Biodegradability Summary
ASTM D 5864-00 Report

Test Organization: Renewable Lubricants, Inc.
Test Operator: Aaron R. Harnar, Biochemist
Test Samples: RLI Bio-Ultimax Hydraulic formulations
Test Start Date: January 8, 2003
Test End Date: February 5, 2003
ASTM Rating: Pw1 Ultimate Biodegradable

Inoculum Background

A sludge sample containing appropriate biodegradation inoculum was obtained from the Hiram Wastewater Treatment Dept., Hiram OH 44234 on January 7, 2003. The sludge sample was permitted to settle and the upper sludge supernatant was transferred to each 3L biodegradation flask at a volume of 30 ml on January 7, 2003. No inoculum pre-adaption techniques were utilized to enhance biodegradability results.

APHA Standard 9215 C. Heterotrophic Plate Count, Spread Plate Method, was followed to verify presence of live microorganism in sludge supernatant. Live inoculum colonies were noted at a population of approximately 10^6 colony forming units per milliliter.

Reference Substance

As specified by ASTM D-5864 for use with water insoluble test formulations, canola oil was utilized as biodegradable controls in this test. For additional references go to www.renewablelube.com Lab Information, Biobased and Biodegradable Testing, view Understanding Biobased/Biodegradable and the Industry's Standard Tests and Definitions. http://www.renewablelube.com/lab-biobasedtesting.htm

Reference and Test Substance Carbon Content

Robertson Microlit Laboratories, Inc., (29 Samson Ave., PO Box 927, Madison, NJ 07940, (973) 966-6668), measured the carbon content of the canola oil biodegradable control and the six Renewable Lubricants, Inc. (RLI) biobased hydraulic formulations tested in this study according to the procedure set forth in ASTM D 5291-02.

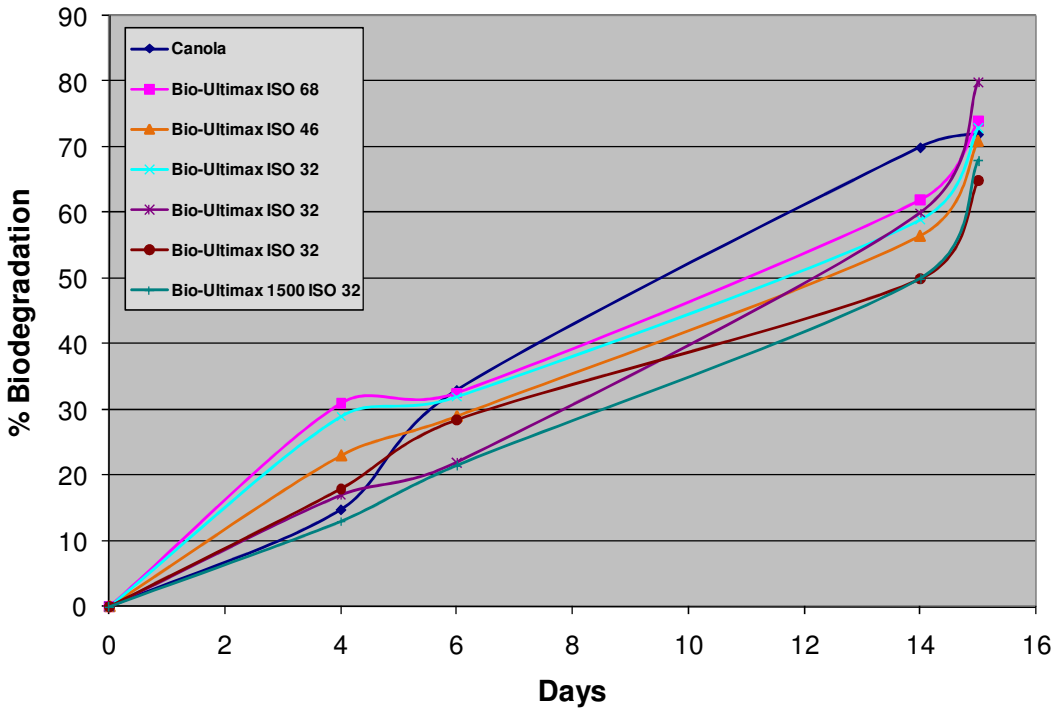
Substance ID	*Carbon Content (%)*
Canola oil	77.42
Bio-Ultimax ISO 32	76.82
Bio-Ultimax ISO 68	76.82
Bio-Ultimax 1500 ISO 32	80.83
Bio-Ultimax ISO 46	77.23
Bio-Ultimax ISO 32	79.01
Bio-Ultimax ISO 32	80.07

Biodegradability Results

A biodegradation plateau for the test substances was observed 15 days into the test and upon confirming the attainment of this plateau, the test was ended in accordance with ASTM D 5864 procedure. At this plateau, all six biobased hydraulic formulations had exceeded 60%

biodegradation before 28 days. These materials can therefore be classified as Pw1, Ultimately Biodegradable or "Readily Biodegradable" according to ASTM D-6046. During the ten day measurement of the reference and test substances, the Hydraulic formulations were lagging in biodegradability with respect to the canola oil control. However, after 15 days, the biodegradability of most Hydraulic formulations exceeded that of the biodegradable canola control.

A visual summary is provided below.



Biodegradability Ratings

ASTM D-5864 requires that the sample fluid should have at least a 60% yield of carbon dioxide (of the total measured carbon content) within 28 days for the "Ultimate Biodegradability Pw1" rating. Biodegradability ratings are identified in ASTM D-6046 (Standard Classification of Hydraulic Fluids for Environmental Impact). However, the Degradation/Accumulation Expert Group of the OECD Environment Committee classifies samples as "Inherently Biodegradable" if they demonstrate biodegradability greater than 20% in 28 days.