European Commission

Addressing the sustainability of lubricants from an LCA perspective

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Outline

1. Introduction to the revision of the EU Ecolabel for lubricants
2. LCA review and limitations
3. Approach for this EU Ecolabel revision
4. Conclusions

EU Ecolabel - voluntary label aiming to target the **best products** on the market in terms of environmental performance **throughout the life cycle**.

Criteria in force for EU Ecolabel Lubricants (EEL):

- Scope:
  - **Total loss lubricants** - released to environment during use
  - **High risk lubricants** - accidental/potential release to environmentally sensitive areas
- Criteria:
  - renewability of raw materials
  - aquatic toxicity, biodegradability and bio-accumulation of the ingredients

Focus on **use phase**

EEL is only awarded to **bio-based lubricants**

- EU Ecolabel is **not a certification for bio-based products**

- The **environmental impact** of a lubricant product **can occur at any stage of its life cycle** (e.g. during raw material extraction or at the end of life), and **not only from its potential release to the environment.**

This revision aimed to **open the scope** to consider best alternatives considering **the entire life cycle** of lubricant products for a large range of applications.

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LCA review (12 Life Cycle Assessment studies) + supplementary sources of information

Functional unit - Production of 1 kg of base oil (most common)

Others (i.e. kilometre covered in automobile applications or hectare of crop production)

Scope and system boundaries

- Comparison of rapeseed and soybean vs mineral oil (use and disposal stages are not considered)
- Contribution of lube additives to the environmental impact of a fully formulated lubricant (cradle to gate)
- Petroleum-based lubricants vs bio-based (soybean) for aluminium rolling (end of life not included)
- Quantification of the environmental impacts of a biobased chainsaw oil (rape seeds) to compare it with a model mineral chainsaw oil (cradle to grave)
- Six different vegetable oils: palm, coconut, olive, soybean, rapeseed and sunflower oil
- …

Limitations

Lubricant sector:

- Broad scope required
- Lubes are typically manufactured as co-products in integrated product networks, based on petroleum refining, oleo chemical refining or chemical processing.
- Tracing fate during use and end-of life → challenge
- Industrial data confidentiality
- Lubes differ greatly in their performance- LCA comparison made on the basis of equivalent outputs for different type of lube applications based only on their resource requirements per Kg or litre would give misleading results.

LCAs studied

- Although different functional units used by different LCAs- Most common: 1 kg of base oil
- Diverse scope and system boundaries however no additives or all types of lubricants available for a same application covered.
- Most LCAs studies only cover cradle-to-gate scope

Overall findings indicate that the main environmental impact of lubricants is produced at the **use stage and the end of life** and that the impact is highly dependent on the **raw materials used** however **quantification of the relevance of these stages was not feasible.**

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Despite these limitations, some **indications about environmental impact** have been extracted for each of the stages of the life cycle

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Comparing **different base fluids**:

Vegetable oils:

- **Main impacts due to agriculture stage.** Most affected impact categories associated to bio-based lubricants are **eutrophication, aquatic ecotoxicity and acidification**
- Lower energy consumption during processing and lower global warming potential than mineral and synthetic oils

Synthetic oils:

- Refining/synthesis phase is the main contributor of environmental impacts
- PAOs - highest impacts in most categories with exemption of photochemical oxidant formation, freshwater eutrophication, freshwater and marine ecotoxicity, metal depletion and agricultural and land and urban occupation compare to hydrocracked base oil
- **Longer life** and lower impact during use

Mineral base oils: Highest contribution due to the extraction phase
Climate change, abiotic depletion, ozone layer depletion and photo-oxidant formation

Re-refined oils: CO_2 emissions can be reduced by more than 50% as compared to the conventional mineral oils

Water base fluid: Environmental impact mainly during disposal of waste fluids

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- Very difficult to quantify the environmental impact for the different types of lubricants on the market
- Nearly 50% of all lubricants sold worldwide pollute the environment, through spillage, evaporation and total loss applications

Proposed approach in this EU Ecolabel revision:

- **Focus** of the EU Ecolabel is proposed **to be kept on lubricants that are released to the environment** during use **(TLL, PLL, ALL) but not only on bio-based lubricants**
- **Focus on biodegradability and toxicity** that are key environmental aspects for lubricants **released during use**

Renewable oils, due to their natural origin (**vegetable and animal fats**) and **synthetic oils (esters, PAO, PAG)** that can be fine-tuned during their synthesis to have proper biodegradability and toxicity level **seem to be best options for loss lubricants.**

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- **Critical LCA review in current revision – Limitations associated to the lubricant sector**

- **Against impossibility quantify environmental impact at the different stages for all lubricants: Focus** of the EU Ecolabel **on lubricants that are released to the environment** during use

- **biodegradability and toxicity -** key environmental aspects: EU Ecolabel to promote alternatives presenting low toxicity and high level of biodegradability.

- For **future revisions**: Additional LCA studies, perform different LCAs for different applications at the preliminary stage of the project. In order to allow a **robust quantification of the overall environmental impact** of different type of lubricants in the market: C**radle-to-grave LCAs** with a scope covering manufacturing, use and fate at end of life, and with system boundaries encompassing petroleum, petrochemical, oleochemical and engineering industry activities together with considerations of the particular issues which are characteristic of the lubricant industry and their applications.

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Thanks for your attention

More information : Documents prepared for the revision of the European Ecolabel Criteria for Lubricants

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 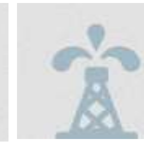 

1. Raw material extraction, transport and processing of components:

Raw materials impacts associated with extraction and processing (energy consumption).

- ➢ The composition of lubricants will condition the potential impact to the environment during and after use (inherent biodegradability and toxicity)

Additives: Between 7-20% of formulation by weight. Not covered in most LCA studies

- ➢ In some impact categories with up to 50% of the total impact (in particular for carcinogens and mineral extraction)

2. Manufacturing of lubricant, packaging and distribution

Manufacturing comprises blending and has lower environmental impact than the **processing of raw materials** (where energy consumption is more relevant), although it can have relevant impacts in some categories.

Packaging

- ➢ Less covered in LCA studies
- ➢ Relevance of the potential impacts is not well known

3. Use phase

- **Probability of release to the environment** has consequences in terms of toxicity and impact on human health and the different environmental systems
- **Approximately 50%** of all traditional lubricants are **released into the environment during use**, through spills, or during disposal
- Releases threaten ground soil and surface waters with oil contamination there by endangering drinking water supply and aquatic organisms

4. End-of-life

- **Uncontrolled disposal** of lubricant has adverse effect on the soils, aquatic life and drinking water
- 50% of **used oils** become waste oils. These are potentially recoverable.
- **Waste oils** (WO) are hazardous waste
- **Proper collection and posterior re-refining** – lower impacts than disposal (burning) and associated environmental savings with respect to using new lubricant as raw material

Proposed approach for this revision

Renewable oils, due to their natural origin (**vegetable and animal fats**) and **synthetic oils (esters, PAO, PAG)** that can be fine-tuned during their synthesis to have proper biodegradability and toxicity level **seem to be best options for loss lubricants.**

- **Vegetable oils** large impacts are produced during the **agricultural stage** (cultivation practices, energy used in the production process, use of significant amounts of water, fertilizers and pesticides, etc.)

⇨ it is being proposed to explore the possibility to set **sustainability criteria** for vegetable based lubricants (third party certification schemes)