

Biolubricants: technical and market survey

SURVEY 1 : January 2007

[LEGISLATION](#)

[MARKETS](#)

[BOOKS](#)

[TECHNICAL SIDE](#)

[ON THE WEB](#)

[ECO-LABELS IN EUROPE](#)

1 -- LEGISLATION: 02 November 2005 : FRANCE

Projet de Loi agricole, Sénat français.

A law is proposed in France to ban the use of lubricants that are not biodegradable when they can be replaced by the ones that got the Euro-ecolabel. Will come into force on 1st January 2008.

2 -- LEGISLATION: ValBiom react to the enquiry conducted by the PEFC

January 2007

The PEFC Council (Programme for the Endorsement of Forest Certification schemes) is an independent, non-profit, non-governmental organisation, founded in 1999 which promotes sustainably managed forests through independent third party certification. The PEFC provides an assurance mechanism to purchasers of wood and paper products that they are promoting the sustainable management of forests. ValBiom put an emphasis to include in Wallonie, the use of biolubricant in the requirements.

3 -- MARKETS: Biolubricants: the green way to make the earth move

Whitby, R.D., Oils & Fats International, Publication Date: 01-NOV-06

For further information, please contact: R D Whitby, chief executive, Pathmaster Marketing Ltd, Willowhayne, Brynford Close, Woking, Surrey GU21 4DW, UK. E-mail: pathmaster@dial.pipex.com

Free download of the full article on http://goliath.ecnext.com/coms2/summary_0199-5994415_ITM

The promotion of lubricants that are more friendly to the general environment is gaining ground. Numerous applications exist for environmentally friendly lubricants, of which biolubricants are just one type, and they are gaining market share from conventional mineral oil lubricants. Vegetable oil biolubricants are niche products with a smaller market share than synthetic esters derived from natural materials. However, there is no such thing as a wholly environmentally benign product. The activities of all living things have good and bad impacts on all other living things. Environmentally friendly products are intended to have either lower or minimal impact.



4 -- **MARKETS: Bio chain saw oils in French forests: call for 200.000 liters**

The call (closed 15.01.2007) is on <http://www.onf.fr/data/habase/IF000000e08a.pdf>

The French Forests Office (ONF) launch a call for providing biobased bio-chain saw oil. The two-year market is estimated between 167 000 and 262 000 liters.

5 -- **MARKETS: Market introduction program in Germany**

From Dr.-Ing. Heinrich Theissen, IFAS, Aachen University.

For more information see: www.bioschmierstoffe.info.

Conversion from mineral oil to bio-based oil is being supported with 10 million €/year by the German government since 2000, all lubricant applications are accepted except chain saw oil and mold release agent (but mold release agent to be included in the future). Bio-based oils means that they content more than 50% renewable raw materials. A Positivliste monthly update content more than 440 lubricant products supplied by more than 40 vendors. The demand is 95 % asked for conversion of mobile hydraulic equipment (construction, forestry, agriculture). In 6 years, more than 13,000 machines have been converted. Since 2002, about 10.000 T of Bio hydraulic oil are sold in Germany. From a technical point of vue, the main problem occurred when mixing **bio-oil and mineral oil**. Changeover instructions can be found on the web site (Menu: Literatur/Fachwissen). According to a 2005 survey, more than 90% of the users are satisfied with bio-based hydraulic oil.

6 -- **MARKETS: US Government : Bio-Friendly Lubricants Purchases 2006**

<http://www.govexec.com/features/0206-01/0206-01na4.htm>

Even before the Agriculture Department finalizes the federal program that encourages agencies to buy products made from plant and animal sources in place of petroleum goods, some already are making the switch. A few examples: the Defense Logistics Agency buys bio-based hydraulic fluid for helicopters and the Agriculture Department's Beltsville Agricultural Research Center uses plant-based hydraulic fluids and lubricants on farm equipment.

7 -- **MARKETS: Pentagon shapes key market for bio-based products**

Philip Brasher, Des Moines Register. 09/13/2006.

Full article on <http://aimpoints.hq.af.mil/display.cfm?id=13793>

The Air Force are supporting bio-based products because buying products made from crops rather than petroleum is an essential part of the strategic approach to national security. The agency started tracking its purchases of bio-based products and other environmentally friendly items in 2002. Since then, they have grown from \$57 million to \$100 million last year. A list of bio-based items the agency has bought includes packaging, hand cleaners, adhesive removers, metalworking fluids, cutlery and a firearm lubricant. Vibroacoustics Solutions Inc. of Ames offers a truck lubricant made from corn, soybeans and graphite called 5th Wheel LubePaste.



8 -- MARKETS: Bio-lubricant market could compliment Montana's interest in biodiesel production

By Shannon Burkdoll, *The Prairie Star* editor. July 5, 2006

Montana's oilseed crops have a place in the bio-lubricants market. Montana could produce bio-lubricants on a small scale basis when compared to its biodiesel production potential. The market size is 1.12 billion gallons of crank case oil, 209,000 gallons of hydraulic oil and 55,000 gallons of marine oil to be purchased in a year. Twenty-four percent of the consumers say it is okay to use bio-lubricants in crank case oils, 60 percent in hydraulic oils, 75 percent in marine oils and 23 percent in natural gas markets. Smaller markets are the ones being pursued, not so much the larger markets. Consumers have indicated they are willing to spend more money, up to 50 percent more, for the bio-lubricants than petroleum-based products. Nevertheless, there are limitations in producing bio-lubricants in Montana. One such limitation is obtaining enough high oleic oil from sources such as canola and safflower. These oilseed crops have more lucrative markets in biodiesel and nutritional markets. The second one is that it has to be certified by the Petroleum Institute.

On the same subject: A CONFERENCE: Future crops for Bio-Diesel and Bio-Lubricants. Duane Johnson, Northwestern Ag Research Center Kalispell, Montana State University. On http://www.harvestcleanenergy.org/conference/HCE5/HCE5_PPTs/Johnson.pdf

9 -- MARKETS: US preferentially product program

The catalog is on <http://www.biobased.oce.usda.gov/fb4p/Catalog.aspx>

The Farm Security and Rural Investment Act was signed into law in 2002. A goal of that legislation is to increase the government's purchase and use of biobased products. The U.S. Department of Agriculture was directed to develop and implement a comprehensive program for designating biobased products. The USDA has already designated several items as "preferred," and will be adding significantly to that list in the coming months. Many government agencies are now using these products, and have found them to have comparable or superior performance to their petroleum counterparts. The USDA launches a Product Catalog on line: 54 hydraulic fluids (including transmission oils and UTTO) and 15 Penetrating oils are registered, respectively by 10 and 6 Companies (see table below).

Hydraulic Fluids	Penetrating Lubricants
Bio-Gem Services	
	Bi-O-Kleen Industries
Cargill Industrial Oils & Lubricants	
	Desilube Technology
Environmental Lubricants Manufacturing	
Fuchs Lubricants Co.	
Houghton International	
Hydro Safe Oil Division	
	International Lubricants
Quaker Chemical Corp.	
Renewable Lubricants	Renewable Lubricants
SoyClean	SoyClean
Terresolve Technologies	Terresolve Technologies



10 -- BOOKS : Synthetics, Mineral Oils, and Bio-Based Lubricants: Chemistry and Technology

Leslie R. Rudnick, 928 pp. Publisher: CRC Press, Publish Date: 2006

Rudnick (senior scientist, The Energy Institute, Pennsylvania State U.) presents an expanded version of his earlier Synthetic Lubricants and High-Performance Functional Fluids. The format has been retained, but the coverage now includes new chapters on natural oils as lubricants, chemically modified vegetable oils, biotechnological enhancement of soybean oil, environmentally friendly hydraulic fluids, vegetable oil-based engine oils, fluids for food-grade applications... For the various lubricants and fluids, the authors describe the historical development, chemistry, properties, performance features, manufacturing, marketing, economics, applications, and market trends. The CD-ROM contains Internet resources.

11 -- BOOKS : Lubricants to 2010 - Demand and Sales Forecasts, Market Share, Market Size, Market Leaders.

Published: 08/2006. Pages: 346 (Full Study Price: US\$ 4,400, Per Page Price: US\$ 30.00).

Table of contents on <http://www.freedoniagroup.com/Lubricants.html>

US lubricant demand will reverse recent declines through 2010. Increased manufacturing activity will fuel demand for process oils, hydraulic fluids and greases; a bigger motor vehicle park will benefit engine oils and transmission fluids. Environmental concerns will favor bio-based lubricants and re-refined basestocks. This study analyzes the \$11.2 billion US lubricant industry. It presents historical demand data for 1995, 2000 and 2005 and forecasts to 2010 and 2015 by lubricant base oil, product (e.g., engine oils, process oils, hydraulic fluids, turbine oils, automatic transmission fluids, power steering fluids, metalworking fluids, gear oils, greases); and by market. The study also considers market environment factors, details industry structure and competitive strategies, evaluates company market share and profiles 36 major players including Shell, Exxon Mobil, Chevron, BP, CITGO, ConocoPhillips, and Ashland.

12 -- BOOKS: Production of wax esters in Crambe - EPOBIO

Report (free downloading) on <http://www.epobio.net>

This report shows that the GMO production of wax esters for the manufacture of lubricants, from the non-food oilcrop *Crambe abyssinica* can become viable in Europe. Wax esters have lubrication properties that are superior to ordinary vegetable oil, i.e. triacylglycerols, due to their high oxidation stabilities and resistance to hydrolysis. High performance lubricating oils are often based on synthetic esters (such as wax esters) sometimes with the fatty acid part from plant sources. These are adapted to special applications such as high pressure, high temperature lubricants for use in gearboxes, differentials, crankcase lubricant; cutting oils, etc.

13 -- TECHNICAL SIDE: Tribological evaluation of coconut oil as an environment-friendly lubricant

N.H. Jayadas, K Prabhakaran Nair and Ajithkumar G

Article in *Tribology International*, Volume 40, Issue 2, February 2007, Pages 350-354

Increased concerns about environmental damage caused by mineral oil based lubricants, has created a growing worldwide trend of promoting vegetable oil as base oil for automobile lubricants.

In the framework of the Project IBIOLAB --



HORIZONTAL ACTIVITIES INVOLVING SMES



Coconut oil, which is abundantly available in southern states of India, is reportedly being widely used as two-stroke engine lubricant (2T oil) by autorikshaw (a tri-wheeled three seated vehicle powered by two stroke air cooled engine used as a taxi in India) drivers. A survey among the users of coconut oil as 2T oil brought forth complaints of increased engine wear. This paper presents tribological properties of coconut oil evaluated using a four-ball tester and a test rig to test the wear on two stroke engines. The influence of an antiwear/extreme pressure (AW/EP) additive on the tribological performance of coconut oil was also evaluated experimentally. The addition of the AW/EP additive has brought about considerable reduction in wear with coconut oil as 2T oil.

14 -- TECHNICAL SIDE: Rectal cancer and exposure to metalworking fluids in the automobile manufacturing industry

Elizabeth J. Malloy 1, Katie L. Miller 1 and Ellen A. Eisen (Harvard School of Public Health, United States) Occup Environ Med. Published Online First: 15 August 2006.   2006 by BMJ Publishing Group Ltd Abstract on <http://oem.bmj.com/cgi/content/abstract/oem.2006.027300v1>

Rectal cancer has been previously associated with exposure to metalworking fluids (mineral oils) in a cohort mortality study of autoworkers. Nonparametric smoothing of lagged exposures has revealed stronger evidence for a causal association between straight metalworking fluid and rectal cancer than was previously described using standard analytical methods.

15 -- TECHNICAL SIDE: Solid lubricant formulations containing starch-soybean oil composites

G. Biresaw and S. M. Erhan, Cereal Products and Food Science Research Unit, NCAUR, ARS, USDA, 1815 N. University St., 61604 Peoria, IL, USA Journal of the American Oil Chemists' Society, Springer Berlin / Heidelberg, Volume 79, Number 3 / March, 2002 Pages 291-296, November 30, 2006

Starch-oil composites comprising purified foodgrade corn starch (PFGS) and soybean oil (SBO) were investigated as potential ingredients for water-based solid lubricant formulations. Current solid lubricants are almost exclusively petroleumbased and are used for protecting sheet metal and/or as sheet metal forming lubricants. Starch-oil composites are preferred ingredients for formulating solid lubricants because they are based on renewable and abundantly available raw materials and also have superior environmental and health characteristics. Steel sheets coated with the PFGS-SBO containing solid lubricant were evaluated for boundary coefficient of friction (COF) and wear properties using ball-on-flat test geometry. The COF was highly dependent on the SBO to PFGS ratio in the composite. In the absence of SBO, the COF was high (≈ 0.8) and decreased sharply with increasing SBO content to a minimum value of 0.07. Wear evaluation showed no scratches or lubricant transfer on the ball. There were also no wear tracks observed on the flat sheet before or after the solid lubricant was washed off. It was concluded that waterbased solid lubricants formulated with the PFGS-SBO starch-oil composite have acceptable friction and wear properties and should be evaluated further for use in sheet metal forming.



16 -- TECHNICAL SIDE: Lubricant Formulation with Vegetable Oils - Interfacial Aspects

Biresaw, Girma. Society of Tribologists and Lubrication Engineers, May 20, 2004. p.172.

Vegetable oils are amphiphilic fluids since their molecules comprise distinctly separated polar and non-polar groups. As a result, vegetable oils can be used both as base oils and film strength additives in lubricant formulation. However, for some lubricant applications, vegetable oils by themselves might not be adequate to provide all the necessary needs. In such cases, the vegetable oils are blended with synthetic or mineral oils, which are non-polar. Such blending of amphiphilic fluids with non-polar oils will have a profound effect on various properties of the blend, and most notably its surface and interfacial properties. Surface and interfacial properties are particularly important because they affect various lubricant functions, including the formulation of water-based lubricants from such neat blends. In this work, the dynamic interfacial tension between synthetic oil and water is investigated as a function of vegetable oil chemistry, and vegetable oil concentration in the synthetic oil. The impacts of the resulting observations on the lubricating and non-lubricating properties of such blends are discussed.

17 -- TECHNICAL SIDE: Metalworking Lube From Soy Oil

By Jan Suszkiw, May 8, 2006. ARS is the U.S. Department of Agriculture's chief scientific research agency. More on <http://www.ars.usda.gov/is/AR/archive/may06/lube0506.htm>

A biodegradable metalworking fluid derived from soybean oil is earning high marks in trials under a five-year, cooperative research in Peoria, Illinois. The fluids are critical to Alcoa's hot and cold flat-rolling operations, which produce aluminum sheets. The ARS team's first step was to examine the chemical structures that give mineral-oil-based metalworking fluids their functional properties. Then they had to keep those observations in mind in making a biobased equivalent, which they did using modified soy oil and antioxidants for oxidative stability. After evaluating several soy-based formulations, Alcoa chose one for a first round of tests at its aluminum-continuous casting plant. Operators there who evaluated the formulation were so pleased they promptly substituted it for their synthetic fluids. The soy-based formulation also performed well in large-scale trials involving a reversing-mill process.

18 -- TECHNICAL SIDE: Dialkyl Carbonates As Lubricant Additives

Kenar, J.A., Kurth, T. Annual Meeting and Expo of the American Oil Chemists' Society, May 3, 2006 p. 74.

It has been previously reported that dialkyl carbonates represent attractive lubricants, in part, to their amphiphilic nature and their decomposition to non-corrosive simple alcohols and carbon dioxide. In this work, a series of symmetric and asymmetric dialkylcarbonates prepared from oleochemical alcohols were synthesized and examined for performance as lubricant additives in hexadecane. A standard 4-ball wear test was performed, the wear scars were examined, and the used hexadecane mixtures were examined for decomposition products. The results were compared to those for analogous fatty acid methyl esters of similar chain length. It was found that the methyl esters performed better as evidenced by superior (smaller) wear scars. No alcohol decomposition products could be detected via GC for the dialkyl carbonates or fatty acid methyl esters. Asymmetric methyl fatty alkyl carbonates were synthesized to more closely explore the cause for this behavior. It was found that the asymmetric systems performed worse than the corresponding esters and alcohols containing the same number of carbons. These results suggest the inherent structure and/or electronics of the carbonate moiety does not lead to improved interaction of the polar headgroup with the metal surface.



19 -- ON THE WEB : CORTEC ® .

Cortec® Corporation, Headquartered in St. Paul, Minnesota. Release date: May 25, 2006
Website: www.CortecVCI.com

Cortec® Corporation is a pioneer of environmentally friendly, corrosion protection: Vapor phase Corrosion Inhibitors (VpCI™) & Migratory' Corrosion Inhibitors (MCI®) Technologies for the Packaging, Metalworking, Construction, Electronics, Water Treatment, Oil & Gas and other industries. EcoLine™ Bearing, Chain, & Roller Lubricant is a bio-based, rust preventative lubricant, formulated with American grown soybeans. It offers superior lubricity over most conventional lubes. As a sustainable product, it contains 86% less petroleum than traditional lubricants. It contains VpCI™ molecules that form a thin, tight, layer on the metal, surface completely sealing off the metal against moisture or air, protecting it from corrosion. It provides protection for up to 24 months, even in the most aggressive environments. By resisting sling-off on high speed systems, this innovative lubricant reduces the need for reapplication and keeps the work place area cleaner and safer than using traditional lubricants.

20 -- ON THE WEB: Rapid Energy Services

Administrative Center, 1424 S. Hugh Wallis Road, Lafayette LA 70508,
<http://www.terrabond.net/Collateral/Collateral.asp>

Rapid Energy Services manufactures and supplies a range of environmentally friendly lubricant products for a number of industrial applications: hydraulic fluids grades from 22 to 68, penetrating oil, chain oil and marine oil. These high performance bio-based lubricants are equal in performance to their petroleum-based counterparts while offering operators the advantage of complete biodegradability when released into the environment. All of Rapid's bio-based lubricant products are formulated from renewable agricultural (natural seed) plant base oils. The base oils and additives in these products pass and exceed acute toxicity (LC-50) criteria adopted by the U.S. Fish and Wildlife and U.S. E.P.A.

21 -- ON THE WEB: Genetically engineered plants to produce ricinoleic acid

Linnaeus Plant Sciences Inc., Suite 244, 4438 West 10th Ave., Vancouver, BC Canada V6R 4R8. Contact:
info@linnaeus.net. www.linnaeus.net

Castor oil (*Ricinus communis*) is unique in that it is a triacylglycerol oil in which nearly 90% of the fatty acids are the unusual fatty acid, Ricinoleic acid (18:1-OH). Hydroxy fatty acids are only rarely found in the plant kingdom. A small number of species are known to produce ricinoleic acid but none make an oil of the incredible acyl purity of castor oil. Biochemical studies have revealed that ricinoleic acid is produced in castor by the direct hydroxylation of the common fatty acid, oleic acid (18:1). The hydroxylation reaction is catalysed by a single, highly efficient enzyme, the fatty acid hydroxylase. This enzyme has been cloned and expressed in genetically engineered plants to produce novel seed oils containing ricinoleic acid. *Linnaeus* has exclusive rights to this enzyme and the utilization of fatty acid hydroxylases in transgenic plants to produce seed oils containing hydroxy fatty acids. This oil is used in engine oils, two-strokes and also to polymers building (cooperation with AtoFina).



22 -- Eco-labels in Europe: lists of lubricants suppliers that got licenses

Swedish Standard Hydraulic oils SS 15 54 34 -	Swedish Standard Lubricating greases SS 15 54 70	Nordic Swan (Finland)	BLUE ANGEL Hydraulic Fluids RAL-UZ 79	BLUE ANGEL Lub. and Form. Oils RAL-UZ 64	EUROPEAN ECO-Label (country)
				Addinol Lube Oil	
Agro Oil	Agro Oil				
			Agip Schmiertech.		
				ARAL Aktiengesell.	
			AVIA Mineral�l		
				BayWa	
			Bechem (Carl)		
Binol	Binol	Binol Biosafe Oy			Binol Biosafe (FIN)
BP Sm�rjmedel	BP Sm�rjmedel		BP Schmierstoff		
			Bremer & Leguil		
Canadian Oil AB					
			Calpam Mineral�l		
Castrol					
Cargo Oil	Cargo Oil AB				
Carl Bechem					
Car Oil (Gulf)					
Caterpillar			Caterpillar Overs.		
Cognis Deutsch.			Cognis Deutsch.		
			Deutsche BP Lub.		
Eliassons Maskin					
			Esso Deutschland		
Exxon Mobil Lub.					
			FINKE Mineral�lw.		
F L Nordic (Ambra)					
			Fragol Schmierstoff	Fragol Schmierstoff	
			Fuchs Eu Schmier.		
G. A. Lindberg					
Green Oils					
			Handelsges. f�r Kr.	Handelsges. f�r Kr.	
				Hebro Chemie	
Hydroscand					
Kajo-Chemie			Kajo-Chemie	Kajo-Chemie	
Matrix Lubricants					
	MCB Larsson Mill.				
Midland	Midland				
Mobil Oil					
			Motorex		
				M�ller (H. Math)	
Neste Oil AB	Neste Oil AB				
Nordisk D�ck.(Agip)					
Norsk Hydro Olje					
					Novance (FR)
NYCO.					
OK-Q8	OK-Q8				
				OMV Aktiengesells.	
Panolin Scandinav.			Panolin	Panolin AG	
			Pap Star, Vertrieb.		
Partek For (Valmet)					
Preem Pet (Texaco)	Preem Pet (Texaco)				
			Raiff. Haupt-Gen. N		
	Ramby Oljor& Verk.				
Skand. Oljecentr.					
	SKF Maint. Prod.				
Shell AB			Shell Deutsch.Oil		
				Starke & Sohn	
Statoil Lubricants	Statoil Lubricants				
Sunoco					
	Svenska Shell				

Swedish Standard Hydraulic oils SS 15 54 34 -	Swedish Standard Lubricating greases SS 15 54 70	Nordic Swan (Finland)	BLUE ANGEL Hydraulic Fluids RAL-UZ 79	BLUE ANGEL Lub. and Form. Oils RAL-UZ 64	EUROPEAN ECO-Label (country)
				Technolub Schmier	
Total Lub.Sweden					
Valvoline Intern.					
			Veba Oel Vertrieb		
Voitel. Tont. Comet					
Volvo CE			Volvo CE Intern.		

