Attachment X

Ester Oils

(I. G. Leuna-Paper on Properties and Applications.)

Ester Oil. - I. G. Leuna-Paper on properties and applications.

The term "ester oil" is taken to mean synthetic esters which are prepared from isobutyl alcohol, phenol, and cresol. The following esters have thus far been manufactured:

1. Ester Oil 504, prepared from methyladipic acid and Leuna alcohol (Fraction 160°-200°C),
2. Ester Oil 515, prepared from methyladipic acid and Leuna alcohol (Fraction 180°-250°C),
3. Ester Oil 455, prepared from adipic acid and Leuna alcohol (Fraction 140°-180°C),
4. Ester Oil 426, prepared from Leuna carboxylic acid (Fraction 200°-250°C) and trimethylolethane,
5. Ester Oil IT 4, prepared from Leuna carboxylic acid (Fraction 140°- 180°C) and trimethylolethane,
6. Mollith L.85, prepared from Leuna carboxylic acid (Fraction 160°-180°C) and trimethylolethane,
7. Ester Oil 623, prepared from methyladipic acid and 1/2 dimethylolpropane + 1/2 isobutyl alcohol (Fraction 180°-250°C).

Preparation of Ester Oils.

Acid and alcohol are mixed in an agitator at ordinary temperature and, at the same time, zinc oxide or toluenesulfonic acid is added as catalyst. Zinc oxide is taken for trimethylolethane esters, toluenesulfonic acids for adipic and methyladipic acid esters.

The mixture is then heated externally with gas and raised to 180°-220°C. The water liberated in the reaction is distilled off azeotropically with the aid of an oil fraction (180°-220°C) which is recycled. The reaction lasts for 6 to 8 hours and is finished when no more water is formed.

The crude ester is washed with dilute sodium hydroxide and finally with water until neutral, freed from the oil and low-boiling impurities by distillation until a flash point of 210°C is reached, and finished with clay.

The following materials were required for the preparation of 100 kg. of ester oil.

1. Ester Oil 504: 56 kg. methyladipic acid,
   160 kg. Leuna alcohol (Fraction 160°-200°C);
2. Ester Oil 515: 50 kg. methyladipic acid,
   164 kg. Leuna alcohol (Fraction 180°-250°C);
3. Ester Oil 455: 48 kg. adipic acid,
   158 kg. Leuna alcohol (Fraction 140°-180°C);

4. Ester Oil 426: 90.4 kg. Leuna carboxylic acid (Fraction 200°-250°C),
6.5 kg. higher fatty acids,
24.5 kg. trimethylolethane;

5. Ester Oil IT 4: 96.1 kg. Leuna carboxylic acid (Fraction 140°-180°C),
30.8 kg. trimethylolethane;

6. Mollith L.85: 97.0 kg. Leuna carboxylic acid (Fraction 160°-180°C),
29.7 kg. trimethylolethane;

7. Ester Oil 623: 57 kg. methladipic acid,
133 kg. isobutyl alcohol,
9 kg. dimethylolpropane.

Applications and Properties of Ester Oils.

1. Ester Oil 504 was employed for the preparation of axle oil suitable for low-temperature railroad operations, "Y-Axle Oil Red"; it was mixed with an equal part of R-Oil* obtained from SS-Oil (polyethylene) manufacture subsequently treated with aluminum chloride. This low-temperature axle oil must provide satisfactory lubrication of the railroad cars at -40°C.

Properties:
Viscosity (Engler, at 50°), : > 3.4,
Viscosity (Engler, at -40°), : < 3300,
Pour Point : < -60°C,
Flash Point : > 140°C.

In addition, Ester Oil 504 was employed in the preparation of ink suitable for low temperatures.

2. Ester Oil 515
Ester Oil 426 were employed in a 3:2 mixture for the preparation of low-temperature aircraft and motor oils. The low-temperature aircraft oil was obtained by the addition of

25% ester mixture
to 75% of SS 903 Oil (polyethylene).

This made it possible to start aircraft engines at -30°C.

Properties:
Viscosity (Engler, at 99°) : > 2.0,
Viscosity (Engler, at -30°) : ca 3000,
Pour Point : < -50°C,
Flash Point : > +220°C.

* R-Oil is obtained on neutralizing the $AlCl_3$ catalyst in synthetic lubricating oil manufacture.

The low-temperature motor oil was obtained by mixing

50% of SS 903 (polyethylene)
with 50% of ester mixture.

This made it possible to start automobiles at -35° to -40°C.

Properties:		
	Viscosity (Engler, at 99°)	; >1.6,
	Viscosity (Engler, at 20°)	: ca 2000,
	Pour Point	: <-50°C
	Flash Point	: > 200°C.

3. Ester Oil 455 served in the preparation of "Gun Oil Blue," which was suitable for operation at -60°C and was used in machine guns. "Gun Oil Blue" is a mixture of

46% Ester Oil 455,
47% high-boiling fractions of the volatile recycle stock ("Vorlauf" Oil) from SS 900 (polyethylene) manufacture,
2% SS 906 Oil (polyethylene),
5% amyl xanthate tetrasulfide.

Properties:		
	Viscosity (Engler, at 20°)	: > 2.0,
	Viscosity (Engler, at -50°)	: < 350,
	Pour Point	: <-70°C,
	Flash Point	: > 120°C.

4. Ester Oil IT 4 was employed as an insulating oil in liquid-cooled electric switches. It is less combustible than mineral oils, very suitable at low temperatures (in regard to pour point), and does not precipitate any carbon in service so that it also has a high dielectric strength.

Properties:		
	Viscosity (Engler, at 20°)	: 4 to 7,
	Viscosity (Engler, at -30°)	: < 800,
	Pour Point	: <-50°C,
	Flash Point	: > 200°C.

5. Mollith L.85 is employed as a non-gelling softener for nitrocellulose.

Properties:		
	Viscosity (Engler, at 20°)	: 5 to 6,
	Pour Point	: < -60°C,
	Flash Point	: > 200°C.

6. Ester Oil 623 serves as a substitute for rapeseed oil in the performance of heavy-duty cutting operation.

Properties:		
	Viscosity (Engler, at 20°)	: 8 to 13,
	Pour Point	: < -50°C,
	Flash Point	: > 200°C.

Plants Now in Construction or Contemplated.

	Leuna:	Schkopau:	Auschwitz:
Ester Oil 504	1000 metric tons/yr.	-	2400 metric tons/yr.
" 515	1500 metric tons/yr.	2400 metric tons/yr.	-
" 455	230 metric tons/yr.	-	-
" 426	1000 metric tons/yr.	-	1600 metric tons/yr.
" IT 4	200 metric tons/yr.	-	-
Mollith L.85	1000 metric tons/yr.	-	-
Ester Oil 623	500 metric tons/yr.	-	-