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Leading the way to sustainable lubricants: Process development for the production of tailor-made, bio-based, high-performance lubricants

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PURPOSE OF THE ABSTRACT

The current raw material change, away from fossil feedstocks to renewable raw materials, is one of the greatest challenges of the 21st century. In the field of lubricants an additional key criterion is the biodegradability of such alternatives, while maintaining the desired performance properties of the known petrochemical feedstock lubricants. Especially in those fields, where lubricants are in direct contact with the environment, the resulting pollution can have a severe negative impact. For example, the US governments Environmental Protection Agency (EPA) classified lubricant oils as toxic pollutants and made the utilization of biodegradable lubricants mandatory for the marine sector in the Vessel General Permit. Accordingly, there is a high demand for bio renewable and at the same time biodegradable lubricants, which still meet the requirements for high performance applications.[1,2]

We designed a class of modular bio-based lubricants fulfilling the above criteria and at the same time being produced in an environmentally friendly and economically attractive way. Starting from commercially available, plant oil based methylol stearic acid esters, an enzymatic polymerization, utilizing immobilized lipase B from candida antarctica, was developed. The polymerization meets the necessary requirements for a sustainable process, as it can be carried out under mild conditions, without any solvent, using the enzymatic catalyst alone.

In this work the enzymatic polymerization was brought into an industrially applicable setup, in which the properties of the lubricant can be precisely adjusted throughout the process. The resulting lubricant polymers can be recovered directly from the reactor without any form of workup. The reactor design also includes a packed bed reactor for the immobilized enzyme, giving the opportunity to recycle the catalyst in an easy manner. The catalyst´s excellent long-term stability and usability in this process were also demonstrated in a recycling study.

FIGURES

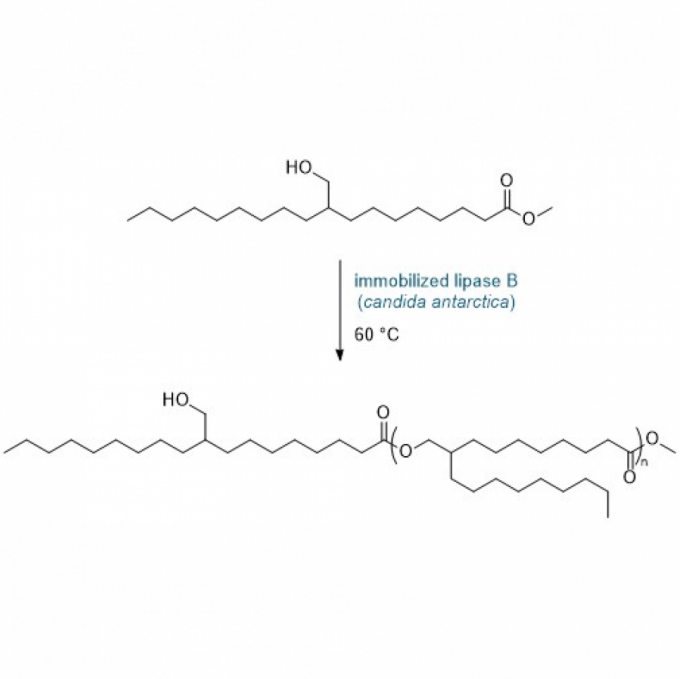

FIGURE 1

Enzymatic lubricant synthesis

Enzymatic polymerization of methylol stearic acid metyhl ester with lipase B from candida antarctica.

FIGURE 2

KEYWORDS

lubricants | polymer synthesis | sustainable production | renewable raw materials

BIBLIOGRAPHY

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