.

It would appear to be inaccurately designated as the tests are quite different from previous inspections of the K.I. fuel.

The Petroleum Board, 2, 10 Essex Street, W.C.2
Shell-Mex House, W.C.2
S. J. M. Auld
Chairman,
for the Enemy Oils and Fuels Committee

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30th June 1944

War Cabinet Technical Sub-Committee on Axis Oil

ENEMY OILS AND FUELS COMMITTEE

Samples Nos. AIR 374 (Engine Oil), AIR 375 (Engine Coolant), and AIR 376 (Hydraulic Fluid) taken from Ju.88 shot down at Chigwell, Essex, 24.3.44.

Analyses by Shell Marketing Co., Ltd., Fulham

AIR 374 (Approximately 1½ litres ENGINE OIL) - This sample was used engine oil, dark in appearance, containing some coarse sediment, and with 1% of diluent. After removal of the diluent and sediment the oil had the following characteristics:-

Specific Gravity	0.886	
Viscosity at 100°F	S.U. 1145"	C.S. 247.8
210°F	100"	20.78
Viscosity Index	105	
Pour Test	-10°F	
Saponification Value (mg.KOH/gm.)	0.8	
Sulphur Content	0.25% wt.	
Ramsbottom Coke No.	0.38	

The oil is therefore of the un compounded high V.I. type generally met.

AIR 375 (Approximately 500 ml. ENGINE COOLANT) - Although described as an Engine Coolant this is likely to be a De-icing Fluid. It consists of:

Ethyl Alcohol	70% vol.
Water	5% vol.
Ethylene Glycol	25% vol.
plus 1% wt. of a lithium soap, probably lithium ricinoleate.	

The lithium ricinoleate is probably intended to act as a corrosion inhibitor, lithium being selected as the base due to increased solubility of the soaps at low temperatures.

AIR 376 (Approximately 1½ litres HYDRAULIC FLUID) - This is a Mineral Hydraulic Fluid of very low viscosity and containing approximately 4% of fatty oil. In appearance it is light red with strong green fluorescence. Its general characteristics are as follows:

Specific Gravity	0.858
Flash Point (P.M.), Closed	240°F
Open	255°F
Kinematic Viscosity @ 100°F	4.85 C.S.
210°F	1.65 "
Viscosity Index	107
Pour Test	Flowing at -60°F
Neutralization Value (mg.KOH/gm.)	0.1
Saponification Value (mg.KOH/gm.)	8

S.J.M.Auld
Chairman,
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The Petroleum Board,
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Strand, W.C.2.

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30th June 1944
AIR MINISTRYWar Cabinet Technical Sub-Committee on Axis OilENEMY OILS AND FUELS COMMITTEE

Samples Nos. AIR 378, AIR 379, AIR 380, AIR 381.
AIR 384 (drawn by The Petroleum Board under instructions
from R.A.F. 67 M.U., Taunton, April 1944.)

AIR 378 - USED OIL from undamaged engine of Ju.88 A-4 Trop. PL.1214,
Jumo 211 J-1, Eng.Nos.Port 4755, Starboard
1061302465, shot down at Bradwell Bay, Essex,
19.4.44. Tank from which sample taken undamaged.

AIR 379 - UNUSED OIL from Port Wing (Reserve) of Ju.88 A-4 Trop.
PL.1214, Jumo 211 J-1, Eng.Nos.Port 4755,
Starboard 1061302465, shot down at Bradwell Bay,
Essex, 19.4.44. Tank from which sample taken
undamaged.

AIR 380 - HYDRAULIC FLUID from Ju.88 A-4 Trop. ditto. ditto.
Tank from which sample taken damaged.

AIR 381 - COOLANT from Ju.88 A-4 Trop. ditto. ditto.
Tank from which sample taken damaged.

AIR 384 - ENGINE OIL ex Ju.88. (No further details received.)

Analyses by Shell Marketing Co., Ltd., Fulham

The Used Engine Oils (AIR 378 and AIR 384) are very similar in properties; their characteristics after removal of the diluent and sediment suggest that the oils are of the uncompounded, high V.I. type, probably solvent-extracted oils.

The Unused Engine Oil (AIR 379), although from the same aircraft as the Used oil (AIR 378), is of a different type. The oil contains a proportion of diluent apparently less volatile than a gasoline diluent and the diluent-free oil has a lower specific gravity, viscosity, coke number and pour point than those of the Used oil (AIR 378). The oil evidently contains no Bright Stock and its low specific gravity and other physical properties suggest the presence of synthetic lubricating oil.

AIR 380 is a light compounded Hydraulic Fluid similar to AIR 376, and AIR 381 (Engine Coolant), is an aqueous soluble oil emulsion containing approximately 4% vol. of oil, as judged from the small sample submitted (11 ml.).

	AIR 378	AIR 384	AIR 380
Size of SampleApprox.	2-glns.	2-glns.	3 qts.
Diluent (Gasoline)	2.0% vol.	1.7% vol.	-
Sediment insoluble in I.P.spirit	0.79% wt.	0.83% wt.	-
Ash (sulphated)	0.22% wt.	0.29% wt.	-
Nature of Ash	Chiefly lead sulphate, some iron compounds also present.		
	<u>Tests on diluent- and sediment-free oils.</u>		
Appearance	Dark red oil, dark green bloom.	Dark red oil, dull green bloom.	Cloudy light red oil, strong apple-green fluorescence.
Specific Gravity	0.892	0.889	0.862
Viscosity:			
Kinematic @ 32°F (C.s.)	-	-	17.5
100°F "	246.2	283.5	4.90
140°F "	-	-	3.08
210°F "	21.16	21.90	1.65
Saybolt Universal @ 100°F (Secs.)	1137	1310	-
210°F "	102.4	105.6	-
Viscosity Index	107	101	103 (approx.)
Pour Point	-5°F	-5°F	Flows @ -85°F
Saponification Value (mg.KOH/gm.)	1.2	0.8	5.0
Sulphur	0.30% wt.	0.20% wt.	-
Ramsbottom Coke No.	0.37	0.32	-

INCLOSURE 4 TO REPORT
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30th June 1944

War Cabinet Technical Sub-Committee on Axis Oil

ENEMY OILS AND FUELS COMMITTEE

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Samples Nos. AIR 378, AIR 379, AIR 380, AIR 381 and AIR 384 - Continued

Additional tests on AIR 380

Neutralization Value (mg.KOH/gm.)	0.1
Flash Point, P.M., Closed	190°F
Open	230°F

The oil was tested for the presence of polymers with negative results.

The relatively low closed flash point indicates that the sample contains a small quantity of a more volatile fraction possibly due to contamination.

AIR 379 (Approximately 1 quart) - This sample was examined originally as a normal unused oil, but the figures did not correspond with these for the used oil from the same aircraft. It was therefore examined further for diluent (gasoline fuel), when 5.2% vol. was recovered. The diluent distilled over at a slower rate than is normal for gasoline diluent and when the sample was examined by a modified diesel diluent method, with a bath temperature of 120°C, the diluent was equivalent to 6.8% vol. and was recovered at a faster rate than is normal for diesel diluent.

It appears, therefore, that the sample contains approximately 7% vol. of a "diluent" intermediate in properties between those of a gasoline and a diesel fuel diluent.

The properties of the sample before and after removal of diluent by the modified diesel diluent method are tabulated below:

	AIR 379 As received	AIR 379 Diluent-free
Appearance	Red oil with medium green bloom, containing fine sediment as received.	
Specific Gravity	0.876	0.879
Flash Point, P.M., Closed	130°F	-
Open	230°F	-
Fire	350°F	-
Viscosity:		
Kinematic @ 100°F (C.S.)	137.7	195.4
140°F "	49.4	66.3
210°F "	14.28	17.64
Redwood 1 " 100°F (Secs.)	203	269
Saybolt Universal " 100°F "	636	903
210°F "	74	88
Viscosity Index	109	105
Ash (sulphated)	0.01% wt.	-
Pour Point	-30°F	-20°F
Saponification Value (mg.KOH/gm.)	0.8	-
Sulphur	0.20% wt.	0.20% wt.
Ramsbottom Coke No.	0.16	0.17

AIR 381 - The total volume of the sample was 11 ml. The sample had the appearance of a white, soluble oil emulsion with a small supernatant layer of dirty curd. It was diluted with water, and no further separation of material occurred, confirming that the sample represented an aqueous emulsion. The entire sample was demulsified in a Babcock bottle, and yielded 0.45 ml. of separated oil. The concentration of the emulsion was, therefore, approx. 4% vol.

Oil emulsions were frequently used in Germany as coolants prewar but for I.C. engines in road vehicles usually to the extent of not more than 1%, the oil being added as an anti-corrosive. It was the first indication of its use in coolants for aero engines.

S.J.M.Auld

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