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TECHNICAL BULLETIN
BIODEGRADABLE
ALUMINUM COMPLEX GREASES

The development of biodegradable aluminum complex greases has progressed to the point where formulations are available which can provide the performance characteristics required for most industrial applications. Formulation factors effecting biodegradability are the composition of the soap, the additive package, and most important, the base oil. Most mineral oil bases are not biodegradable so that formulations must rely on 2 and 4 cSt PAOS, TMP synthetic esters, and seed oil. In many cases, blends of oil provide suitable characteristics for specific applications.

The choice of additives is important as well. Some additive suppliers provide information concerning biodegradability and most have toxicity data to help in making sound choices although a low toxicity level is no guarantee of biodegradability.

The formulations shown below were developed as examples and were submitted for biodegradability testing using the Gledhill Test (EPA Method 796-3100). Samples 1 and 3 exceeded the minimum threshold of 60 % in the 28 day test. Sample 2 achieved 52 % but modifications to the formula would likely permit reaching 60 % as well. There are other compositions which would be equally biodegradable and which could be tailored to more specific end uses.

Formulations

SAMPLE ID	1	2	3
Base oils	80% trimethylolpropane tri-oleate, 7.0% T-6000	75.5% sunflower oil 9.3% t-6000	75.5% canola 9.3% T-6000
Fatty Acids (FW=277.5)	5.36%	5.36%	5.36%
Benzoic Acid	2.12%	2.12%	2.12%
Aluminum (100%)*	0.52%	0.52%	0.52%
% Soap	8.0	8.0	8.0
Molar ratios	0.9 benzoic/fatty acid 1.9 total acids/aluminum	0.9 benzoic/fatty acid 1.9 total acids/aluminum	0.9 benzoic/fatty acid 1.9 total acids/aluminum
% antiwear/EP	3.0 A	4.0 B	4.0 B
% anti-oxidant	1.0 D + 1.0 E	1.0 D + 1.0 E	1.0 D + 1.0 E
% anti-rust	1.0 C	1.0 C	1.0 C

* In all three examples, aluminum is supplied by Kolate 7013LV
T-6000= rapeseed oil telomer from International Lubricants Inc.

Additives I. D.

A	**TM-887**	**Lubrizol**
B	**Di-calcium phosphate**	**Rhodia**
C	**Na-Sul 729**	**King industries**
D	**Vanlube PCX**	**R.T. Vanderbilt**
E	**\Vanlube 848**	**R.T. Vanderbilt**

TEST RESULTS

SAMPLE ID	**1**	**2**	**3**
Pens: P 60 – P 10T	**297 / 306**	**270 / 280**	**262 / 275**
4-ball wear (mm)	**0.50**	**0.43**	**0.44**
4-ball EP KgF	**315**	**250**	**539**
Dropping point F	**527**	**541**	**539**
100 hr Oxidation	**28 psi loss**	**15 psi loss**	**38.5 psi loss**

PROCEDURE

The samples were prepared using Kolate 7013LV as the aluminum source. The procedure is straight forward. All of both acids and about 90% of the oil chosen as the base oil should be heated with slow stirring to about 90 C. It is important that the solution be clear with no undissolved acids. At this point the required amount of Kolate is added. It is important that the batch not exceed this temperature because of the possible sublimation of the benzoic. This would change the mole ratios of the formula and likely effect the results adversely.

Once the Kolate is in, the temperature can be increased to 200 C. With a bench scale size batch, cooling can be started immediately. When the temperature comes down to 125 C, it it safe to introduce the additive package and any cut-back oil necessary.

Further information is available in the technical bulletin on Kolates.