

# HIPS

High Impact Polystyrene

Proprietary  
process technology



polimeri europa



## **POLIMERI EUROPA PRODUCTION TECHNOLOGIES NOW AVAILABLE FOR LICENSING**

### **Polimeri Europa**

Polimeri Europa – the petrochemical company of Eni – manages the production and marketing of Basic Chemicals, Polyethylene, Elastomers and Styrenics.

With its 17 production sites throughout Europe and a widespread sales network, Polimeri Europa can present itself to the intermediates, thermoplastic resins and elastomers market as a sound and comprehensive supplier whose key strength is its integration. From raw materials to production plants, from research laboratories to technology, through to the interface with the market which can turn to a single source with the certainty of finding solutions to its requirements not only in terms of products, but also in terms of assistance and service. Thanks to the definition of the e-commerce and the logistic portal express, Polimeri Europa can offer to its customers the opportunity to use their tailored made e-shopping and logistics. Saving time and money.

On the basis of its first hand experience, Polimeri Europa can also license its proprietary production technologies aiming to satisfy the even more specific customers needs.

Polimeri Europa's commitment to quality, improvement and innovation continues, as does its pledge to promote sustainable growth with regard to the community and the environment.

### **Licensing**

#### **Proprietary process technologies**

##### **Phenol and derivatives**

PBE-1 Zeolite catalyst based Cumene \*  
Phenol, Acetone, Alkylphenylstyrene \*  
Isopropyl Alcohol Acetone hydrogenation \*  
Isopropyl Alcohol to Cumene \*  
PBE-1 Zeolite catalyst  
TS-1 Titanium silicalite catalyst based Ammoxidation

##### **DMC and derivatives**

Dimethylcarbonate  
via Carbon Monoxide and Methanol \*  
Dimethylcarbonate / Diphenylcarbonate \*

##### **Polyethylene**

LDPE  
HDPE  
EVA

##### **Styrenics**

PBE-1 and PBE-2 Zeolite catalyst based Ethylbenzene  
Styrene monomer  
GPPS  
HIPS  
EPS  
ABS continuous mass polymerization  
SAN

##### **Elastomers**

e-SBR  
s-SBR  
SBS / SB / LCBR  
Polybutadiene

#### **Proprietary catalyst technologies**

Titanium silicalite  
PBE-1 Zeolite  
PBE-2 Zeolite

\* Co-licensing in cooperation with Lummus Technology

## Introduction to Polimeri Europa High Impact Polystyrene process

At the end of the 1970s, Polimeri Europa (at that time Montedison and then EniChem) started the production of high impact polystyrene (HIPS), via a continuous mass process, in two plants located in Italy and Belgium. During the following decade, the Italian plant was modified by the introduction of new equipment, designed by its R&D at the Mantova Research Centre.

Within a few years, two new units, acknowledging the improved proprietary technology developed meanwhile by Polimeri Europa R&D, were started up in Italy.

The main features of Polimeri Europa HIPS process technology are as follows:

- proprietary, accurate process and mechanical design of key equipment (reactor, devolatilizer);
- simple process scheme and easy process control;
- flexible technology allowing tailor-made solutions for specific needs, in terms of plant capacity and products portfolio range;
- minimum quantity of different external materials introduced in the process.

Even though HIPS production technology can be considered to be well established, especially in the last decades the market requirements in terms of quality and environmental impact of HIPS pushed Polimeri Europa R&D to continuously update its technology and product portfolio, by improving its key proprietary equipment and optimizing the process cycle. The results of this effort make Edistir® HIPS, with its wide products portfolio, a benchmark within the European scenario.



# TECHNICAL DATA

## Material balance and process economics for typical HIPS unit

	<i>per MT HIPS</i>
Raw materials	1,005-1,008 kg
Electricity	120 kWh
Fuel gas (10 <sup>4</sup> kcal)	15-20 kg
Steam	0-30 kg

### Process performance and economics

For all the reasons mentioned earlier, the Polimeri Europa HIPS technology minimizes the effects of raw materials and chemical impurities on the process and product structural parameters.

Assuming 99.9% styrene purity, the typical raw materials and utilities consumption per metric ton of polymer is reported in table above.

The versatility of Polimeri Europa HIPS technology makes easily possible to provide convenient solution in a broad range of capacities, from 50 to 200 kt/y. The plant arrangement can be tuned to fit required targets, such as special grades and/or peculiar product range.

### Industrial applications

Polimeri Europa HIPS units, based on proprietary technology, are on-stream in Italy (1981, 75 kt/y; 1992, 40 kt/y), in Hungary (1991, 75 kt/y), and in Belgium (1979, 80 kt/y), making Polimeri Europa one of the major European producers of high impact polystyrene. One HIPS unit (80 kt/y) licensed by Polimeri Europa is on-stream in Hong Kong since the early 1990s. A second one (70 kt/y) was started up in Brazil in 2000.



### The Edistir® HIPS product portfolio

Polimeri Europa HIPS products are characterized by a unique balance between key properties:

- very low residual monomer and oligomer content;
- very high rubber phase efficiency (reduced rubber consumption);
- minimized rubber cross-linking and polymer degradation.

The flexibility of Polimeri Europa HIPS technology allows to manufacture all main HIPS grades, suitable for the most challenging fields of application.

### Refrigeration Industry

- environmental stress cracking resistant (ESCR) grades for highly chemical-resistant inner liners;
- very high gloss grades to enhance the aesthetic properties of the internal cabinet;
- medium-impact grades combining high flowability and stiffness for injection-molded internal parts.

### Telectronic

- a wide range of grades having a very good balance among toughness, stiffness, gloss, and flowability for injection molding of technical parts, housings, and covers;
- high impact grades with good flowability and high stiffness;
- high impact grades, with good stiffness and high thermal resistance.

### Packaging

- high-performance grades for extrusion and thermoforming of disposable tumblers, flatware, cups, lids, and containers for diary products and frozen food.

### Other Applications

- high-flowability grades for very fast injection molding of toys and housewares.

## PROCESS DESCRIPTION

The Polimeri Europa HIPS technology is based on a continuous mass peroxide-initiated polymerization of styrene in a rubber-styrene solution.

Rubber, after being ground in a mill, is dissolved in styrene in a proper section and then added with chemicals in a mixing section. The mass reaction occurs in the presence of solvent, and it can begin in the same section, in a CSTR reactor.

This mixture is thus fed to the polymerization section, generally composed by a sequence of two/three plug-flow reactors; the reaction thermal profile is controlled by diathermic oil circulating inside internal coils.

The whole reaction section arrangement is selected case-by-case, in order to meet specific requirements.

At the end of reaction train, the polymer solution is sent to a devolatilizing section, under vacuum, in two stages in series.

The monomer and low-boiling compounds are removed from the polymer, which is finally sent to the pelletizing unit. The heat is provided by the diathermic oil system.

The vapor mixture, after condensation, is constantly recycled to the mixing section. Noncondensed vapors/inert gases from the vacuum system and liquid organic purge from the condensation section are recovered as fuel in a furnace, where diathermic oil for the process is heated.

### Process design advanced features

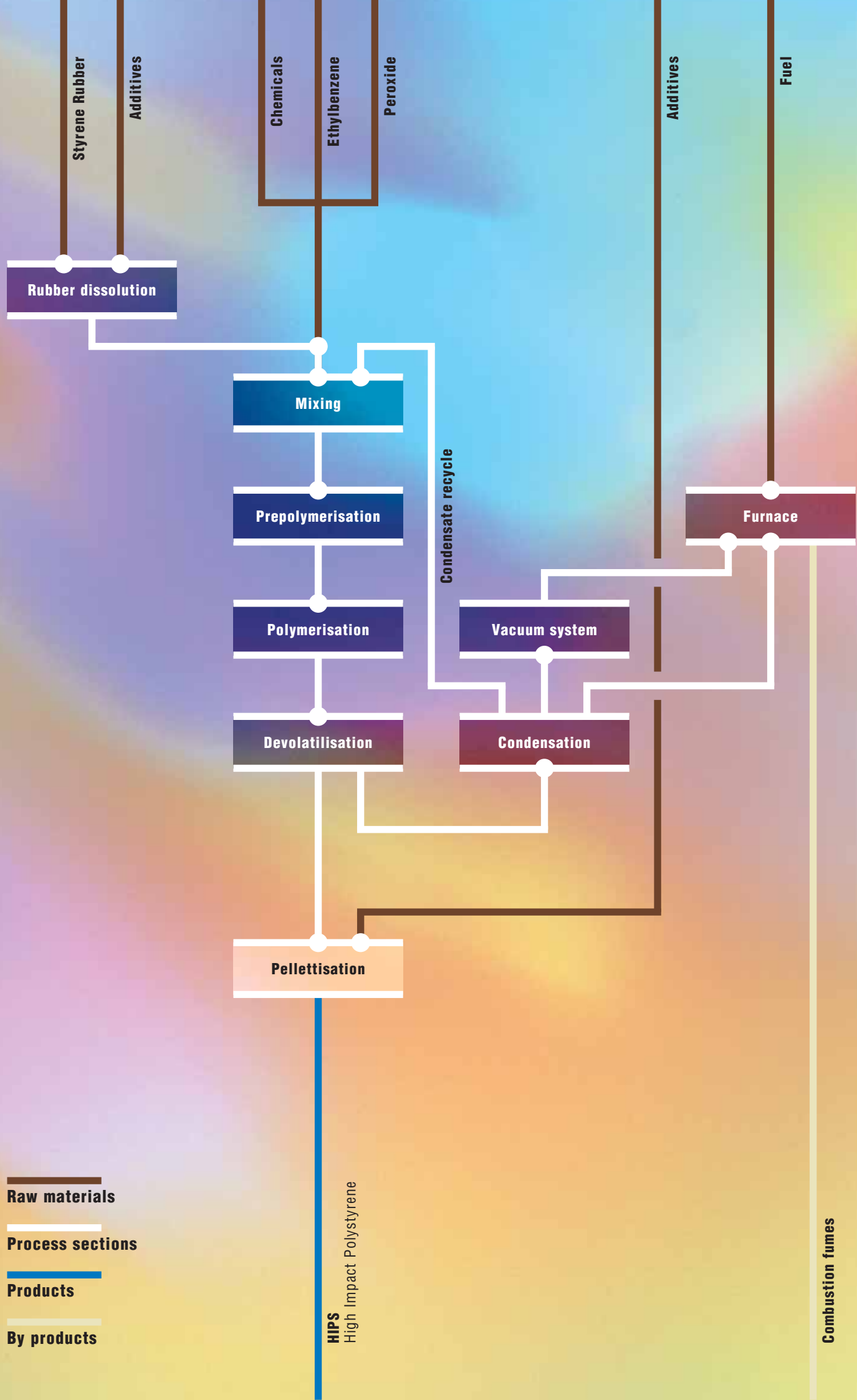
Even if the process scheme basically calls to mind the most common current technologies, the Polimeri Europa HIPS technology is unique among the producers, being provided with the following proprietary advanced design features:

#### Polymerization section

The main items are full plug-flow reactors (PFRs); thanks to agitation and a high specific thermal exchange surface area, they are characterized by very precise control of the thermal reaction profile. Any specific need in terms of product quality/portfolio can be matched by tuning reaction train arrangement, even by adding a further pre-polymerization CSTR section. In this way, it is possible to achieve maximum control of the morphology of the disperse phase, together with good efficiency of the catalytic grafting reaction. This synergy allows to optimise the balance between production rate and polymer quality.

#### Devolatilization section

This involves two-stage operation, with high heat and mass transfer rates at very low residence times. This combination of factors leads to a very efficient monomer and organic matter removal even at relatively low temperature (where polymer chain degradation and cross-linking of the rubber phase are minimized) and without the addition of water or other stripping agents.



Raw materials

Process sections

Products

By products

**HIPS**  
High Impact Polystyrene

Combustion fumes

## Polimeri Europa SpA

A subsidiary of Eni SpA  
Sole shareholder company

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