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THERMAL ANALYSIS OF POLYSYNTHETIC BASIC OILS

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On the base of results obtained by thermal analysis of mineral oils, synthetic ester oils and their mixtures, it should be stated that the synthetic components reduce the volatility and thermooxidation stability of oils without basically influencing the thermal stability.

Mineral basic oils obtained from crude oil show a number of quality drawbacks as far as the requirements of modern technical devices are concerned. Even the introduction of very effective additives does not often allow achievement of the required properties, e.g. low-temperature operation, thermal and thermooxidation stability, appropriate viscosity coefficient or low volatility.

Synthetic lubricants (esters, alkylbenzenes and polyolefins are characterized by excellent selected maintenance properties. The basic reason for their limited use is their very high price compared with that of oils of crude oil origin. Some synthetic oils also show certain quality drawbacks, e.g. the corroding of copper and its alloys, the low solubility of some improving additives and the destruction of elastomer linkages.

A compromise solution from technical and economic points of view might be the application of semisynthetic basic oils for mass product formulation, e.g. gear and Diesel oils.

The derivative-and-graphic method used in this paper allows only a preliminary formulation of the thermal durability and thermooxidation stability of basic oils.

Due to the level of accuracy of recording the basic values such as mass loss, sample temperature or heat influence, the results obtained with the method do not permit the full differentiation of samples with similar chemical constitutions.

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Experimental

For the analysis described in this paper, a derivatograph (Paulik-Paulik-Erdey, MOM, Hungary) was used. 200 mg samples were heated in atmosphere at a constant rate of 2.5 deg/min. The samples were placed in a platinum crucible, with an empty platinum crucible for comparison.

The analysed materials were compositions of two mineral oils and two synthetic ester oils: diisooctyl adipate (DOA) and a complex adipate ester of isooctyl and neopentyl glycol (AGNO).

The synthetic components used at present in the production of high-quality lubricants for the aviation industry are distinguished by excellent low-temperature properties.

The application of these components for the production of semisynthetic lubricants for land vehicles is planned. A synthetic component content of up to 20% must provide a significant improvement of the rheological properties, without their specific negative properties being exhibited.

Results

The temperature, sample mass changes and heat effects show similarities in character. Figure 1 depicts typical curves.

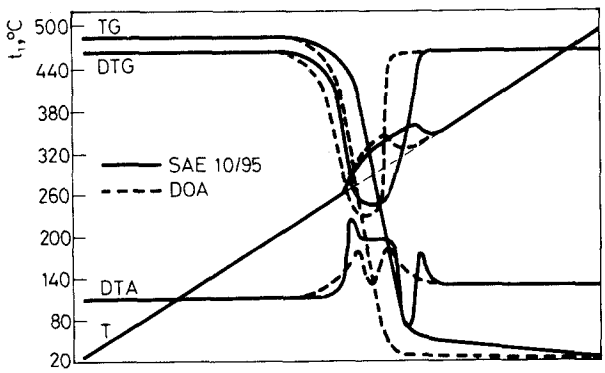

Fig. 1 TG, DTG and DTA curves of SAE 10/95 DOA oils

The temperatures of 1, 2 and 5% mass loss from the samples might be taken as criteria for evaluation of the oil volatility, the DTA curve deflection from the baseline temperature (t_1) as a criterion of the thermooxidation

stability, and the extrapolated temperature of the start of decomposition (t_2) (TG curve breakpoint) and the T curve deflection from the baseline temperature (t_3) as criteria of the thermal durability.

The analysed synthetic oils are characterized by high volatility relative to that of mineral oils, with resulting significant decreases in the temperatures of 1, 2 and 5% samples massless at AGNO concentrations over 10% and DOA concentrations over 20%.

The thermooxidation stability of the synthetic oils (190°) is much lower than that of mineral oils (228 and 247°). DOA exerts a significant influence on the oxidation resistance of SAE 30/85 oil at concentrations over 20%. AGNO causes a much lower decrease in the thermooxidation stability of mineral oils.

Table 1 Fractional and thermooxidation stability of base oil components

Oil grade	Temperature of mass loss, °C			t_1	t_2	t_3
	1%	2%	5%	°C	°C	°C
SAE 10/95	217	231	256	228	266	265
SAE 30/85	245	259	285	247	285	280
DOA	198	213	233	190	263	260
AGNO	195	209	228	192	242	253
11.1% DOA-SAE 30/85	237	247	273	248	281	280
19.5% DOA-SAE 30/85	244	259	279	242	282	275
33.2% DOA-SAE 30/85	215	229	251	212	274	274
43.5% DOA-SAE 30/85	211	225	245	212	269	273
54.6% DOA-SAE 30/85	208	225	245	212	270	273
5% AGNO-SAE 10/95	215	228	250	220	263	265
10% AGNO-SAE 10/95	217	228	249	218	264	267
15% AGNO-SAE 10/95	199	216	242	210	262	263
20% AGNO-SAE 10/95	203	218	242	207	262	263
5% AGNO-SAE 30/95	240	256	278	240	274	278
10% AGNO-SAE 10/95	231	245	270	228	272	276
15% AGNO-SAE 10/95	229	242	267	236	270	276
20% AGNO-SAE 10/95	222	238	264	228	274	278

To summarize the derivative-and-graphic analysis of mineral oils, synthetic ester oils and their mixtures, it should be stated that the synthetic components reduce the analysed quality parameters such as volatility and thermooxidation stability, without basically influencing the thermal stability.

These changes are small at low concentrations of the synthetic components.

Final conclusions concerning the thermal and thermooxidation stabilities of semisynthetic basic oils require the application of more precise quantitative analysis techniques.

Zusammenfassung – Auf der Basis thermoanalytischer Meßergebnisse von Mineralölen, synthetischen Esterölen und deren Gemischen kann behauptet werden, daß die Flüchtigkeit und Thermooxidationsbeständigkeit der Öle durch die synthetischen Bestandteile vermindert wird, ohne dabei derennc thermische Stabilität wesentlich zu beeinflussen.