

## MANUFACTURING EXPANDABLE POLYSTYRENE

Expandable polystyrene is the raw material used to manufacture articles finished with expanded polystyrene. Like all other types of plastic material, expandable polystyrene is a petroleum derivative.

The diagram below shows the components and the different stages from petroleum distillation to obtaining the expandable polystyrene.

This raw material is presented in the form of small polystyrene beads that contain an expanding agent homogeneously distributed inside them, which allows them to expand during the transformation process.

The expanding agent is a low-boiling hydrocarbon (normally pentane). In the production of expandable polystyrene expanding gases from the family of CFCs, HCFCs, or HFCs are not and have never been used; these gases cause the depletion of the Ozone Layer.

Expandable polystyrene beads are presented in spherical form with a diameter that oscillates between 0.2 - 3.0 mm and they are treated with different additives to influence the properties of the expanded material.

### ***Manufacturing process***

The process is in the following two stages:

- **POLYMERISATION**
- **DRYING AND FINISH**

Polymerisation consists in obtaining macromolecules based on long chains of the basic unit or monomer. In the case of expandable polystyrene the monomer is styrene. The polymerisation is carried out by suspending the styrene in water in reactors equipped with stirring mechanisms that produce the division of the styrene in small drops suspended in water. The reactors are covered by a refrigeration/heating sleeve that enables the internal temperature of the reactor to be regulated. During this process additives are also used for the following purposes:

- *To stabilize the suspension and regulate the diameter of the beads.*
- *As catalysers to the polymerisation reaction.*
- *For the addition of fireproof agents (for raw materials that require this characteristic).*

The polymerisation reaction is exothermic and it is developed following a defined program of temperatures, when it reaches a certain conversion rate, which varies according to the different processes, the pressurised expansion agent is introduced. When this stage concludes, a mixture of expandable polystyrene beads and water is obtained and is sent to homogenisation tanks.

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In the drying and finishing stage the abovementioned mixture is dried by air and centrifugation and is moved to a certain height to be later sieved to different bead sizes, as there is always a certain variation in the diameter of the beads obtained. The different samples are mixed with additives, generally stearates, to improve the later transformation. After intermediate storage in raw material storage containers it is packed into cardboard containers covered inside with a plastic film, although metallic containers can also be used.

The product should be conserved at a moderate temperature (lower than 20°C) to avoid the expanding agent becoming volatile.

### ***Characterizing Parameters***

- **Bead size:** The smallest products, with diameters between 0.2 and 1.0 mm are mainly used to produce packaging. The largest products (1.0 to 3.0 mm) are used for the production of thermal insulation plates.
- **Expansion potential:** The nature of the polymer, the expanding agent content and the presence of certain additives enables us to obtain products with a more accurate final density.
- **Moulding rate:** The additives and surface treatments allow products to be obtained with shorter moulding/de-moulding cycles.
- **Fireproof agents:** When necessary (e.g. construction) this raw material can be treated with fireproof additives that considerably improve its reaction to fire properties.
- **Low pentane content:** the normal content of pentane in expandable polystyrene is around 6-7%. Over the last few years, raw materials have been developed with low pentane content (4%) that are suitable for the production of medium-high density pieces and blocks and with which reductions are achieved in stabilization times and in moulding/de-moulding cycles.

The manufacturing industry continually researches new developments, which have led to the production of products in the last few years with improved insulating properties or improved behaviour with regard to water absorption.