New perspectives in thermal insulation and product design

Economic added value

Expanded polystyrene is a widespread material used primarily all for thermal insulation and in the packaging sector. Sulzer Chemtech has developed a continuous manufacturing process for the production of a more eco-friendly end product with improved properties.

Today, global consumption of expandable polystyrene (EPS) exceeds 3 million tons with an increase of approx. 6% a year. This makes EPS one of the most important plastics worldwide. It is used as thermal insulation in buildings and for packaging consumer goods and foodstuffs. In Europe, around three-quarters of the material is used for thermal insulation of buildings. Above all, the latest generation of EPS stands out among all thermal insulation materials available on the market because it has the best yield factor, i.e., the ratio of energy saved trough use to energy expended manufacturing it. In a typical single-family dwelling with EPS thermal insulation, a yield factor of approx. 50 can be realized.

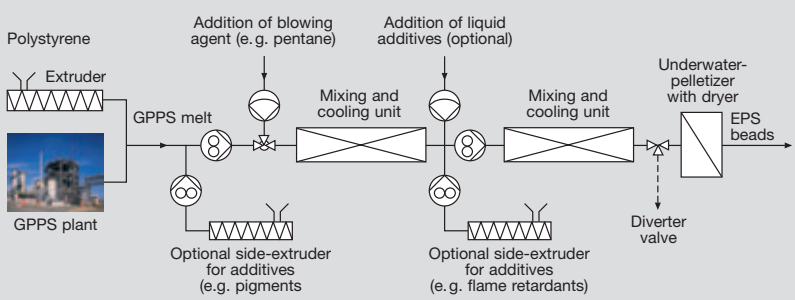
Conventional EPS process

The basic building block of polystyrene is the monomer styrene, a petroleum product. The conventional way to manufacture EPS granulate is through suspension polymerization of this monomer. Polymerization takes place batch-by-batch in tank reactors. During polymerization, a blowing agent – generally pentane – is added. Once the reaction has ended, the EPS beads are washed, dried, sieved, coated and packed. The beads then have a shelf life of several months until the blowing agent evaporates through diffusion. EPS is marketed by raw materials manufacturers as a round granulate containing blowing agent and is processed locally into foam, at specialized processing companies. This takes place through physical foaming: The granulate that contains the blowing agent is steam heated to a specific temperature that is high enough to soften the polymer and simultaneously cause the blowing agent to evaporate. During the process, the EPS beads expand greatly and then—generally after a 24-hour compensation period—are filled into molds and further expanded with steam. Through this expansion, foam fills the mold and the individual particles melt together at the edges. When foamed, 20 tons of material will expand to a volume of 1 million liters or 1000 m^3.

Continuous Sulzer process

Within the scope of its innovation activities, Sulzer Chemtech developed and brought to market a new continuous process for manufacturing EPS granulate 1. This process is especially suitable for producing EPS with low thermal conductivity λ. The process is fed with molten general purpose polystyrene (GPPS) directly from a polymerization plant or an extruder. The new process combines proven components such as the SMX™ static mixer or Sulzer SMR™ mixer reactors along with process know-how provided by the experts at Sulzer Chemtech. The interaction of the individual components leads to a process that holds substantial advantages.

1 Continuous Sulzer process for expandable polystyrene EPS



Good thermal insulation systems significantly reduce energy consumption – even on the 3454-meter high Jungfraujoch, where the average annual temperature is –10 °C.

The high quality of pigmentation is a major advantage of the Sulzer EPS process.

High thermal insulation

Low thermal conductivity, which – depending on the formulation – may be as much as 20% lower than ordinary EPS, benefits raw materials manufacturers, processors, end customers and the environment [2]. Up to 50% fewer raw materials are required in production, thus enabling the use of panels that are 50% thinner and lighter. Thinner panels are ideal for applications in which space is important, for example, when renovating old buildings. In addition, especially in the construction sector, these products meet with higher consumer acceptance through the addition of pigments.

At the pilot plant in Winterthur, Sulzer engineers develop customer-specific materials.

High-quality pigmentation, fewer additives

The new Sulzer EPS process also has several advantages over the conventional process. Additives such as blowing agents, for example, can be dosed very precisely and added with very low losses. The quality of pigmentation in EPS manufactured using the Sulzer process is substantially higher than with conventional material. This is important for consumer products such as bicycle helmets since ordinary white EPS has a cheap appearance due to its use as disposable packaging. Shorter holding times and precise temperature control in the process also reduce the need for expensive additives when manufacturing EPS. Moreover, microgranulates manufactured through underwater pelletization do not have to be graded as in the classic process, but instead can be produced in a very narrow size distribution. This reduces space requirements and simplifies logistics as well as improves economics, since only those sizes, which can be sold on the market, are produced.

Positive overall balance

The new process requires significantly less process water and produces less scrap, since granulate that does not meet the product specification can be returned to the process. For manufacturers of EPS moldings and panels as well as makers of the necessary processing machinery, it is important that new material can be processed using the same processes employed with conventional EPS. As mentioned above, the size distribution of the granulate beads is much narrower than with standard material, which has an especially positive effect on filling behavior in the foaming molds. With identical process settings in the prefoaming unit and molding machines, a level of fusion of the foamed beads results that is substantially higher than with conventional EPS. This leads to improved mechanical properties of the foam products.

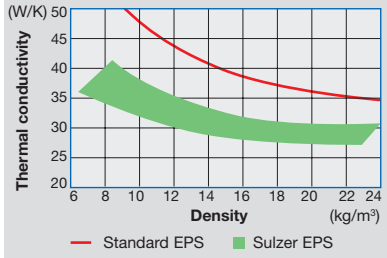
Flexible plant sizes

Many of the process engineering limitations of conventional suspension polymerization do not apply to the Sulzer systems, therefore the plants are freely scalable. This means that, in contrast to the batch process, both large-scale plants and smaller units are possible. Sulzer EPS plants have extremely high potential in hot or humid regions of the globe, where it is imperative to avoid long transport routes due to increased blowing agent losses for the unfoamed EPS granulate. In situations like these, the Sulzer process makes it possible to erect several small plants in close proximity to the final processors.

Industrial use

Sulzer Chemtech has completed precommercial development of the new process and is now moving forward with industrial use. The division is building a processing plant for a renowned chemicals company, which will be commissioned in late 2009. The pilot plant in Winterthur, with which Sulzer Chemtech engineers can manufacture special grades of EPS according to specific customer demands, is unique. The plant is open to potential customers.

[2] Standard EPS and Sulzer EPS



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