Tyrolese Hydroelectric Power Invests for the Future

author Wolfgang Kofler (TIWAG)

The TIWAG-Tyrolese Hydroelectric Power Inc. based in Innsbruck is a prosperous internationally-active venture. Next to men Tyrol considers its nature their most valuable capital. Any investment which contributes to preservation and protection of natural resources is therefore considered to be a profitable investment for the future. TIWAG-engineers attach great importance to sustainable construction and operation of the plants. The lately constructed rotor blade power station at the river Inn sets technical and ecological standards.

With more than 160.000 customers, an energy production of 7 billion kilowatt hours TIWAG is one of the most important energy suppliers in Austria. To perform its tasks TIWAG runs 11 medium and big sized hydroelectric power stations and 32 smaller plants, 43 transformer stations, more than 3.600 distribution stations and a mains system of more than 9.800 kilometres. The total capacity of the 43 energy production plants cumulates to 1.511 MW producing 3.000 GWh.

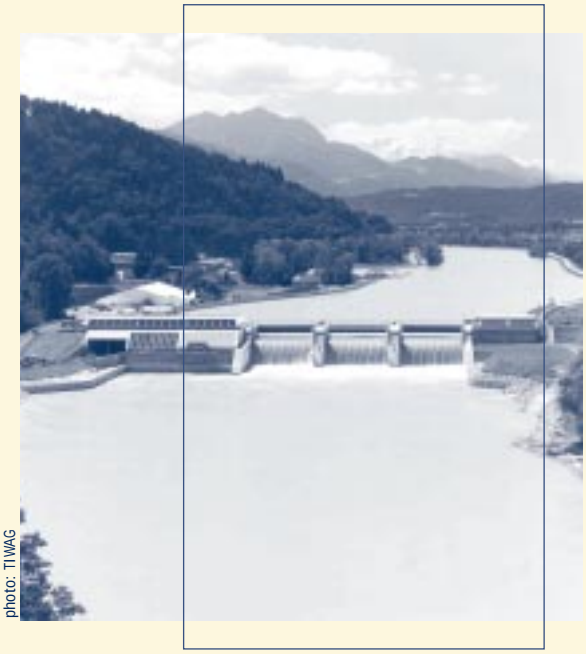


photo: TIWAG

A good view over TIWAG's hydroelectric power station in Innsbruck.

TREND-SETTING

The environmentally friendly construction of the lately completed rotor blade power station 'Langkampfen' on the river Inn is trend-setting.
TIWAG-engineers are experts in projecting and development of hydroelectric power stations. To protect the ecological situation of the river landscape a number of technical innovations were realised during the construction of the hydroelectric power station 'Langkampfen' (32 MW, 169 GWh) in 1995-1998.
During the design of the plant special care was taken to ensure the preservation of the nature reserve at both river banks. For the weir a specially developed extremely resistant concrete was used. All dredging was performed by using a swimming pump dredge in order to keep the complete fouling of the river bank intact. The barrages above the water line were sealed up with a certain technique to minimise impacts on trees and underwater regimes.

ECOSYSTEM

Use of bio-lubricants prevents long-term damages of the ecosystem in case of a potential catastrophe.
The choice of the type of lubricant for the bearings was based on technical, economical as well as ecological considerations. Radial and axial bearings (of 120 tons rotating parts) are now lubricated with the rapidly biodegradable fluid PANOLIN TURWADA SYNTH 68. This product is also used for the final controlling equipment of the turbine guide vanes. The control of the massive driving cylindres of the weir is filled with a biodegradable grease, PANOLIN HLP SYNTH 15. In total each of the two driving machines is filled with more than 14 000 litre of rapidly biodegradable bearing-, compression- and lubrication fluid. By using bio-lubricants long-term damages of the ecosystem in case of a potential catastrophe is avoided.

HIGHLIGHTS

Tekniker news

In the field of biodegradable oils TEKNIKER has collaborated in the following projects:

- New compatible biodegradable and non toxic hydraulic and gear oils based on the renewable sunflower oil manufactured by REPSOL (Project FAIRCT96-2025) is working now successfully in a LIEBHERR excavator during 2652 and 1792 hours respectively. The oil change was at 2000 hours.
- A new biodegradable and non toxic oil is being developed by FUCHS, to substitute the mineral oil for forging applications. The forging application will consume each day around 1000litres/company.
- Biodegradable non toxic lubricants have been developed by BRUGAROLAS for pipe bending, cutting, drilling/collaring and deep-drawing operations (Project CRAFT BRST 98 5388). The cutting, pipe bending and deep-drawing oils have been successfully implemented in industry.

The substitution of mineral oil by vegetable oil will decrease the environmental impact of the rivers.

author Amaya Igartua (Tekniker)

The Ranking System

author
Hildo Krop
(Chemiewinkel)

The Ranking System (RS) is a screening system extracted from existing ecolabelling schemes. It is the principal mechanism LLINCWA employs to differentiate between acceptable and not-acceptable products with respect to environment and human health. It does so by using information principally available in Material Safety Data Sheets. By July 2002, the Ranking System will be extended in order to be compatible with the revised Dangerous Preparations Directive.

There are already different national ecolabels for hydraulic fluids, greases and two-stroke oils etc. Examples of labelling schemes that enjoy market acceptance are the Swedish standard SS 15 54 34, the German Blauer Engel, the Gothenburg Clean Lubrication Act and the Dutch VAMIL Directive. One of the reasons for their success is the inclusion of technical criteria related to viscosity, anti-oxidation behaviour etc.
The Ranking System (RS) developed within LLINCWA ranks lubricants with respect to: 1) renewability, 2) biodegradation, 3) aquatic toxicity, 4) human health hazards, 5) technical performance and 6) similarity with existing ecolabels. The evaluation of each product is preferably based on the classification of its distinct components (typically the base oil and additives).

Minimum acceptance criteria

Besides, the RS sets minimum acceptance criteria which apply to the final product. Products that meet these minimum acceptance criteria, are considered as bio-lubricants within the LLINCWA project.

For hydraulic fluids the minimum acceptance criteria are derived from the Dutch VAMIL Directive. This comes down to the following requirements for the final product:

- Primary degradation (>90%)
- EC_{50}> 1 mg/L based on OECD 201 and 202
- No substances with R-phrases or combinations thereof in relation to sensitization, carcinogenity, mutagenicity and reproductive toxicity (R39, R40, R42, R43, R 45, R46, R48, R49, R60-R64)
- Technical performance in accordance with SS 155434 or VDMA 24568 norm or guaranteed by supplier/OEM

For lubricating greases and gear oils the minimum acceptance criteria are established in an analogous fashion and apply again to the final product. This comes down to the following requirements:

- Based oil from vegetable oil or synthetic ester from vegetable oil
- Biodegradability according to OECD 301>70% or CEC>80%
- EC_{50}>100 mg/L for OECD 201 and 202 or WGK≤ 1
- No substances with R-phrases or combinations thereof in relation to sensitization, carcinogenity, mutagenicity and reproductive toxicity (R39, R40, R42, R43, R45, R46, R48, R49, R60-R64). No R/S - phrase for the final product.
- Technical performance guaranteed by supplier and/of OEM.

Material Safety Data Sheets

The information needed in order to verify whether a product meets the above mentioned minimum acceptance criteria can be found in the currently available Material Safety Data Sheets. When, by July 2002 the revised dangerous preparations directive (1999/45/EEC) will come into force the information that is then required on the Material Safety Data Sheets, will allow for a comparison of the lubricants on the basis of their ingredients.

A list of products that comply with the national eco-labelling standards can be obtained on the following web pages:

- **Swann:**
http://www.ecolabel.no/
- **SS 15 54 34:**
http://www.sp.se/km/sv/tekn_tj/kmo/hydraul.htm
- **Blauer Engel:**
http://www.blauer-engel.de/Englisch/index.htm
- **Gothenburg Clean Lubrication Act:**
http://www.gbgreg.kommunalforbund.se/regionalplanering/miljo/miljofetteng.html

Bio lubricants at the Water-Board of Rijnland (NL)

Cees Ouwehand: “Biolub

Already for several years the Waterboard of Rijnland in the Netherlands successfully applies biolubricants and can be regarded as a leader in this field. Rijnland is an organisation that takes care of dams, water quality and water quantity management in an area of 1100 km^2 between Amsterdam, IJmuiden, the Hague, Leiden and Gouda. About 200 polders, lakes, rivers and canals are located in this area. Of course, for this type of large-scale management lubricants are needed for machinery such as pumps and waste water treatment installations.

Cees Ouwehand works for the Waterboard of Rijnland as maintenance technologist. At the moment he is working on the project ‘application of bio lubricants’. In his organisation Cees is actively engaged with biolubs on both the policy and the user level. Since Rijnland started to apply biolubricants in 1992, the amount used

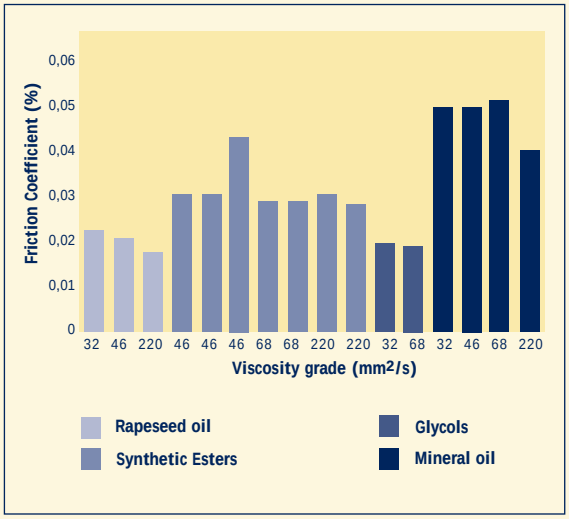
TECHNICAL RESEARCH

Control of biodegradable lubricants will save money and improve environment

author
Amaya Igartua
(Tekniker)

Monitoring oil during use is recommended by all machinery and engine manufacturers. The life time of oil can be increased by changing oil after tests proved that the oil quality is no longer sufficient instead of changing oil after a preventive fixed deadline. In this way, it is possible to reduce the generation of contaminated residues and maintenance cost.
By increasing the oil lifetime of 40%, the reduction of maintenance costs of just an engine (200 l) is around 380 €/year. TEKNIKER planned to perform physical-chemical and environmental analyses of the biodegradable oils during use for LLINCWA Project. From an environmental point of view, it is necessary that both new and used oil are biodegradable and non toxic.
When changing mineral oil by biodegradable lubricants, it is possible to reduce the friction coefficient by 50% (see figure). This will also reduce the energy consumption of the equipment by 50%. TEKNIKER will compare wear and friction properties of biodegradable and mineral oils for the LLINCWA project. Abrasion and adhesion resistance will be evaluated by measuring the friction coefficient and wear of the different oils.

Parameter	Measurement	Protocol
Physical-chemical analysis of used oils		
Physical properties	Viscosity	ASTM D 445 ASTM D 2270
Oxidation	TAN, Acid number	ASTM D 664
	IR, Infrarred	PE-5008-AI
Wear particles, additivation, contamination	ICP, Plasma	ASTM D 5185
	PQ, Wear index	PE-5024-AI
Environmental analysis of used oils		
Biodegradability	Water/inoculum	OECD 301, CEC-L-33-93A
Toxicity	Daphnia Magna	OECD 202, ISO 6341
Friction and wear tests of new biodegradable oils/mineral oils		
Adhesion resistance	Coef. Friction, wear	P11.10/001
Abrasion resistance	Coef. Friction, wear	P11.10/003



Friction coefficients of various base fluids.
(FZG - Michaelis, Höhn 1994)

INTERVIEW

simply function well”

has increased enormously. Currently, more than 50% of the lubricants being used at Rijnland are bio lubricants.

QUALITY AND COSTS

Within his organisation he frequently argues for using bio lubricants instead of lubricants based on mineral oils. This is because Cees is more than satisfied with the quality and applicability of bio lubricants. What is more, bio lubricants are also safer in use and less harmful, according to Cees. With these arguments he can easily persuade his colleagues to switch to biolubricants. To convince the users also of the positive cost aspects turns out to be more difficult because users only take notice of the price per litre. “Users tend to believe that bio lubricants are more expensive than lubricants based on mineral oils and initially this seems to be true.” says Cees. “However, when long term aspects such as longer lifetime of the oil, energy reduction, and noise reduction are taken into account, this is no longer true” he immediately adds. Due to Cees’ goal-oriented and cost-effective lubricant policy Rijnland currently saves about 10.000 € a year.
To the question why LLINCWA is important to him, Cees answers that LLINCWA is able to clarify all the different aspects of lubricants. Both users and suppliers will benefit from this. “The integral approach enables LLINCWA to compare the different products on the basis of quality, environment and health aspects.” “Using such an approach makes it clear which products are suitable and which are not”, according to Cees. His opinion about bio lubricants is brief and to the point: “Biolubs simply function well”.

author Cindy de Groot (Chemiewinkel)

Introducing biolubs for use on inland waters;

The need for further governmental interventions

authors
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The environmental benefits of biolubs justify favourable conditions. Governmental regulations are the best way to stimulate the introduction of biolubs for use on ships, waterworks and harbour installations. LLINCWA research points out that only few governments have taken initiatives so far. Hence a call for further-going government interventions is done.

The Belgian example

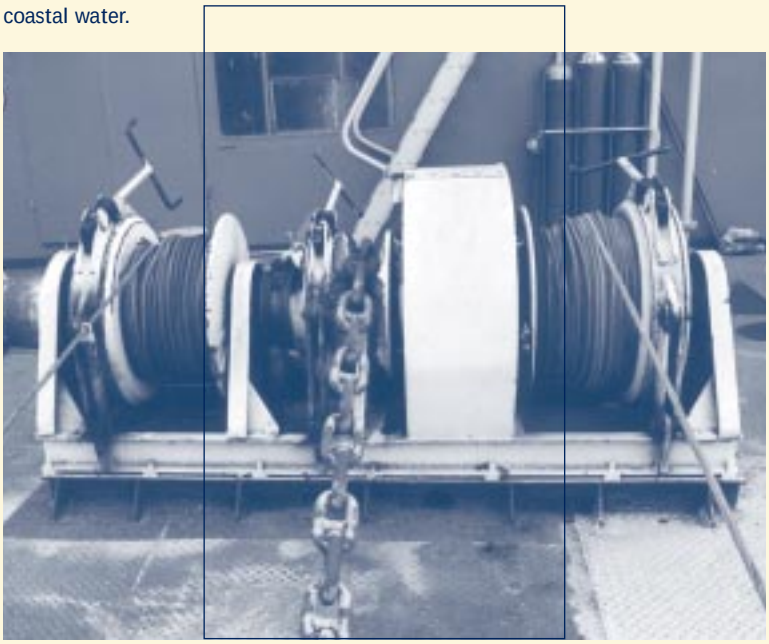
Biolubs currently used for inland and costal water activities in Belgium represent less than 1% of the total market of lubricants. However, governmental initiatives have been set up in recent years, permitting a minor breakthrough in the use of biolubs in the public sector up to 3.6% in 1999. In particular 18.7% of the chain oils and 2.6% of the hydraulic fluids purchased by the Walloon Ministry for Infrastructure and Transport were biolubs. However, most of those biodegradable lubricants are used by the Roads and Highways Department, and not on the waterways.

MARKET PENETRATION

Market penetration of biolubs for inland and coastal water activities is very low: far less than 1%, while the share is higher in forestry (chainsaw oils) and construction (concrete release agents). Biolubs for applications in inland and costal water activities are currently mainly applied in Austrian, Swiss and German lakes, in German public ships and utilities and in certain equipments in the Netherlands.

DRIVING FORCE

Governmental regulation has often been the driving force for the use of biolubs up till now. Highlighting examples of such practices include regulation in Germany for the protection of the water quality in lakes in several *Länder* and a call by the Federal government to all public users to apply biolubs. This German initiative has led to high levels of substitution in some applications – without, however, providing a definitive push to the market as a whole. Similar regulation pertaining to sensitive areas in Belgium appears to be largely ineffective, due to the lack of enforcement. In the Netherlands the 'VAMIL' regulation is set up to encourage environmental-friendly business. Investments with a positive effect on the environment –like equipments running on biolubs– gain an interest advantage by free writing off. Dutch policy makers consider the still higher prices of biolubs as the main reason for the limited level of actual change, and additionally as a risk for falling back into the use of traditional mineral lubricants in case the VAMIL measure would no longer be in place. Another example in this context is a market introduction program recently launched by the German Ministry of Nourishment, Agriculture and Forestry. Within this programme, which will be running for the next two years, all additional costs that may arise due to the use of biolubs will be borne by the Government.



Lubricated machine parts on board a ship are in close contact with inland and coastal water.

GOVERNMENTAL INITIATIVES

Despite its limited success so far, governmental initiatives are perceived by different stakeholders –like users, suppliers and law enforcement authorities– as the most effective means to improve biolub market penetration. In addition to the typical advantages of regulation –like the provision of a common set of standards and the prevention of free riders to disturb markets– regulation may have a positive effect on innovation. Moreover, legislation may contribute to more competitive prices for biolubs. Currently, users of biolubs pay two to three times the price than their polluting 'mineral oil lubricant' colleagues. From all the findings it is clear that clean lubrication has a price – a price that most users will only pay if their colleagues pay the same. Technologically speaking, biolubs are highly competitive. The real problem is the change itself, and the need to break a polluting order. It's clear that here's a task for regulators. For a successful and sustainable substitution, initiatives should not restrict themselves to a limited selection of areas and should be well enforced.

Assessment of ecological hazards: determination of substantial environmental compatibility

How to evaluate environmental aspects

author
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BIODEGRADABILITY : THE MOST COMMON PARAMETER

The most important aspect with respect to the environmental fate of a substance is its bio-degradability.
Biodegradability means that a substance is susceptible to biochemical breakdown by micro organisms. The first step is the disappearance of the original molecule which is called primary degradation. In fact, the determination of ultimate degradability of substances to CO_2 and H_2O is much more important, since it corresponds to the complete mineralisation of organic material.

The CEC test was originally developed for two-stroke engine oils to assess *primary biodegradability*. The French standard (NF T60-198) and the German one (DIN 51828) have spread the field of application to all lubricants. The disappearance of original compounds is measured through the infrared vibration of the carbon-hydrogen bond during a 21-day-period.
Standardized test methods (ISO, CEN) have been established for the investigation of *ultimate biodegradability*. However, the documents mostly used are OECD guidelines (301 A-F). The European directives also refer to OECD guidelines.
The evaluation whether a substance is ready biodegradable or not is very important for its environmental classification and the determination of its water hazard class. The threshold level is 60% of the CO_2 production. According to the OECD definition, ready biodegradability requires an additional kinetic criteria, i.e. the so-called 10-day-window. This gap of ten days starts when the rate of degradation reaches 10%.

ECOTOXICITY : FURTHER INFORMATION ABOUT SUBSTANCE-INHERENT PROPERTIES

Ecotoxicity data describe the toxic effects of chemicals on living organisms in the environment. As it is not feasible to investigate all the different wildlife species in the laboratory, the evaluation of ecotoxicity concerns only certain standard species representing the different levels of the natural food chain. For the aquatic medium, fish, daphnia, algae and bacteria are the most relevant test organisms. OECD 201, 202, 203 guidelines describe the methods and are also used in the European Directives on dangerous preparations.

ECOLABELS

Ecolabels allow to compare the products from a ecological point of view. *Blauer Engel* in Germany and *Nordic Swan* in Sweden are the ecolabels mostly used. The major criteria considered are biodegradability, ecotoxicity, type of additives, origin of the base oils and technical references.

ABOUT LUBRICANTS FROM OLEOCHEMICAL ESTERS

The new generation of biolubricants based on oleochemical esters combine technical performance with ecological properties. Biolubricants are much better biodegradable than mineral lubricants (90% versus 30%). The biodegradability of used oils after 1000 hours of operation is only reduced by 10% compared to the values of new oils. Moreover, biolubricants do not present ecotoxicity for algae or fish, contrary to mineral fluids for which inhibiting and lethal growth rates are low.

These data confirm the reduced impact of biolubricants and their importance for ecological sensitive places such as rivers or forests.

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No 2 Newsletter

LLINCWA

Lubrication in Inland and Coastal Water Activities

Llincwa is a technology transfer project sponsored by the European DG Enterprise

The LLINCWA project aims to reduce diffuse water pollution by stimulating the use of non-toxic biodegradable lubricants in inland and coastal water activities.

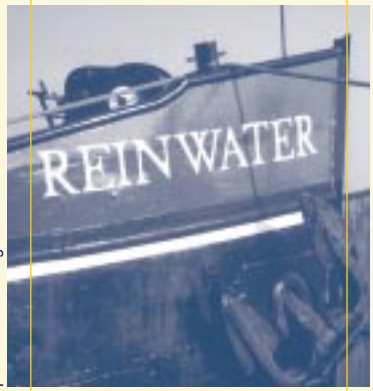

photo: W. Verhoog

LLINCWA's Sailing Campaign promoting bio-lubricants

In September and October the first LLINCWA sailing campaign will be launched in order to promote biolubs and to get publicity for the LLINCWA's research activities.

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author
Cindy de Groot
(Chemiewinkel)

A ship of the Dutch foundation Reinwater will depart Amsterdam and go via Germany and France to Strasbourg. Meetings will be organised for all water related lubricant professions: water managers, inland skippers, hydro-electric power managers and national and European policy makers. It is the first and biggest sailing campaign for lubricants in inland and coastal water activities ever!

Pilot projects

The LLINCWA project runs already for more than a successful year. During this period more than 40 pilot projects have been initiated at installations at water boards, hydro-electric power plants, stern tubes and harbour related activities to demonstrate the good performance of biolubs.

Research activities

In addition to the pilot projects the LLINCWA partners are conducting a range of research activities. Current activities involve a cradle-to-grave analysis and the development of a ranking system. In a later stadium of the project, a cost-benefit analysis will be conducted.

September and October 2001: first sailing campaign!

In September LLINCWA's first sailing campaign will commence. The sailing campaign is intended to: a) disseminate knowledge gained through research and pilot projects to all interested parties; b) share independent and high quality information about the environmental, technical and financial aspects of a change-over to bio-lubricants; and c) invite outside parties to participate in this process.

Activities and schedule sailing route

During the sailing campaign meetings and workshops will be organised and fairs will be visited. In this way all relevant and interested parties will be reached: water-, hydro-electric power- and harbour managers, users, inland skippers, members of the European Commission and Parliament, local and national governments, lubricants suppliers and Original Equipment Manufactures. The first sailing campaign will include the Netherlands, Germany and France. A ship of the Dutch foundation Reinwater will sail via the Rhine, Moselle and Canals to Strasbourg.

Join us!

All interested parties are welcome on board the Reinwater ship. For more information about the local activities during LLINCWA's first Sailing Campaign, please contact your nearest LLINCWA partner.

Schedule
LLINCWA's 1st Sailing Campaign September and October 2001

Day	Date	Location	Activity	Responsible
Wednesday	5 /9	Amsterdam	workshop inland shippers and/or water management politicians	Chemiewinkel (CW)
Friday	7 /9	Arnhem	Workshop water boards	CW
Tuesday	11/9	Duisburg	Duisberger Schifffahrtmesse (Inland Shipping Fair)	ISSUS
Wednesday	12/9	Duisburg	Duisberger Schifffahrtmesse (Inland Shipping Fair)	ISSUS
Tuesday	25/9	Nancy	Workshop Biodegradation and pilot projects	INPT
Tuesday	2/10	Strasbourg	Meeting European Parliament	CW/INPT
Friday	5/10	Mannheim	Meeting for harbour management, government and political parties	Fuchs Lubritech
Friday	12/10	Utrecht	Meeting for Dutch government	QA+