

Improving the Production Process of the Most Popular Man-made Fiber

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Among man-made fibers, Polyester for both textile and industrial use makes up for about 55% of the yearly production of 31 million tons. Dimethylterephthalate (DMT) and purified Terephthalic Acid (PTA) are feedstocks for the production of Polyester. Sulzer Chemtech in collaboration with H&G Hegmanns improved the DMT production process, making it more energy-efficient and increasing the purity of the product compared to the conventional process. If desired, the pure DMT can be subsequently hydrolyzed to produce top-purity PTA.



▶ DMT or PTA are polymerized with diols to produce polyester. In 1941 in the UK, J.R. Whinfield and J. T. Dickson developed the first polyester fibers. Today, it has become the world's major man-made fiber for textiles and industrial applications (Fig. 1). Polyester is so versatile, that it is an ideal choice for virtually any plastic application such as films, bottles (PET), and molded parts.

Conventional Process Requires Solvents

Today, most DMT is manufactured from para-xylene by successive oxidation and esterification. The crude ester is distilled to remove heavy boilers and light esters. The

remaining DMT is further purified by two stages of suspension crystallization with methanol as solvent. Large quantities of solvents are needed, which require considerable amounts of energy to recover.

Improving the Process

Sulzer Chemtech and the German engineering company H&G Hegmanns GmbH jointly developed an improved DMT/PTA process which is based on dramatic enhancements to the conventional Witten-Katzschmann process and on Sulzer's environment-friendly melt crystallization technology (Fig.2). The improved process combines an enhanced oxidation

reaction with efficient byproduct and energy recovery, a revised raw-ester and byproduct distillation train, as well as melt crystallization technology for the final DMT purification. The improvements allow new opportunities to optimize the DMT/PTA process for maximum purity, minimum residue and overall plant economy, and result in both lower investment and operating costs compared to other current processes.

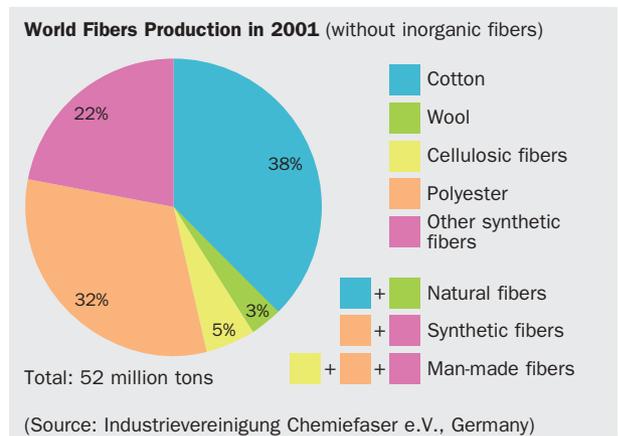
Sulzer Technology as a Key

Sulzer mass transfer technology and extensive know-how play a key role in redesigning the distillation and crystallization units of the DMT process. Following the esterification reaction and subsequent byproduct recovery train, the liquid stream is sent on to two vacuum distillation columns in series. In the first column, methyl p-toluate is recovered and sent to

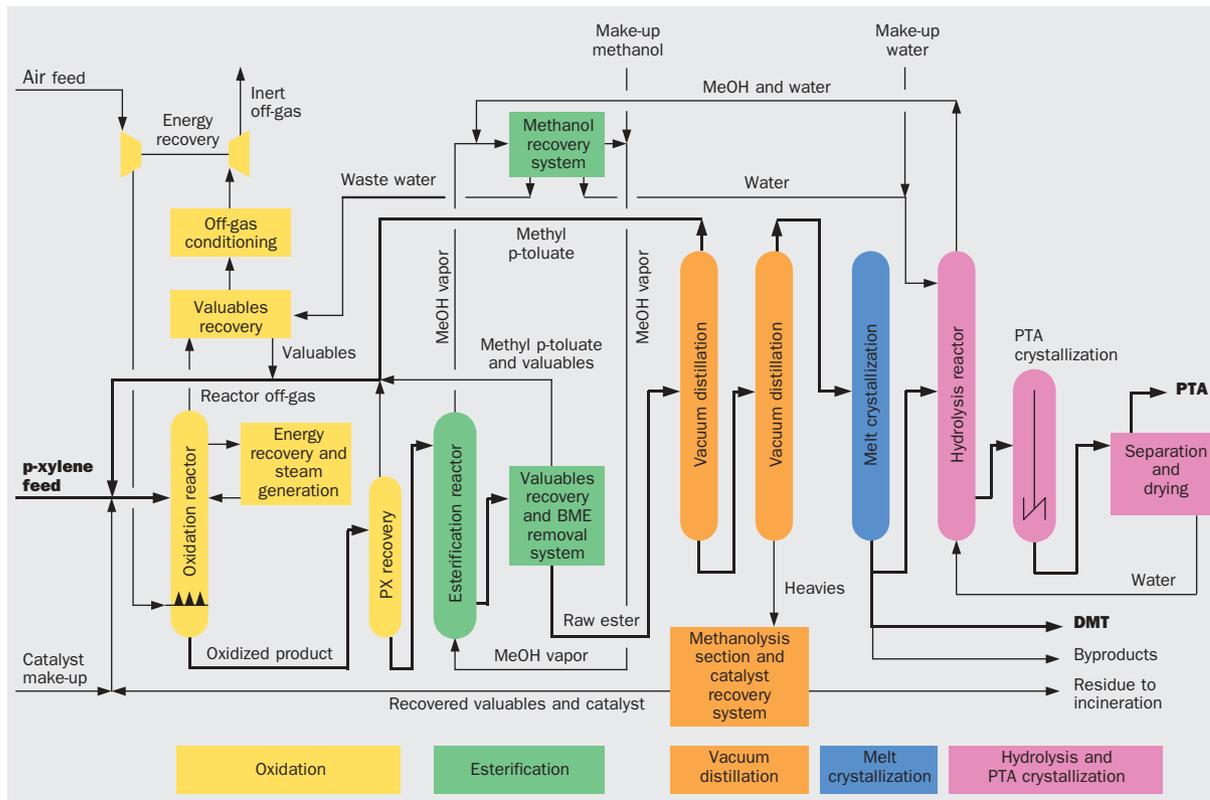
the oxidation reactor. In the second column, the DMT product – including isomers – is taken overhead, leaving catalyst and heavies in the sump. In this step of the process, advanced vacuum distillation technology using Sulzer structured packings leads to high separation efficiency and massive capacity increase in the distillation unit. Smaller equipment can be used, thus reducing investment costs. This technology along with proven control strategies allows optimum recovery of methyl p-toluate in the first column, as well as an efficient DMT purification on the second.

Solvent-free Crystallization

In the conventional process, the distilled crude DMT is further purified to make polymer grade DMT by way of a two-stage countercurrent suspension crystallization in methanol. The crystallization train and associated methanol

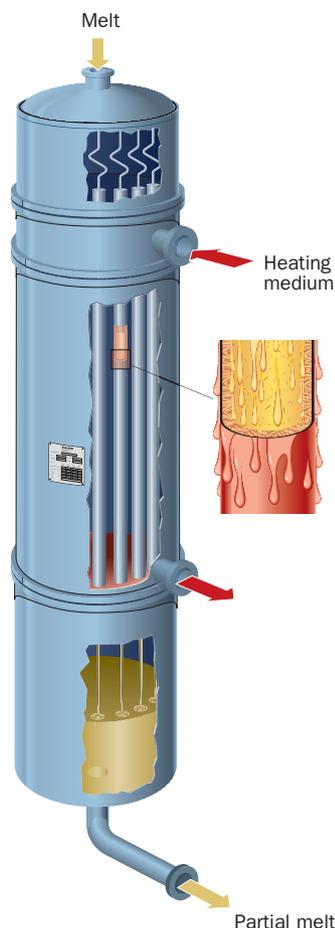


1 Polyester makes up for about 55% of all man-made fibers produced worldwide. With the improved process by Sulzer Chemtech, this popular synthetic can be produced more economically.



2 The enhanced process for DMT/PTA production is based on the same unit operations as the conventional process (air oxidation, methanol esterification, purification), but Sulzer technology substantially improves key steps.

3 Falling-film crystallization: The melt flows down on the inside surface of the tubes, whereas the medium used for cooling and heating is distributed to wet the external surface of the tubes.



recovery section of a conventional DMT plant typically account for approximately 45% of the total investment costs. The improved process eliminates the suspension crystallization and the use of methanol as solvent altogether. It instead makes use of Sulzer's fractional melt crystallization technology (see STR2/2002, p.4, and STR 4/2002, p.16) to reduce both investment and operating costs, while at the same time improving the operability and flexibility of the process.

Melt crystallization represents one of the most innovative aspects of the improved process. Sulzer's melt crystallization technology (Fig.3) makes use of layer crystallization, which can be either static or falling-film crystallization. The falling-film crystallizer contains

vertical tubes. Crystal layers are grown from a falling film of melt on the inside of the cooled tubes. Impurities are rejected from the crystals and concentrated in the remaining melt. Falling-film crystallization is generally used for relatively pure feeds and high capacities. This technique has been shown to be ideally suited to the purification of distilled crude DMT to polyester grade.

Competitive Option

Both investment and production advantages make the enhanced process a competitive alternative to the conventional PTA process. This technology can be licensed from H&G Hegmanns and Sulzer, and product from this improved DMT/PTA process can be sold worldwide without restriction. ◀

DMT Separation with Mellapak® and MellapakPlus®

Esters of terephthalic acid (DMT and its isomers) can be separated by distillation. However, some of the isomers are close-boiling components and require special know-how. In order to optimize operating conditions and achieve high purities, Sulzer Chemtech carried out comprehensive trials in a series of pilot columns under semi-industrial conditions. Today, DMT columns are designed based on these trials, frequently using MellapakPlus, Sulzer Chemtech's high-capacity packing (see back cover of STR 4/2002).

DMT columns with Sulzer structured packings are successfully in operation to separate isomers in industrial DMT plants, for instance:

- ▶ Three of the largest DMT columns were delivered to Formosa Chemicals & Fibre Corp. in Taiwan. The biggest isomer column with Mellapak has a diameter of 5 m. The performance guarantee was fulfilled in 1989.
- ▶ In 1996, a DMT plant of SASA in Turkey was revamped from tray columns to structured packings. The predicted purities could be met easily.
- ▶ In a German plant, the high pressure drop of valve trays resulted in an elevated bottom temperature in a methyl p-toluatoe column. In 1996, this risk of decomposition could be eliminated by revamping the trays with Mellapak. At the same time, capacity could be increased significantly.

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