A New Technical Solution for Glycol Ether Production:

Brake Fluid from Sugar Cane

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Sulzer Chemtech has a good name as a supplier of key components for column internals in the chemical industry. A new plant for the production of ethylene glycol ether in Kashipur (India), which went on stream in July 2001, also shows that the engineers from Oberwinterthur are up to the mark when it comes to providing technology for complete plants with reaction and distillation sections.

Quite often, it is not only the market requirement that determines the decision for the manufacture of a specific chemical product. The available raw materials or logistic standpoints play the more important role from time to time, which was also the case by the above-mentioned glycol ether plant (see Box and Fig. 1■).

FIELD OF APPLICATION AND MARKET

Ethylene glycol ether is produced through the conversion of alcohols (methanol, ethanol and n-butanol) with ethylene oxide. Behind trade names such as Cellosolve®, Carbitole® and Dowanole®, we find various glycol ethers that are employed in diverse fields, e.g. as solvents in the varnish and lacquer sector, emulsifiers for mineral and vegetable oils or for the forming of ball-point pen paste and printing inks.

One of the main fields of application for glycol ether, however, is its use in brake fluid (Fig. 2■). Numerous producers of glycol ether therefore build a production facility for the manufacture of brake fluids in the immediate vicinity of the glycol ether plant and can thus oper-

1■ The first plant with a continuous process in India has been producing glycol ether for the manufacture of brake fluid since summer 2001. It produces 10 000 tons per annum. The largest plant engineered by Sulzer is designed for a production of 40 000 tons ethylene glycol ether per year.

2■ The brake fluid in hydraulic brakes (with glycol ether as the main constituent) transfers the brake effort from the brake cylinder to the brake block in a uniform manner. The fluid must have a high boiling point and is not allowed to attack the brake-line materials or the seals.

ate the two installations flexibly and according to market requirements – like India Glycols Limited with its plant in Kashipur.

The worldwide consumption of ethylene glycol ether is about 750 000 t/a, the largest manufacturers are found in Europe, the U.S.A. and Japan. The worldwide growth is determined at present by the brake fluid requirement, whereby the biggest growth rates are expected in the countries of Asia and South America.

CUSTOMER-SPECIFIC DEVELOPMENT

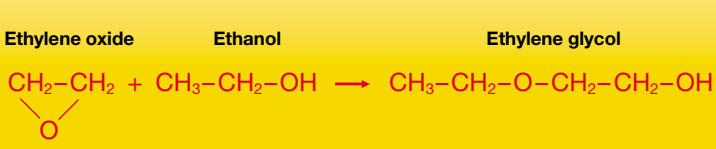
Distillation plants all over the world have been equipped with column internals from Sulzer for some 40 years. In co-operation with experienced partners and interested customers, the know-how acquired thereby is also utilized for the development of technology for complete plants with reaction and distillation sections.

On the basis of a contract study, Sulzer Chemtech developed a continuous process for the production of ethylene glycol ether. The partners are the Polish institute Ciezkiej Syntezy Organicznej "Blachownia" (ICSO), where the necessary customer tests were made, and the Italian company Conser S.p.A., which was responsible for the design of the reactor. In a later step, a customer was found with India Glycols Limited who was convinced of the new technology.

DESCRIPTION OF THE PROCESS

The various glycol ether types are created with a catalytic reaction of ethylene oxide with the alcohols – methanol, ethanol or butanol (Fig. 3■). This reaction is exothermic; the reactor therefore has to be cooled constantly. The continuous process as offered by Sulzer Chemtech (Fig. 4■) facilitates extremely good utilization of the raw materials. Since the reaction is operated with a surplus of alcohol, an atmospheric distillation separates the unused alcohol from the glycol ether, so that it can be used again. The quantity of alcohol fed to the reactor also influences the distribution of the end product. However, the reaction of glycol ether with alcohol cannot be controlled in such a manner that only one single type of glycol ether is formed. Consequently, the glycol ether mixture is separated off in a three-stage vacuum distillation. The lower-boiling mono-glycol ether is distilled under vacuum in the first column. The pressure is even lower in the second vacuum column, where the di-glycol ether is taken off. The less volatile tri-glycol ether is separated from the still higher boiling polyglycol ethers in the third vacuum column.

3■ Ethanol, butanol or methanol can be used for the reaction with ethylene oxide. A number of distillation stages separate the resultant mixture into mono-, di- and higher glycol ethers which, as constituents of solvent and cleaning agents or as processing aids, are suitable for the manufacturer of varnishes and lacquers. Shown here is the reaction formula by the use of ethanol.



ADVANTAGES OF THE SULZER PROCESS

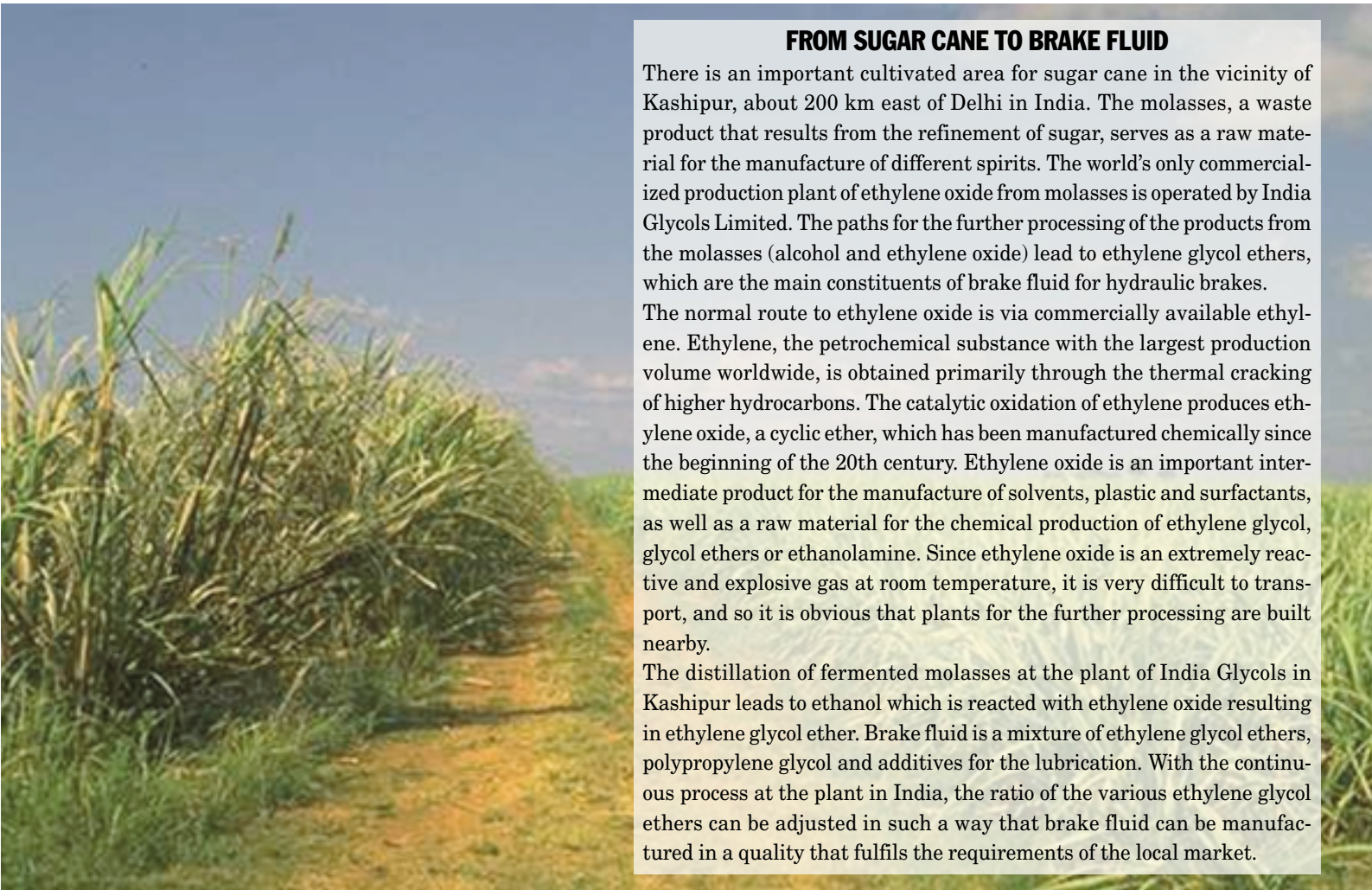
The production experience gained from the very similar ethanolamine plants (see STR 2/2000, p. 32) was incorporated in the ethylene glycol ether technology. The Sulzer reaction takes place at relatively low temperatures and pressures, which minimizes the formation of by-products. The design of the reactor ensures great flexibility in the distribution of the products. A further advantage of the Sulzer process is the possibility of producing ethylene glycol ether from various alcohols in the same plant, for which a suitable catalyst is required.

The catalyst employed by Sulzer is characterized by the following advantages:

- Homogenous
- No incrustation in the downstream evaporators of the distillation columns
- Hardly any water has to be removed
- Non-corrosive

For the equipment of the distillation units, Sulzer Chemtech draws upon its wide and long experience in the field of vacuum distillation technology:

- The columns are equipped with Mellapak structured packing (Fig. 5■). The excellent efficiency of the separation reduces the consumption of energy and permits a lower overall height of the column.
- Thanks to its special design, the condensers only cause very low-pressure loss during the vacuum distillation.
- The use of falling-film evaporators facilitates low temperatures which, in turn, prevents losses and possible deterioration in the quality of the end product.

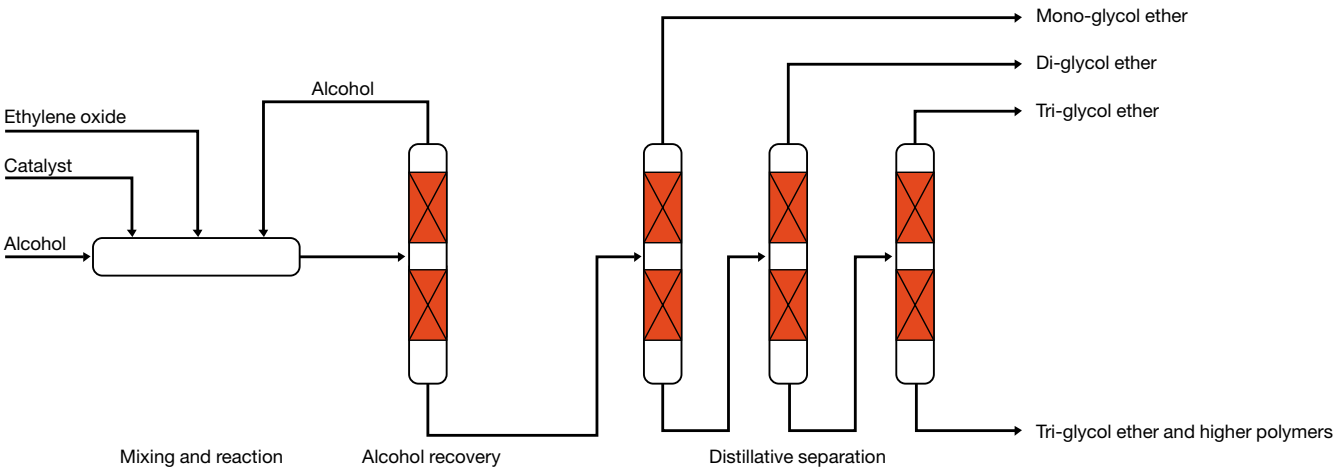


FROM SUGAR CANE TO BRAKE FLUID

There is an important cultivated area for sugar cane in the vicinity of Kashipur, about 200 km east of Delhi in India. The molasses, a waste product that results from the refinement of sugar, serves as a raw material for the manufacture of different spirits. The world's only commercialized production plant of ethylene oxide from molasses is operated by India Glycols Limited. The paths for the further processing of the products from the molasses (alcohol and ethylene oxide) lead to ethylene glycol ethers, which are the main constituents of brake fluid for hydraulic brakes.

The normal route to ethylene oxide is via commercially available ethylene. Ethylene, the petrochemical substance with the largest production volume worldwide, is obtained primarily through the thermal cracking of higher hydrocarbons. The catalytic oxidation of ethylene produces ethylene oxide, a cyclic ether, which has been manufactured chemically since the beginning of the 20th century. Ethylene oxide is an important intermediate product for the manufacture of solvents, plastic and surfactants, as well as a raw material for the chemical production of ethylene glycol, glycol ethers or ethanolamine. Since ethylene oxide is an extremely reactive and explosive gas at room temperature, it is very difficult to transport, and so it is obvious that plants for the further processing are built nearby.

The distillation of fermented molasses at the plant of India Glycols in Kashipur leads to ethanol which is reacted with ethylene oxide resulting in ethylene glycol ether. Brake fluid is a mixture of ethylene glycol ethers, polypropylene glycol and additives for the lubrication. With the continuous process at the plant in India, the ratio of the various ethylene glycol ethers can be adjusted in such a way that brake fluid can be manufactured in a quality that fulfils the requirements of the local market.



4■ The manufacture of glycol ether is conducted in three main stages: mixing and reaction, alcohol recovery as well as the separation of the end products in a three-stage distillation. The key components developed by Sulzer Chemtech are employed in all three stages.

SCOPE OF DELIVERY FROM SULZER CHEMTECH

Sulzer Chemtech provides the basic engineering for continuously operating glycol ether plants, as well as the license for the production of ethylene glycol ether and for the manufacture of brake fluids. Furthermore, the detail planning and delivery of the key components that are essential for the proper functioning of the plant are within the scope of supply of Sulzer Chemtech. These are: the reactor, packing in the distillation columns, heat exchangers, vacuum system, and the control system.

With the aforementioned scope of delivery, Sulzer Chemtech can guarantee that the plant will operate reliably and as planned. Moreover, that it will fulfil the requirements for important values, such as the product purity and capacity of the plant.

Sulzer Chemtech does not only offer tailor-made technology for the production of ethylene glycol ether alone. Technology is also available for ethanolamine. For example, a Sulzer plant has been producing ethanolamine from ethylene oxide and ammonia in north-eastern China since 1997. Ethanolamine is employed for gas-washing purposes and as a starting material for the synthesis of fine chemicals. Ω

FOR MORE DETAILS

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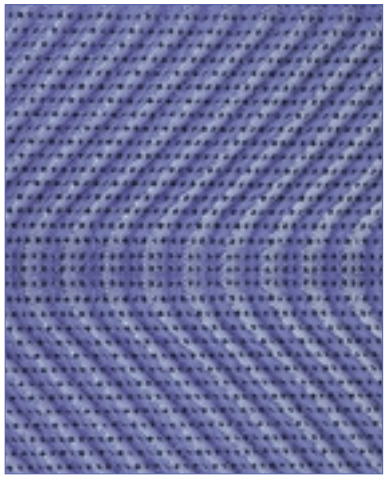

5■ Since the metal packing from Sulzer Chemtech (photo: MellapakPlus) cause only extremely low pressure losses, the distillation can take place at low temperatures. This increases the purity and quality of the separated glycol ethers.