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FEATURE

Glycerol — an important product of the oleochemical industry

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Summary

Glycerol is an important by-product of many important oleochemical processes and its value is a significant contributor to the economic viability of the oleochemical industry and its products. The growing demand for fatty acids, fatty alcohols, and of esters for biodiesel is leading to increased production of glycerol. Concern has been expressed about the balance between glycerol supply and demand and of the consequences of this on the oleochemical industry.

Introduction

Oils and fats are mainly triacylglycerols and are generally used for human consumption in this form. However in the oleochemical industry they are used mainly for the manufacture of acids, soaps, methyl esters, alcohols, or nitrogen-containing derivatives and the production of these compounds will almost always involve the liberation of glycerol (1,2,3-propanetriol; glycerine) at a level of around 10% of the oil or fat. This is a useful and valuable by-product and its economic value is an important part of the profitability of the oleochemical industry. Oversupply of glycerol is therefore a matter of concern for glycerol producers.

Glycerol is also a product of the petrochemical industry where it is made from propylene via epichlorohydrin (1-chloro-2,3-epoxypropane). The increasing supply of glycerol from the oleochemical industry, the high price of propylene, and the very good demand for epichlorohydrin for other purposes have together made the petrochemical supply route less important. It is now about 5% or less of total supply compared with 25% twenty years ago.

Glycerol is available in several grades depending on its purity and the requirements of the industries to which it is sold. Refined material is at least 86.5% pure and generally greater than 99.5%. Its value lies in its physical properties: it is hygroscopic, colourless, odourless, viscous, sweet-tasting, low-boiling, non-toxic, emollient, a good solvent, and water-soluble. It is also easily biodegradable. Its major uses include oral care products, food and food emulsifiers, tobacco products, polyurethanes, prescription drugs, over-the-counter medicines, and cosmetics. Attempts are being made to develop new uses by conversion to other valuable compounds such as glycidol (2,3-epoxypropanol), glycerol carbonate, and polyglycerols.

In some of its uses glycerol (produced at a level of 0.9 million tonnes a year) competes with other polyols such as pentaerythritol and trimethylolpropane (together 0.4 million tonnes a year), sorbitol

Table 1. World production, consumption, exports and imports of glycerol (thousand tonnes) in 2003.

	Production	Consumption	Exports	Imports	From
World	930[a]	936	251	248	
USA	142	201	24	75	SE Asia, Europe, S America
Europe	315	325	25	35	SE Asia
China	20	65	2	45	Malaysia and Indonesia
Japan	45	85	2	43	SE Asia
ASEAN [b]	197	33	164	–	
Rest of world	211	227	34	50	

[a] Details of sources by oleochemical products are given in Table 2 at the bottom of this page.
[b] Malaysia, Indonesia, Philippines, Thailand, and Singapore.

(1.1 million tonnes), propylene glycol (1.5 million tonnes) and ethylene glycol (7.5 million tonnes).

Production and trade in glycerol by country/region

In 2003 the annual production of glycerol (930 000 tonnes) came from countries with significant oleochemical industries including USA, Europe, Japan and South-East Asia. Significant importers were USA (37% of its glycerol market) and Japan (50% of its glycerol market) while South-East Asia was the major exporting region. The ASEAN countries (Malaysia, Indonesia, Philippines, Thailand, and Singapore) alone exported around 164 000 tonnes of glycerol in 2003. The figures in **Table 1** clearly show that ASEAN countries are now important producers of glycerol and have become the dominant exporter of this commodity.

Production of glycerol by oleochemical processes

Sources of glycerol by oleochemical products are detailed in **Table 2**. Between 1999 and 2008 glycerol production is expected to rise 38% (from 804 000 tonnes to 1.11 million tonnes). Changes in the supply levels from various oleochemical processes over this ten-year period are (in thousand tonnes): soaps (–58), fatty acids (+88), biodiesel (+293), fatty alcohols (+32), and petrochemical glycerol (–50). These figures demonstrate the growing importance of biodiesel production and the continuing demand for fatty acids and fatty alcohols as sources of glycerol. The change through increased biodiesel production will be mainly in Europe but will also be apparent in North America and elsewhere.

The market for fatty acids continues to increase and new plants are being established in China and other developing countries. These will add to local supplies of glycerol and affect import requirements.

Biodiesel

In the past 30 years many countries have toyed with the idea of producing and using biodiesel as part replacement for diesel fuel. This concept is driven in part by financial and political uncertainties over the supply and price of diesel, by the desire to reduce carbon dioxide emissions to meet the Kyoto agreement (carbon dioxide trapped from the atmosphere a year earlier in bio-material is treated differently from that locked up millennia earlier in fossil fuels), and in part by the superior environmental properties claimed for biodiesel.

It is the environmental issues which are more significant and drive governments to arrange fuel taxes so that biodiesel can be economically competitive (1). Without this favourable tax arrangement biodiesel would be much more expensive than traditional diesel. The EU has calculated (2) that the subsidy paid to the biodiesel producers in the form of lost revenue from reduced tax earnings on normal diesel (known as 'defiscalisation') is €250/tonne of biodiesel (with the crude oil price at US$30 per barrel) .

Biodiesel is usually the mixed methyl esters produced from readily-available fatty oils (soybean oil in USA, rapeseed oil in Europe, and sunflower oil, tallow, and waste frying oil elsewhere). Specifications for biodiesel have been produced in many countries. These esters may be used as a replacement for diesel fuel or, more commonly, be supplied as a 5–20% blend with diesel fuel (3). The production and use of biodiesel will have only a marginal effect on the mineral oil industry but will have a more marked effect on the vegetable oil and fat business. It will reduce the supply of vegetable oil otherwise available for food use, make local demands affecting traditional

import–export patterns (as with rapeseed oil in Europe), and will lead to a large increase in the supply of glycerol.

In 2003, 41% of the European glycerol supply came from biodiesel production and this is expected to increase. At the beginning of 2004, biodiesel in Germany was 'defiscalised' when used in 5% blends, and in the first three months of 2004 tens of thousands of tonnes of biodiesel were sent to major mineral oil refineries for mixing and testing for the adjustment of other additives. Usage of biodiesel in this blend is expected to increase rapidly, leading eventually to the production of 140 000 tonnes of glycerol in Germany in addition to part of the 65 000 tonnes produced in 2003 for the existing pure biodiesel market. The biodiesel market in the rest of Europe will also move ahead strongly and it is anticipated that production of the 2004–05 rapeseed oil crop will reach 1.9 million tonnes throughout Europe. With current biodiesel capacity in Europe now over 2.6 million tonnes, there is more than sufficient capacity to produce this volume.

New projects for large biodiesel plants continue to be announced although doubts have been expressed about the economic viability of some of these programmes (4–6). It is nevertheless quite possible that European biodiesel capacity will reach 3 million tonnes by the end of next year, with the largest capacities being in Germany (1.1 million tonnes/year), Italy (0.6) and France (0.4).

Table 2. World production of glycerol (thousand tonnes) in 1999, 2003, 2004, and 2008 by the oleochemical product of which it is a by-product.

	1999	2003	2004	2008
Total	804	930	970	1110
Soaps	198	180	170	140
Fatty acids	322	350	365	410
Biodiesel	57	160	210	350
Fatty alcohol	108	110	120	140
Synthetic	75	80	50	25
Other	44	50	55	45

Price changes

Glycerol is an important by-product for the oleochemical industry and its value is important to the economics of the industry. During the last 5 years, the price of Kosher-quality refined glycerol has ranged between €1876 and 932/tonne in the USA and between €1457 and 630/tonne in Europe. The lowest prices relate to December 2003 and there were significant increases to €1075 and 900/tonne respectively by the beginning of May 2004. At the time of writing (end of May 2004), there are signs that the market has stabilized worldwide, although Procter & Gamble in the USA has announced further price rises for refined glycerol for 3rd quarter 2004 sales.

The 'Glycerine Market Report' of March 2004 published by Oleoline (see the web site www.oleoline.com run by HB International) forecasts a reduction in glycerol prices during the second half of 2004 as a consequence of the growth in production from the biodiesel industry and of the reduction of inventories by some major producers to improve their half-year financial results.

The year 2005 is expected to be critical with demand growing in line with growth in gross domestic product (GDP; a 3% growth in GDP would lead to an increased demand for glycerol of 11 000 tonnes) and production increasing from manufacture of both fatty acids and biodiesel. Changes in mineral oil prices during the remainder of 2004 and of 2005 will influence the economic viability of biodiesel. On the other hand, oil and fat prices after a period of very low levels are now very high but may not be sustained through the rest of 2004. These price movements also influence the biodiesel industry. The Oleoline analysts consider the long-term outlook (to 2008) to be bearish and expect the price of refined glycerol in Europe to remain in the range €500–700/tonne through the next five years.

Acknowledgement

Information has been taken from Oleoline's March 2004 'Glycerine Market Report'. Reports of this kind are published quarterly through the Oleoline web site and are available on subscription from HBI. Please contact Sophie Carle; email: sophie.carle@hbint.com.

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