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Application of ECLs and Today's Legislation

ABSTRACT: Environmentally considerate lubricants (ECLs)—the so called “bio oils”—were introduced in the mid 80s to minimize impact of lubrication on the environment. In the early 1990s the German RAL (Blue Angel) and the Swedish Standard organisations defined corresponding specifications for ECLs, other Eco-Labels followed. In 2005 the European Community released the directive 2005/360 defining the toxicity and ecotoxicity profile for ECLs, which qualifies them for the Euro-Marguerite. For more than 20 years top tier ECLs were used in mobile and stationary hydraulic equipment. Well documented field experiences not only demonstrate these lubricants contribute to the fulfillment of the new laws but also meet technical requirements for this equipment. In this paper important EC Directives related to lubricants and the protection of the environment are discussed and how they are implemented into national laws. In addition the benefits of ECL in hydraulic equipment are addressed.

KEYWORDS: ECL/ECLs, environmentally considerate lubricants, sustainability, bio oil(s), lubricant(s), top tier, eco label(s), EC directive(s), legislation, Blue Angel, RAL, Euro-Margerite

Introduction

Today's modern society enjoys nature, and it makes sense that the wonderful environment should be preserved as best as possible. In daily work, legislation has a great impact and environmental protection becomes a heavy burden on industry's shoulders. These contradictory contexts of economy, technology, and environment are well known. Especially these days the pressure on the entire economy has increased.

Decision makers have to cut costs to remain competitive while applying the latest technology. At the same time extra money should be spent for better environmental compliance on job sites. An increasing requirement to be environmentally friendly can be observed in politics and in public and must be taken into consideration.

Modern Lubricants for Sustainable Companies

It is not so obvious but lubricants can have a great impact on machinery and the environment and therefore on all stakeholders in and around this business. For its continuance and sustainability every company must be competitive in three different aspects: economy, technology, and environment (see Figs. 1–3).

Economy

It is the target of every company to provide a certain profit to the owners and shareholders. Only this profit enables the company to do investments and therefore guarantees the continuance of the business.

Technology

Only the right technology guarantees efficient work and contributes to the target of the company: economic success and sustainability.

Environment

We are facing many changes in our business world today, due to natural progress and the globalization of the last years. No company can ignore the environment. Only respect for the environment contributes to the sustainability of the business. Global trends such as reducing the carbon footprint are important for our industries as well as reduced impact on the environment in general.

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FIG. 1—*Earth moving machine.*



FIG. 2—*Railway machinery.*



FIG. 3—*Hydro power plant.*

How Can a Lubricant Help to Achieve These Goals?

Top tier Environmentally Considerate Lubricants (ECLs) combine several advantages. They are formulated such that the good biodegradability and low toxicity properties reduce their negative impact on the environment, so pollute much less than traditional mineral oil lubricants. Synthetic ester base oils in

combination with excellent additive systems can provide longevity and lead to fewer oil changes. In some systems life time fill has been achieved.

Legislation

In the mid 1980s interest in alternatives to the well-established mineral oil based lubricants increased steadily. At that time it was thought that refined vegetable oils such as canola or sunflower oil could be taken as environmentally friendly lubricants. Although these oils provide very good wear inhibition, they can only be used in a very limited number of applications due to their weak thermo-oxidative stability. If exposed to higher temperatures, sludge and lacquer formation may occur with resultant risk of machinery damage, valve malfunctioning, and filter blockage. The inherent chemical properties of natural oils, or more generally of unsaturated esters, limit their use to “lost lubricant” applications such as in forestry chainsaws.

The development of ECLs, which do not have these demerits, dates back to that time. Over the past 25 years this technology has been further optimized, and with more than 1×10^9 operating hours accumulated so far, it has been proven in practice that environmentally friendly along with top tier performance are no longer inherent contradictions.

Eco Labels

The German Blue Angel was the first eco-label that defined toxicity, ecotoxicity, and performance requirements for lubricants, and in particular hydraulic fluids with minimal environmental impact in case of leakages. The criteria are stringent: they define acceptable toxicity and ecotoxicity profiles not only for the fully formulated lubricants but also for the additives and base fluid components.

The Swedish Standard SS 15 54 34 eco-label also sets toxicity and ecotoxicity limits for each component and the entire formulation. In the Nordic forestry industry, only lubricants carrying the SS 15 54 34 eco-label are in use; also they are used on job-sites where construction machinery has to be filled with “approved hydraulic fluids.”

The most recently introduced eco-labels for lubricants are the Euro-Marguerite (EC Publication 2005/360/EC of 26 April 2005) and the USDA Biopreferred™ label.

EC Directives

The European Community (EC) has long addressed environmental protection by releasing so-called EC Directives that legislate various aspects of this ambitious target. The most important EC Directives and publications regarding the impact of lubricants on the environment are as follows:

Directive 96/61/EC of 24 Sept. 1996 concerning integrated pollution prevention and control.

Directive 2000/60/EC of 23 Oct. 2000 establishing a framework for Community action in the field of water policy.

Directive 2004/35/EC of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage.

Publication 2005/360/EC of 26 April 2005 on eco-label Commission decision of 26 April 2005 establishing ecological criteria and the related assessment and verification requirements for the award of the Community eco-label [Euro-Marguerite] to lubricants.

One goal of these directives is to ensure the prevention of negative impacts on the environment by enforcing the application of state-of-the-art products. Another goal is to allocate the responsibility for any contamination to the polluter. With Publication 2005/360/EC an EC eco-label for lubricants has been introduced. It is the opinion of many that over the course of time the Euro-Marguerite label will take pre-dominance as a reference; thus facilitating Europe-wide the selection and use of ECLs.

In the following, some details of these EC Directives and the Euro-Marguerite eco-label are outlined.

Directive 96/61/EC of 24 Sept. 1996 concerning integrated pollution prevention and control—The target of this Directive is the integrated prevention and control of pollution [1]:

Article 2— Definitions.

Paragraph 2

“... pollution shall mean the direct or indirect introduction as a result of human activity, of substances, vibrations, heat or noise into the air, water or land.”

Paragraph 11

“... ‘best available techniques’ shall mean the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent.”

Article 3—General principles governing the basic obligations of the operator.

Member States shall take the necessary measures to provide that the competent authorities ensure that installations are operated in such a way that: (a) all the appropriate preventive measures are taken against pollution, in particular through application of the best available techniques; (b) no significant pollution is caused.

Related to lubricants it can be said that the “best available techniques” are those which carry the Euro-Marguerite eco-label and in addition meet all performance requirements as defined by international or OEM specifications.

Directive 2000/60/EC of 23 Oct. 2000 establishing a framework for Community action in the field of water policy—Paragraph 1

Water is not a commercial product like any other but, rather, a heritage which must be protected, defended and treated as such [1].

Paragraph 3

The declaration of the Ministerial Seminar on groundwater held at The Hague in 1991 recognised the need for action to avoid long-term deterioration of freshwater quality and quantity and called for a programme of actions to be implemented by the year 2000.

Article 1—Purpose.

The Purpose of this Directive is to establish a framework for the protection of inland surface water, transitional waters, costal waters and groundwater which:

Paragraph d

... ensures the progressive reduction of pollution of groundwater and prevents its further pollution

Article 2— Definitions

Paragraph 29

“Hazardous substances” means substances or groups of substances that are toxic, persistent and liable to bio-accumulate, and other substances or groups of substances which give rise to an equivalent level of concern.

Annex VIII— Indicative list of the main pollutants

Paragraph 5

Persistent hydrocarbons and persistent and bioaccumulable organic toxic substances.

Related to lubricants, in this case to additives and base fluid components, “persistent” and “persistent and bio-accumulative” are important ecotoxicity criteria as defined as follows:

“Bioaccumulation” means the process by which certain toxic substances (such as heavy metals and polychlorinated biphenyls) accumulate and keep on accumulating in living organisms, posing a threat to health, life, and the environment.

“Persistent, bio-accumulative and toxic (PBT)” means substances such as heavy metals that remain unaffected in the environment, travel up the food chain due to their tendency to be soluble in fat but not in water, and are poisonous to animals and/or plants.

Substances that exhibit these characteristics are most problematic for the environment. Lubricants that meet the Euro-Marguerite requirements are not comprised of any such components. Mineral oils are persistent hydrocarbons and therefore cannot be used for formulating lubricants conforming to the Euro-Marguerite requirements.

Directive 2004/35/EC of 21 Apr. 2004 on environmental liability with regard to the prevention and remedying of environmental damage—Article 1—Subject matter.

The purpose of this Directive is to establish a framework of environmental liability based on the “polluter pays” principle, to prevent and remedy environmental damage [1].

Article 3— Scope

Paragraph 1

This Directive shall apply to environmental damage caused by any of the occupational activities listed in Annex III, and to any imminent threat of such damage occurring by reason of any of those activities

damage to protected species and natural habitats caused by any occupational activities other than those listed in Annex III, and to any imminent threat of such damage occurring by reason of any of those activities, whenever the operator has been at fault or negligent.

Article 5—Prevention action.

Paragraph 1

Where environmental damage has not yet occurred but there is an imminent threat of such damage occurring, the operator shall, without delay, take the necessary preventive measures.

Article 6—Remedial action.

Paragraph 1

Where environmental damage has been occurred the operator shall, without delay, inform the competent authority of all relevant aspects of the situation and take all practicable steps to immediately control, contain, remove or otherwise manage the relevant contaminants... the necessary remedial measures.

The key point of Article 6 is that operators (in this case the polluters) are fully responsible at their own expense to take remedial action to minimize the impact of any pollution.

Publication 2005/360/EC of 26 Apr. 2005 on eco-label Commission Decision of 26 April 2005 Establishing Ecological Criteria and the Related Assessment and Verification Requirements for the Award of the Community Eco-Label (Euro-Marguerite) to Lubricants—This directive defines the acceptable toxicity and ecotoxicity profiles of all substances, additives and base fluid components incorporated in the lubricant [1]. In addition, a set of sum rules limits the acceptable combinations of additives and base fluid components. “Fit for purpose,” which includes long drain intervals and full protection of equipment, must obviously be met in all cases. “Environmentally friendly” alone is not an adequate solution to the main objective of minimizing the impact of lubricants on the environment.

The following lubricant classes are explicitly mentioned.

Hydraulic fluids shall at least meet the technical performance criteria laid down in ISO 15380, Tables 2 to 5.

Chain-saw oils shall at least meet the technical performance criteria laid down in RAL-UZ 48 of the Blue Angel.

Concrete release agents and other total loss lubricants.

Two-stroke oils for marine applications shall at least meet the technical performance criteria laid down in the NMMA regulations.

Two-stroke oils for terrestrial applications shall at least meet the EGD level of technical performance criteria laid down.

The benefit of this new eco-label is that it will simplify the situation for buyers and users of lubricants and related products. They no longer have to distinguish between many different eco-labels. When they buy products that carry the Euro-Marguerite eco-label, they can be sure of being on the safe side regarding protection of the environment and their equipment.

The responsibility for fulfilling the required environmental criteria has to be taken by the lubricants manufacturer and hence not by the end-user.

In addition, contrary to other eco-labels like the Blue Angel or Swedish Standard, the Euro-Marguerite label also addresses the renewability of raw materials. Depending on the type of lubricant, the formulated products must have a well-defined percentage of carbon content derived from renewable sources like (vegetable) oils or (animal) fats.

USDA BioPreferred Program

The USDA BioPreferred program was determined by the US Secretary of Agriculture stating the following: Biobased products are commercial or industrial products (other than food or feed) composed wholly or in significant part of biological products including renewable agricultural materials (plant, animal, and marine materials) or forestry materials [2].

Praxis

Many construction machines have operated using these lubricants for more than 10 000 h without an oil change.

TABLE 1—Longevity of a top tier ECL.

Machine		CAT 235	CAT 320 BLN	CAT 322 BLN	CAT 325 BLN	CAT 330 LN	CAT 345 B	CAT 375 L	CAT 385B
Hydraulic System		92	92	79	79	105	132	317	262
Capacity (apx. U.S. gal.)									
Oil Type in use		PANOLIN HLP SYNTH 46							
Working Hours without Oil Drain	Fresh Oil	22 000	10 763	11 950	11 905	10 721	8 910	10 353	7 665
Viscosity @ 100°F (cSt)	47.0	46.5	46.5	45.4	45.4	45.7	45.7	46.3	46.0
Viscosity @ 210°F (cSt)	8.1	8.2	8.2	8.0	8.0	8.1	8.1	8.1	8.1
VI (Viscosity Index)	150	150	150	150	149	151	150	150	149
Iron (ppm)	0	9	38	25	31	31	13	10	19
Copper (ppm)	0	5	4	3	5	6	5	2	5
Lead (ppm)	0	3	< 2	< 2	4	5	< 2	< 2	< 2
“Oil savings” due to fewer oil drains (apx. U.S. gal.)		924	369	317	396	422	396	1268	788

In Hydro Power Plants installations are running now for up to 20 years with specially formulated ECL's.

Machines are running on ECL's for many hours with little change in oil characteristics. The analysis parameters show low wear and therefore proof of the excellent anti-wear properties. It has been found that along with longevity, little to no fresh oil was required during oil drains.

As with any lubricant, appropriate monitoring and upkeep is recommended as a part of any preventive maintenance. Regular laboratory checks will indicate excessive water or dirt content, for example, so that corrective action can be taken in good time.

To conclude, the experience so far with appropriately formulated rapidly biodegradable hydraulic fluids is as follows: they can be approved by OEMs for factory and service fillings; oil drain intervals can exceed 10 000 operating hours or 10 years (life time fill); and they can be used successfully even in demanding applications, such as hydro power plants (see Table 1 that illustrates data for one such product line).

These products have also been found to perform well in the smallest to largest construction machinery, from injection moulding machines to gigantic lock gate hydraulics, and only positive experience has been reported.

Conclusion

The European Community gives high priority to protection of the environment. The EU Parliament and Council address this issue in a series of directives, covering aspects such as integrated pollution prevention and control as well as the liability of pollution originators. In the near future the European Union member states will have to implement and enforce these directives through their national legislation.

Related specifically to lubricants, the EU Commission has established ecological criteria and the respective assessment and verification requirements for awarding the EU eco-label (Euro-Marguerite) to lubricants. In the future this new eco-label, recognized throughout Europe, will enable buyers and users to select lubricants with only minimal environmental impact in case of a leakage.

The USDA biopreferred program was created by the Farm Security and Rural Investment Act of 2002 (2002 Farm Bill) to increase the purchase and use of biobased products. The United States Department of Agriculture manages the program. BioPreferred includes a preferred procurement program for Federal agencies and their contractors, and a voluntary labelling program for the broad scale consumer marketing of biobased products.

The Bottom Line

Over the past 25 years a new lubricant technology has been developed: Environmentally Considerate Lubricants (ECLs) that minimize environmental impact in case of incidental spillages. Today's top performers in this lubricant class meet or often exceed the performance requirements set by the OEMs.

Furthermore, their long drain periods minimize lubricating costs when summed up over the equipment lifespan.

References

- [1] EUR-Lex Access to European Union Law, <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32004L0035:EN:HTML> (Last accessed Sept 15 2011).
- [2] USDA BioPreferred Program, <http://www.biopreferred.gov/> (Last accessed Sept 15 2011).