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Oleochemicals

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Report Abstract
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Nexant

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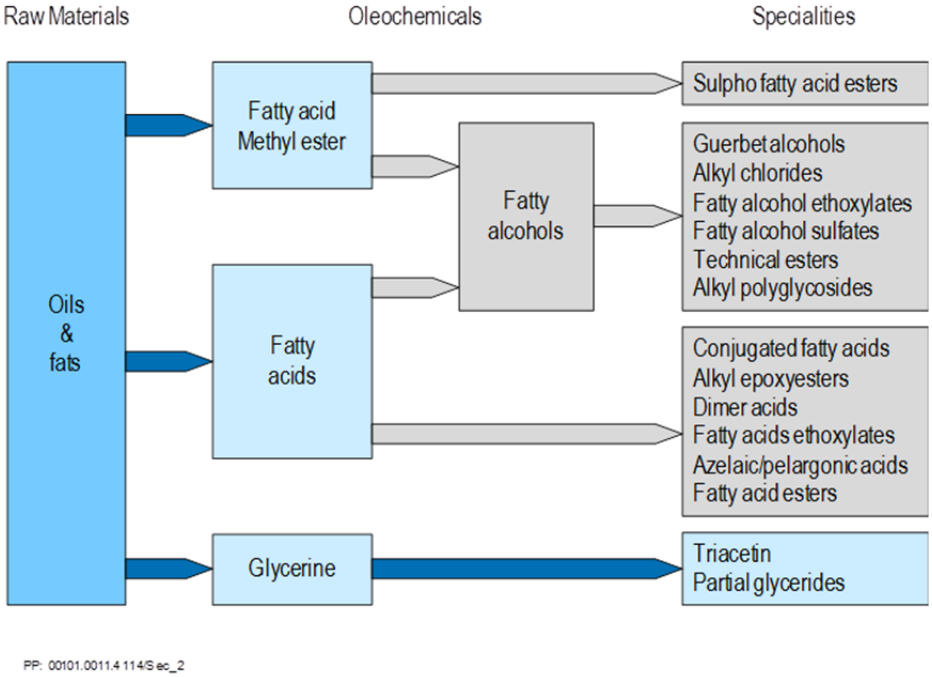
INTRODUCTION

In principle, oleochemicals are products derived directly or indirectly from naturally occurring fats and oils from animals or vegetable sources. Today, the majority of developments in the oleochemicals industry are focused in Asia, in particular China, India, Indonesia and Malaysia, where there is either a strong demand growth and/or availability of raw materials.

Unlike petrochemicals, oleochemicals are generally biodegradable and exhibit low toxicity and therefore are considered to be environmentally friendly. The two major commercially significant oleochemicals are fatty acids and glycerines which are often referred to as basic oleochemicals. Other basic oleochemicals and derivatives include methyl esters and fatty alcohols. Methyl esters were initially produced for use as the intermediate feedstock for natural based detergent alcohol (fatty alcohol) production. More recently, with the introduction of the European Biofuels Directive at the beginning of 2001, methyl esters have been widely used for biodiesel production. Fatty alcohols commonly known as natural detergent alcohols are derived from methyl esters or fatty acids. Fatty alcohols are considered as a mainstream derivative of basic oleochemicals and for the purpose of this report, they will also be assessed. The Figure below summarizes the basic building blocks of the oleochemicals industry.

Figure 1 Overview of Basic Oleochemicals

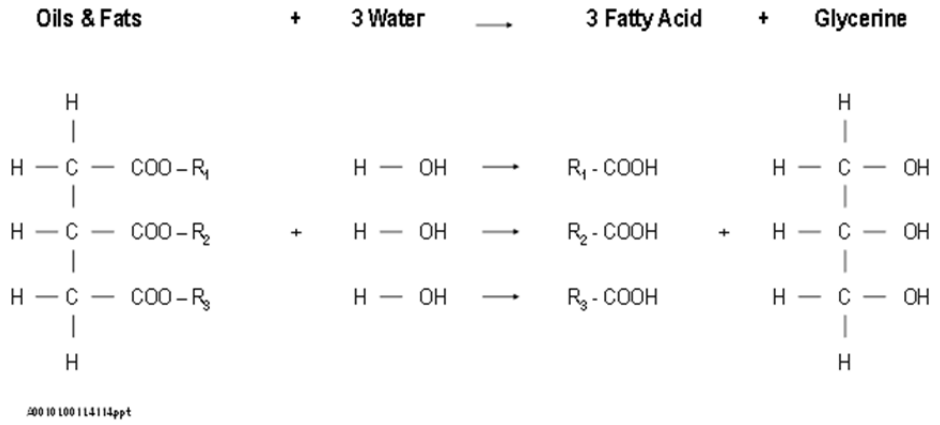


This report provides an overview of the commercial technologies and feedstocks that are available today for the production of basic oleochemicals. In addition, the factors that impact the overall profitability of the industry are analyzed, for investments both inside and outside Asia.

COMMERCIAL TECHNOLOGY

▪ Fatty Acids and Glycerine

Hydrolysis of oils and fats into fatty acids and glycerine can be considered the most basic of oleochemical processes. The vegetable oils and fats undergo a high pressure and high temperature hydrolysis process to split the oil and fat molecules into fatty acids and glycerine. The chemistry of the splitting process of oils and fats is summarized below:

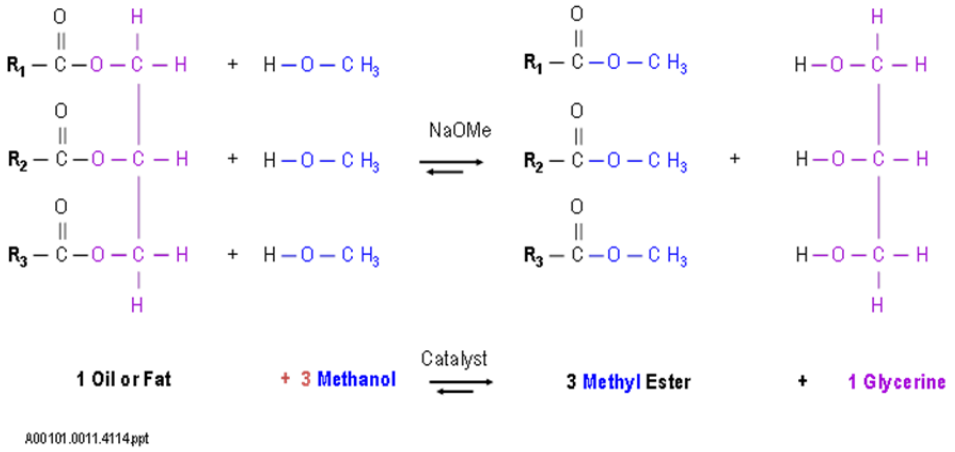


This conventional hydrolysis of oils and fats which was originally based on the Henkel process is discussed in detail in the report.

▪ Methyl Esters

In the past, methyl esters have been produced specifically for the production of fatty alcohols and other oleochemical intermediates, such as alkanolamides and α-sulfonated methyl esters. Methyl esters are also used as the intermediate feedstocks for production of other types of oleochemicals.

Today, the majority of methyl esters can be produced either by catalytic transesterification of oils and fats (see chemistry below), or by esterification of fatty acids with methanol.



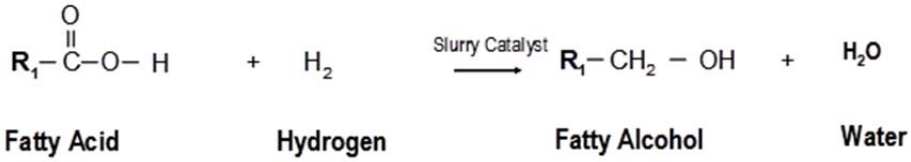
With the rapid development of the biodiesel industry over the past decade, the number of technology providers for methyl esters have increased and today, there are hundreds of companies that claim to own their own technology for methyl ester production. Despite these new developments, Desmet Ballestra (DBO) and Lurgi, continue to dominate the market and still remain as the preferred providers for most oleochemical producers. Other companies such as Crown Ironworks from the U.S., Cimbria Skett from Germany, CM Bernadini from Italy, and AT Agratechnik from Austria have also supplied their methyl ester technologies to various oleochemical producers.

Methyl ester production technologies from DBO, Lurgi and Henkel are discussed in detail in the report.

- Fatty Alcohol

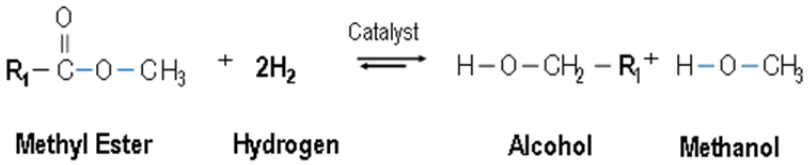
There are two routes for fatty alcohol production: either via fatty acids or via methyl esters.

Throughout the 1990s, Davy Process Technology ("Davy") and Lurgi, both developed and patented technologies for fatty alcohol production, based on fixed bed processes. Although both technologies are based on fatty acid feedstocks over fixed bed reactors, they are very different in terms of their processing routes and reaction phase.



The differences between both reaction routes are highlighted in the report.

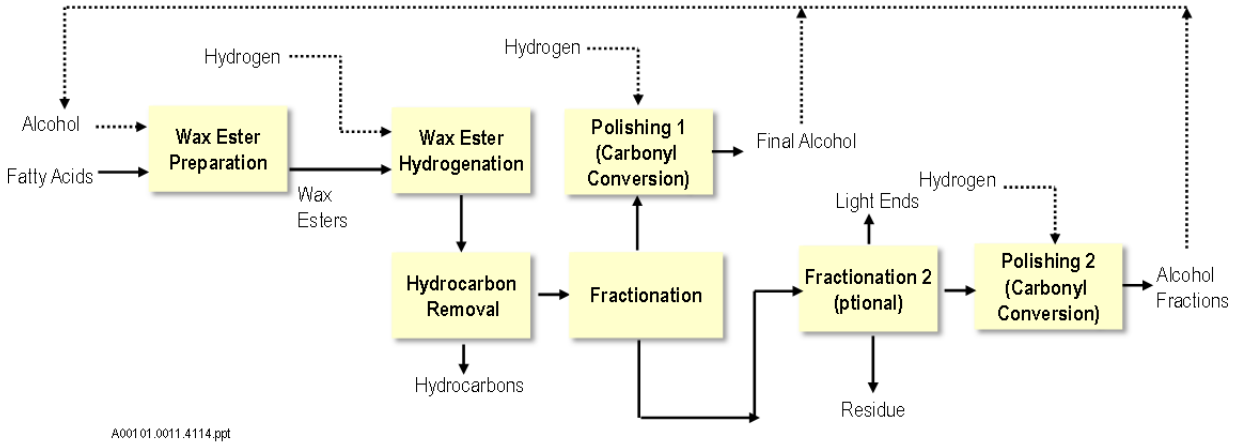
The fatty acid route to fatty alcohol provides the flexibility for producers to market not only the alcohols, but also the fatty acids. However, production of fatty alcohol can also occur via hydrogenation of methyl esters (as illustrated below).



While the production of fatty alcohol from methyl ester feedstocks (derived from transesterification of oils and fats) does not offer such flexibility, it does have the advantage of being less capital intensive since the processing equipment can be constructed from carbon steel material instead of more expensive stainless steel. Moreover, with the recent surplus of methyl ester/biodiesel capacities (especially in South-East Asia), there has been a renewed interest to expand existing methyl ester/biodiesel facilities to other value added production facilities, such as fatty alcohol production from methyl esters. Some existing oleochemical producers have acquired a number of the biodiesel facilities and expanded them for fatty alcohol production.

By the late 1990s, Lurgi had developed a new process technology for fatty alcohol production. The process is also based on fixed bed hydrogenation where the fatty acids are first converted to wax esters prior to hydrogenation. The wax ester produced is then reacted with hydrogen over a fixed bed liquid phase trickle reactor. This processing route is different from the Davy process, where instead of converting the fatty acids first into methyl esters, the production of fatty alcohols are produced via wax esters. Thus, the process avoids the use of methanol and in principle has fewer catalytic reactions. The wax ester route for fatty alcohol production has been commercially proven since 2004. The following block diagram provides a simplified version of the various processing steps involved in the process.

Figure 2 Fixed Bed Fatty Alcohol Production from Fatty Acid via Wax Ester



The various routes for fatty alcohol production, i.e., from fatty acids, methyl esters and wax esters are discussed in detail the report.

PROCESS ECONOMICS

The production cost estimates for various types of basic oleochemicals are provided. Four different regions (China, Malaysia, North America, West Europe) have been assessed for the

production cost analysis, which, in Nexant's opinion, reflect the current oleochemicals production scenario globally. The specific costs of production evaluations included in the report are:

- Fatty acid and glycerine production via fat splitting of palm stearine on both China and Malaysia bases
- Fatty acid and glycerine production via fat splitting of bleachable fancy tallow on both North America and West Europe bases
- Methyl ester and glycerine production via transesterification of refined palm oil on a China basis
- Methyl ester and glycerine production via transesterification of crude palm oil on a Malaysia basis
- Methyl ester and glycerine production via transesterification of soy bean oil on a North America basis
- Methyl ester and glycerine production via transesterification of rapeseed oil on a West Europe basis
- C_{12}-C_{14} Fatty alcohols production via fatty acids on China, Malaysia, North America, and West Europe bases
- C_{12}-C_{14} Fatty alcohols production via methyl ester on a Malaysia basis

All cost tables given in this report include a breakdown of the cost of production in terms of raw materials, utilities, and direct and allocated fixed costs. These categories are presented annually by unit consumption and per metric ton. The contribution of depreciation is also included to arrive at a cost estimate.

Sensitivity analyses have been conducted to explore the effects of variation in key parameters relative to the case and assumptions made in the report for the snapshot in time (i.e., third quarter of 2011) considered. Key parameters that have been varied include feedstock pricing, byproduct prices, and plant capacity (scale).

COMMERCIAL MARKET REVIEW

Commercial applications for fatty acids, glycerine, and fatty alcohols (C_{8-10}, C_{12-14}, C_{16-18}), are summarized. Global and regional market analyses are given in the report and focuses on:

Fatty Acid Supply/Demand/Trade:

- Global supply, demand and trade data are given and discussed
- In addition, supply, demand and trade data is given and discussed according to region (North America, Europe, South-East Asia, and the rest of the World)

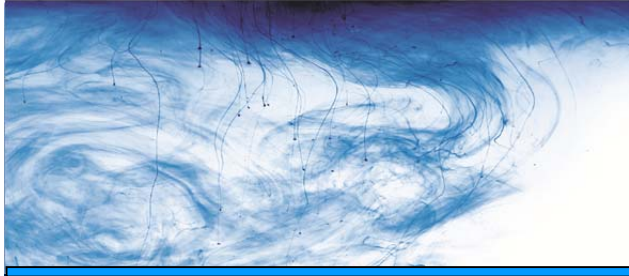
- A list of plants in each region above is given showing specific plant capacities, owning company, location and annual tonnage produced is given

Fatty Alcohol Supply/Demand/Trade:

- Global supply, demand and trade data are given and discussed
- In addition, supply, demand and trade data is given and discussed according to region (North America, Europe, South-East Asia, and the rest of the World)
- A list of plants in each region above is given showing specific plant capacities, owning company, location and annual tonnage produced is given

Glycerine Supply/Demand/Trade:

- Global supply, demand and trade data are given and discussed



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