

Biorefinery Technology: New, High-Performance Approaches in Lubricant Base Stocks

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1. Introduction

Elevance Renewable Sciences, Inc. announced the start up and shipment of commercial products in 2013 from a jointly owned world-scale biorefinery with Wilmar International Limited located in Gresik, Indonesia. The biorefinery was constructed based on proprietary Nobel Prize-winning olefin metathesis¹ technology capable of converting renewable natural oils (e.g., palm, soybean, canola, mustard, algal, etc.) into high-value specialty difunctional molecules, olefins and oleochemicals with a capacity of 180 kMT.² There are large established markets for oleochemicals and olefins in place to provide off take, however, it is the advantaged specialty chemicals that create technology options and value for Elevance partners. This paper reviews the development and design of a new, synthetic base stock obtained through a polymerisation reaction of difunctional ester building blocks. These novel materials enable Elevance to effectively address the lubricants and additives market by addressing both bio-content and, more importantly, differentiated performance.

2. Drivers

There are three drivers steering the lubricant industry today.³ 1) Regulations continue to tighten, with higher requirements on fuel economy and emissions. 2) Original equipment manufacturers (OEMs) are responding to the regulations in part by redesigning engines to deliver more power from smaller displacement engines and, as a result, increasing the performance requirement on lubricants. The fundamental driver influencing society, politicians, consumers and the lubricant industry, however, is 3) the environment. Consumers want more sustainable products and this is driving more environmental solutions across societies worldwide. The net result is that lubricants are shifting in technology, mostly towards higher quality and performance and the lubricant industry is becoming more complex with an increasingly diverse range of performance targets, portfolio of OEMs and customer locations.

3.1 Elevance Inherent™ Building Blocks

Within Elevance, using our metathesis catalyst, we simply “unlock” the unsaturated sites in the long carbon chains present in nature’s triglycerides to create novel, difunctional and renewable building blocks and renewable olefins. Metathesis is the rearrangement of unsaturated carbon bonds (Figure 1). Historically limited to molecules without important functional groups, “Grubbs catalysts” represent a significant breakthrough – opening the chemistry to plant oil applications.

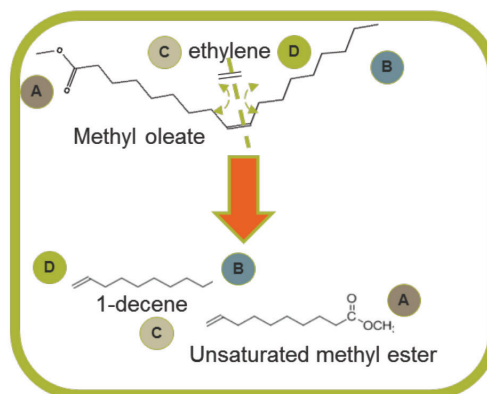


Figure 1. Olefin metathesis of natural oils

Inherent™ C10 methyl ester (ME) is an exciting new platform chemical (Figure 2). With its alpha olefin, carboxylic acid groups and commercially important chain length, it provides functionality for derivatization and a variety of innovation possibilities. Like acrylic acid (a product with a similar difunctional structure) we see this platform chemical and those like it that we produce at scale in our biorefinery as exciting building blocks for a wide variety of applications and industries. This new, difunctional material can be modified to achieve unique functionality via branching, oligomerisation or polymerisation, functional group insertion or exchange.