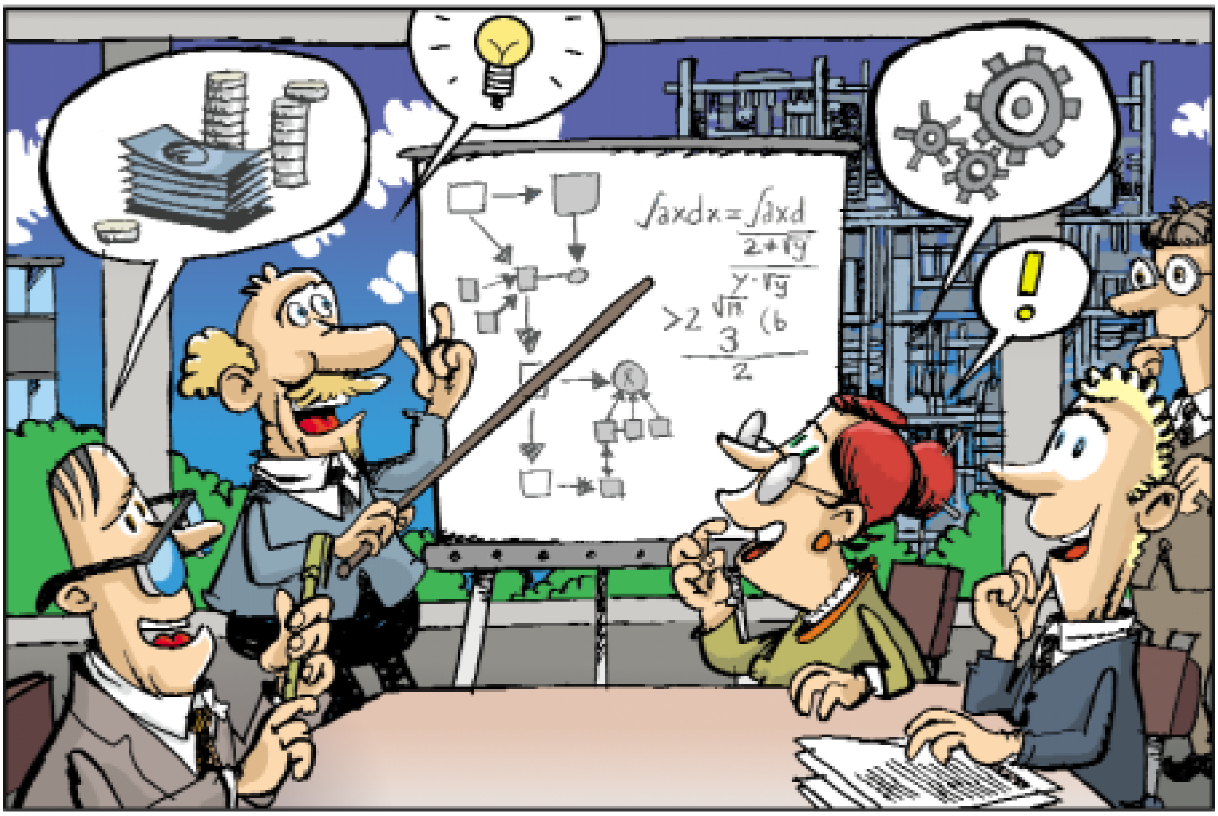
From an Idea to a Production Plant



1■ To realize an idea from paper, it has to be clarified whether it is technically feasible and economically worthwhile. Sulzer Chemtech gives customers every assistance thereby, e.g. with test runs in pilot plants.

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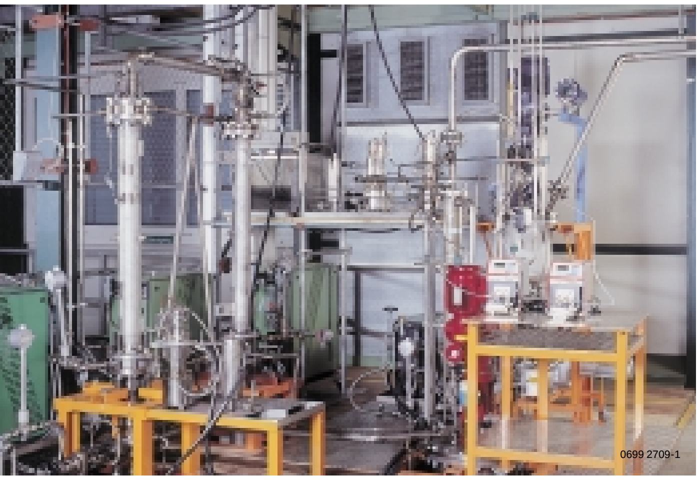
It makes no difference whether plastic drinking cups are made of polystyrene or chewing gum masses from polyvinyl acetate – every plastic is associated with a complex process, which converts the monomer into a polymer with characteristics that are suitable for the intended application. In the field of Static Mixing and Reaction Technology, Sulzer Chemtech has a profound knowledge of the processes and technical apparatus employed in polymer production.

There is an idea at the start of every process (Fig. 1■). The chances that it will be accepted in the practice are good, if the costs are less than those of the already established processes. One important step on the way from the idea to the production plant is the demonstration of the new process in pilot scale. Despite the great progress in the field of numerical process simulation, the close relationship of process kinetics and fluid dynamics still poses immense difficulties in polymer production. In the end, the risk is too great to convert a process idea on paper directly into a production plant.

Sulzer Chemtech has the infrastructure of a technical laboratory, which permits the efficient piloting of processes and process stages at customer's order (see also box). Every pilot plant is designed for the individual questions formulated by the customer. Thanks to the modular design of the pilot plants, they can be modified flexibly and quickly during the piloting phase. If necessary, parts of apparatus



2■ The process requirements of customers can be tested on a small scale in the Sulzer Chemtech pilot plant for polystyrene in Winterthur.

that are not readily available can be manufactured immediately in the company's own workshop. After all, the object of this work is to establish a reliable data basis for the construction of an optimized, process-engineering production plant.

STATIC MIXING AND REACTION TECHNOLOGY

Since the reactor performance is dependent on the respective constituents (monomer, catalyst, and initiator), the mixing as a unit operation plays an important role for polymerization reactions. Furthermore, these reactions are extremely exothermic in the majority of cases and can only be mastered safely if the resultant heat is extracted with only slight differences in temperature. The progressive polymerization of the monomer to polymer causes a marked increase in the viscosity, namely from the watery viscosity of the monomer to a viscous polymer melt, like a molasses spread. In the case of higher viscosities, where the heat transfer to the reactor walls is effected exclusively by laminar flow, there is a great demand for mixing and reaction systems from Sulzer Chemtech.

Quite frequently, the product of a polymerization is not a pure polymer, but a mixture with residual monomer, solvent and diverse pollutants. These constituents are removed by means of the static devolatilization process developed by Sulzer Chemtech and the purity of the polymer thus increased to 99.99%. This technology is also very suitable for the devolatilization of thermal-sensitive polymers and, in comparison with conventional processes, requires less energy. The polymer resulting after the devolatilization has to be frequently upgraded with diverse additives in order to obtain the necessary properties for the further processing. Static mixing systems from Sulzer Chemtech are characterized by their low consumption of energy and minimum maintenance. Thanks to their compact design, they are also especially suitable where space is limited, a difficulty which is frequently the case with retrofits.

PLANT FOR THE PRODUCTION OF POLYSTYRENE

The production of polystyrene is a well-known example of the reactions of polymerization. Sulzer Chemtech has the know-how to design, build and commission complete production plants. And for customers who wish to build a new plant, for example, there is a pilot plant in Winterthur with which it is possible to clarify how cost-effective production and with high quality can be realized with the process from Sulzer Chemtech (Fig. 2■). The polymerization of styrene is not conducted until the monomer is spent completely, which would be unprofitable. With the polymerization technology from Sulzer Chemtech, however, it is possible to polymerize 80–85% as against the 60–75% with conventional processes. The advantage here, for example, is that less monomer has to be separated off and so a smaller devolatilization unit can be planned and operated with less energy, which, in turn, enhances the rentability of the complete plant.

3■ The polystyrene product EPS (expandable polystyrene) is employed as a source material for objects such as packing boxes. Sulzer Chemtech has developed a continuous process for the production of these microgranulates.

ECOLOGICAL MANUFACTURE OF POLYSTYRENE BEADS

A further process developed by Sulzer Chemtech is designed for the manufacture of expandable polystyrene microgranulates EPS (Fig. 3■). This contains a foaming agent, e.g. Pentan, which is used to expand the microgranulates in the further course of processing. The resultant components are employed on a wide scale for thermal insulation purposes in the building, transport and packing industries.

With the process from Sulzer Chemtech, the foaming agent is added continuously to the polystyrene from the mass polymerization. And simultaneously with the successful demonstration of the impregnation of the polystyrene melt and microgranulation in pilot scale, it can be shown that the EPS granulates manufactured in this manner can be processed further in industrially operated pre- and form-foaming apparatus. In comparison with conventional equipment, this process is not only much better ecologically, but also economically. For example, there is no further need for the abundant quantities of water that are required and have to be cleaned for batch processes.

AT SULZER CHEMTECH OR BY THE CUSTOMER

Depending on the questions posed and the boundary conditions, pilot tests are also carried out in a pilot plant at the customer's works or directly in the actual plant. For example, polymerization tests were made on-site on an existing polystyrene plant for a customer in Great Britain. Among other things, the customer wanted to increase the production output of the plant from 2850 kg/h to 4000 kg/h. A complete polymerization system was erected and supplied with a part flow from the full-scale plant. In this way, it was possible to demonstrate the operating conditions to the customer under which the static polymerization reactors would have to be operated in order to obtain his required product characteristics.

4■ *After successful on-site pilot tests on an existing polystyrene plant, Sulzer Chemtech designed and supplied the additional reactor volume with which the capacity increase required by the customer could be realized.*

With these tests, it was also possible to determine the data necessary for the scale-up of the reactors. After a successful demonstration, the additional reactor volume was integrated in the plant during a production stop in 1995 (Fig. 4■); since then, the plant has been operating productively to the complete satisfaction of the customer. Ω

KNOW-HOW FOR POLYMER PRODUCTION

Sulzer Chemtech provides problem solutions for the production of the most diverse polymers. All these processes operate over three stages:

Polymerization	Degasification	Upgrading
Polystyrene (GPPS, HIPS)	Polystyrene (GPPS, HIPS)	Admixture of:
Styrene-Copolymers (ABS/SAN)	Styrene-Copolymers (ABS/SAN)	– Low-viscosity additives
Polymethylacrylate	Polyethylene (HDPE, LLDPE)	– High-viscosity masterbatches
Polyethylene (PE)	Polyvinyl acetate (PVA)	– Other polymers
Silicone polymers	Polycarbonate (PC)	
Polyamide 6 (PA6)	Polyether glycol	
Terpene resins	Polyoxymethylene (POM)	
Polyoxymethylene (POM)	Polyisobutylene (PIB)	
	Elastomer (EPM, EODM)	

FOR MORE DETAILS

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