

## Technical Article

Paderborn (Germany), September 2020

### Processing EPS in the Ploughshare® Mixer

**Expanded polystyrene, or EPS, is an essential material in industries that range from construction to packaging. Depending on the purpose it is used for, EPS may need special characteristics such as anti-static or flame-retardant properties or a specific colour. This can be achieved by introducing additives, often in very small quantities. Horizontal Ploughshare® Mixers have proved to be ideal for this complex process engineering task.**

EPS was invented nearly 70 years ago. In 1952 BASF first presented the material, which is very light in weight but also robust, under the brand name "Styropor" at the plastics fair in Düsseldorf, Germany. Today, EPS is used throughout the world. In 2018, 10.3 million tons of the material were produced.<sup>1</sup> According to market studies, an increase of 2.6 percent per year in the global demand for EPS is expected in the period up to 2026.<sup>2</sup>

#### Expanded polystyrene – a versatile material

There are good reasons for the high level of demand for EPS. The small beads may consist of 98 percent air, but they are highly functional. The air in EPS keeps the material's thermal conductivity to a minimum, which in turn makes it an ideal insulating material. EPS is also characterised by its light weight, high compressive strength and shock absorbing properties. In addition, this cost-effective material can be processed in a number of ways. It can be pressed into a wide variety of shapes and then simply sawn, milled or cut to size.

This makes EPS suitable for a wide variety of applications. In the construction industry, it is used to insulate buildings from cold, heat and noise and helps to

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<sup>1</sup> <https://www.statista.com/statistics/1063653/expandable-polystyrene-production-capacity-globally/>

<sup>2</sup> <https://www.kunststoffindustrie-online.de/branchennews/ceresana-erwartet-weiteres-wachstum-fuer-den-markt-fuer-polystyrol-ps-und-expandierbares-polystyrol-eps>

**Press contact:**

Prospero GmbH  
Müllerstraße 27 – 80469 Munich  
Phone:  
Fax:  
E-mail:

Gebr. Lödige Maschinenbau GmbH  
Elsener Straße 7--9 – D-33102 Paderborn  
Phone: +49-5251-309-0  
Fax: +49-5251-309-123  
E-mail: [info@loedige.de](mailto:info@loedige.de)

increase their energy efficiency. In Europe, 60 percent of the demand for EPS comes from the construction industry.

But EPS is also an essential material in the packaging industry. Boxes made of EPS are perfect for transporting temperature- or pressure-sensitive foods. And, thanks to this material, electric appliances, such as computers and fridges, reach customers undamaged.

EPS is manufactured using a polymerisation process which involves making styrene monomer in liquid form into polymers. The blowing agent pentane is then added to the polystyrene beads that are produced in this process. The result is EPS granulate which can be turned into foam. The hard-plastic beads, which are filled with pentane, are transformed into foam by applying water vapour at a temperature of around 100°C. During this process, the blowing agent evaporates, and the compact EPS beads expand to up to 50 times their original volume. They can then be manufactured into panels, blocks and also more complex shapes.

### **Processing in the Ploughshare® Mixer**

EPS comes in many different forms. After the polymerisation phase, additives can be used to give it specific properties. Horizontal Ploughshare® Mixers have proved to be ideal for this complex process engineering task. These mixers operate on the basis of the mixing and fluid process developed by Lödige Process Technology, which produces excellent mixing results.

The central feature of the mixer is a special arrangement of Ploughshare® Shovels on a horizontal shaft. They rotate in a cylindrical mixing vessel which is positioned horizontally. The size, number, position, shape and circumferential speed of the shovels are carefully coordinated to create a three-dimensional movement in the materials during the mixing process. This means that the materials are continuously mixed by the mixing tools to prevent dead spots or areas of low movement from forming.

To achieve the desired product characteristics, EPS beads are coated with additives after fractioning. Additives are applied to EPS for reasons that include:

- Producing special flow characteristics
- Creating flame-retardant properties
- Adding colour
- Producing anti-static properties

**Press contact:**

Prospero GmbH  
Müllerstraße 27 – 80469 Munich  
Phone:  
Fax:  
E-mail:

Gebr. Lödige Maschinenbau GmbH  
Elsener Straße 7--9 – D-33102 Paderborn  
Phone: +49-5251-309-0  
Fax: +49-5251-309-123  
E-mail: info@loedige.de

Processing the plastic beads presents particular challenges. Only very small quantities (less than one percent) of additives in fine powder or liquid form are introduced. Nevertheless, it is essential to achieve a homogeneous mixture and a consistently high product quality.

Another process engineering problem is the use of pentane as a blowing agent in the production process. Firstly, the gas atmosphere during the design and construction of the system means that the requirements of ATEX directive 2014/34/EU must be met. Secondly, the mixing process, which is intensive but causes no harm to the product, must be performed without any energy input. Even temperatures above 40°C can result in the blowing agent expanding the beads.

### **Introducing additives – a challenge for process engineering**

Lödige mixers can process EPS beads in batches or continuously. The powdered and/or liquid additives can be introduced into the moving product in several different locations. In both mixing systems, tools with a specific design ensure that even the smooth surfaces of the EPS beads come into full contact with the additives. This drum-based mixing process achieves excellent material adhesion. The high mixing quality produced by Lödige mixing machines makes it possible to achieve extremely uniform distribution even if the additives make up less than one percent of the total mixture. At the same time, the mixing process achieves high throughput rates with low retention times and short cycle times, which ensures that production is cost-effective.

The process can be performed both in the batch mixer and in the continuous mixer under inert conditions or with suitable measures to ensure the required level of explosion protection. Lödige mixers have the EU type examination certificate for operation in gas and dust atmospheres zone 0/20 indoors and are approved for operation in potentially explosive atmospheres.

### **A discontinuous or continuous process for the ideal result**

The use of Lödige mixing systems prevents the risk of costly interruptions to production, particularly in the field of bulk plastics, for example caused by inconsistent product properties or fluctuations in quality. The use of batch mixers for processing EPS allows for a high level of flexibility, which is a major advantage, particularly if formulations are changed frequently.

**Press contact:**

Prospero GmbH  
Müllerstraße 27 – 80469 Munich  
Phone:  
Fax:  
E-mail:

Gebr. Lödige Maschinenbau GmbH  
Elsener Straße 7--9 – D-33102 Paderborn  
Phone:+49-5251-309-0  
Fax: +49-5251-309-123  
E-mail: info@loedige.de

Ploughshare® Mixers for continuous operation are especially designed for high throughput rates. These rates can vary depending on the retention time, filling level and material properties. The continuous three-dimensional movement of mixture components in the Ploughshare® Mixer ensures the consistent separation of the particles in the fluidised bed. This makes it very easy to add liquids and coat the particles in a continuous process. The process can be performed at filling levels between 20 percent and 50 percent without any impact on the mixing quality. The mixing units can be set to constantly backmixing the product during retention times. This guarantees that the mixture keeps moving at all times until it is transported through the discharge opening for further processing. The size of the discharge opening, which can be regulated using an adjustable weir, has a significant effect on the retention time. This reliably compensates for any fluctuations in the dosing process caused by the system.

### **Future-proof systems**

As a solution and service provider, Lödige offers not only mixing machines but also accompanying systems for supplying and discharging products to create a complete solution. In addition to the mixer, this includes, for example, weighing, dosing and transport systems and discharge containers. The complete solution is designed to meet the customer's individual requirements and to operate reliably for many years. Lödige has extensive experience in this area. It has already installed 90 mixers and systems for processing EPS in 17 countries.

Lödige has an in-house technical centre at its headquarters in Paderborn which helps to ensure that its systems are future-proof. The centre is equipped to investigate and implement changes in the EPS process resulting from modifications to the main materials or the additives. The centre has modern machines, laboratory devices and scalable systems for testing purposes.

**Press contact:**

Prospero GmbH  
Müllerstraße 27 – 80469 Munich  
Phone:  
Fax:  
E-mail:

Gebr. Lödige Maschinenbau GmbH  
Elsener Straße 7--9 – D-33102 Paderborn  
Phone: +49-5251-309-0  
Fax: +49-5251-309-123  
E-mail: info@loedige.de

**Captions:**

The production of expandable polystyrene (EPS)

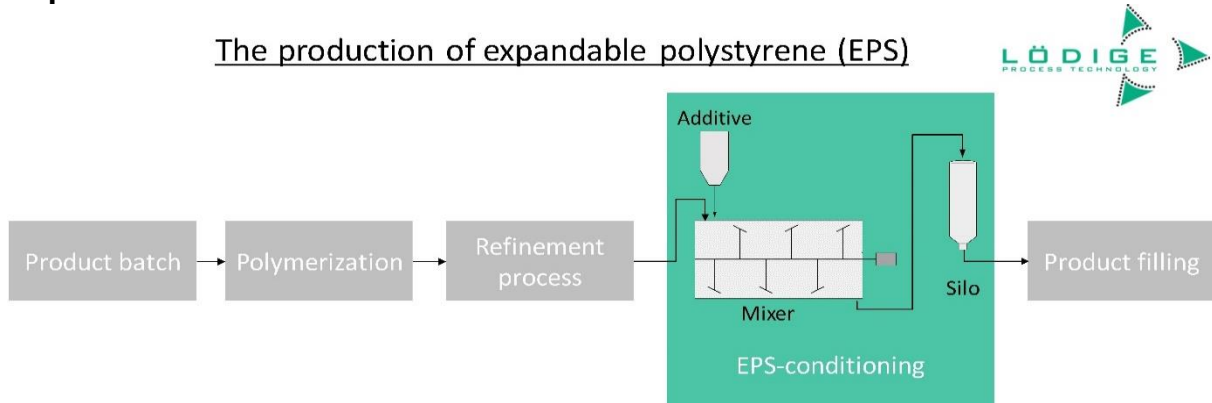


Image 1:  
Lödige mixers can process EPS beads in batches or continuously. (Source: Lödige)



Image 2:  
Lödige Ploughshare® Mixers for continuous operation are especially designed for high throughput rates. (Source: Lödige)

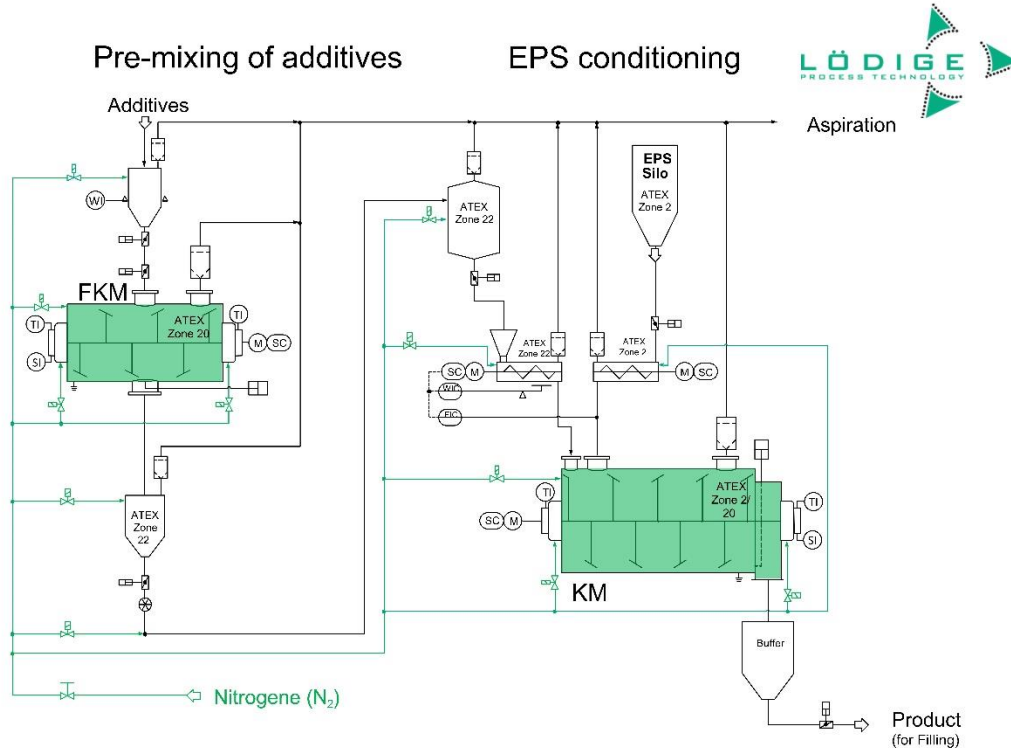


Image 3:  
Lödige supplies complete solutions that include additive preparation, EPS conditioning and filling into containers. (Source: Lödige)

**Authors and contact for reader enquiries:**

Thomas Wegener, Martin Schmitz  
Sales - Mixing and Reacting Technologies

Lödige Process Technology/Gebr. Lödige Maschinenbau GmbH  
Elsener Straße 7-9 – D-33102 Paderborn  
Phone: +49-5251-309-216 /-407  
Fax: +49-5251-309-123  
E-mail: wegener@loedige.de, schmitz@loedige.de

www.loedige.de

**Press contact:**  
Prospero GmbH  
Müllerstraße 27 – 80469 Munich  
Phone:  
Fax:  
E-mail:

Gebr. Lödige Maschinenbau GmbH  
Elsener Straße 7--9 – D-33102 Paderborn  
Phone:+49-5251-309-0  
Fax: +49-5251-309-123  
E-mail: info@loedige.de