



Ethylbenzene

with proprietary catalysts
PBE-1/2 zeolite based

Proprietary
process technology



polimeri europa



POLIMERI EUROPA PRODUCTION TECHNOLOGIES FOR LICENSING

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

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.

* Co-licensing in cooperation with Lummus Technology



NOW AVAILABLE

Introduction to Polimeri Europa Ethylbenzene process

Polimeri Europa is one of the few companies that, with its proprietary zeolite based catalysts and its proprietary process technology, in today's market is in a position to offer an up-to-date and flexible EB production technology. Points of strength of Polimeri Europa technology are the high selectivity and excellent stability of PBE catalysts, along with high design capabilities, always oriented to reliability, safety and great attention to details, based also on its industrial experience as EB producer.

Polimeri Europa EB production technology, based on liquid phase, shows the following well-known advantages over Aluminium Chloride technology:

- low investment and maintenance costs because all equipment in the reaction section are in carbon steel; no need for special alloy or surface lining;
- low operating cost due to no need for washing and neutralizing the reactor effluent;
- low environmental impact because no wastewater is generated by the process and exhausted catalyst itself is a completely inert material;
- high selectivity, due to higher performances of the catalyst, resulting in high ethylbenzene purity.

In addition, Ethylbenzene PBE technology takes advantages from Polimeri Europa solid know-how and continuous activities either in process development and in zeolite catalysts development and production.

Process technology

Process technology has been developed by Polimeri Europa through a deep cooperation between researchers and technicians involved in industrial EB production at Polimeri Europa EB/styrene production site located in Mantova, Italy. Starting in the beginning of the 1990s, a huge number of different zeolite catalysts have been tested, covering a wide range of process operating conditions, for both alkylation and transalkylation reactions. Experimental activities have led to the choice of zeolite catalysts tailored for each section and to the definition of relevant best process scheme and operating conditions. A great effort also has been made in investigating catalysts deactivation due to the different possible poisons and to set up suitable pre-treatment sections, to avoid sudden losses of activity. For all these purposes, several laboratory scale pilot plants have been used, together with a large pilot plant (500 kg/h flow rate), all of them still in operation.

In addition to process development, Polimeri Europa expertise in CFD (Computational Fluid Dynamics) has been applied in the design of key equipment.

TECHNICAL DATA

Product purity and material balance

Ethylbenzene quality

Ethylbenzene

Di-ethylbenzene

Xylene

Butylbenzene

Ethylbenzene plant material balance

Benzene

Ethylene

Process economics

Ethylbenzene plant utilities consumption

Steam import (kcal equiv.)

Steam export (2.5 bar g)

Electricity

PBE type catalysts

The first catalyst developed for industrial ethylbenzene synthesis is the proprietary zeolite based PBE-1 catalyst which is equally effective for alkylation and transalkylation to EB. More recently, the new proprietary zeolite based catalyst PBE-2 has been specifically developed for industrial DEB transalkylation to EB.

PBE type catalysts show very high selectivity for alkylation and transalkylation and, above all, a very high stability, at the highest level among common zeolite based catalysts. More particularly, the preparation procedures allow optimal values for extrazeolite porosity



	99.95% wt
	10 ppm wt max
	100 ppm wt max
	200 ppm wt max
	<i>MT per MT EB</i>
	0.741
	0.265
	<i>per MT EB</i>
	0.540 MM kcal
	1,500 kg
	20 kWh

and degree of interconnectivity, which results in very high catalyst stability, with very low ethylene oligomerisation and deactivation due to coke deposition.

Polimeri Europa has also developed and experienced, for its PBE catalysts, industrial scale production and regeneration.

Up to now, hundreds of tons of PBE catalyst have been produced and loaded in industrial reactors since 1996. In addition, the proprietary catalyst regeneration procedure, which is able to prevent any catalyst modifications (such as zeolite dealumination and/or catalyst sintering) has been proven in industrial scale.

Investments estimation

A 500 kt/y ISBL Ethylbenzene unit has an estimated investment cost of 50 million Euro (NWE basis).

Wastes and emissions

The process produces no liquid wastes or vapour emissions with the exception of oily water and vacuum pumps vents. Spent catalyst can be regenerated several times and at the end of its lifetime can be disposed in a normal landfill.

The plant can be provided with a vent recovery network, for continuous and non-continuous vents, to be sent to a combustor in order to lower all the plant emissions to a practically negligible amount.

Industrial applications

The first industrial Ethylbenzene plant was a PBE type catalyst drop in case and started the operations in 2001; a second grass-root Ethylbenzene unit of 650 kt/y has been licensed by Polimeri Europa and will start up in 2005.

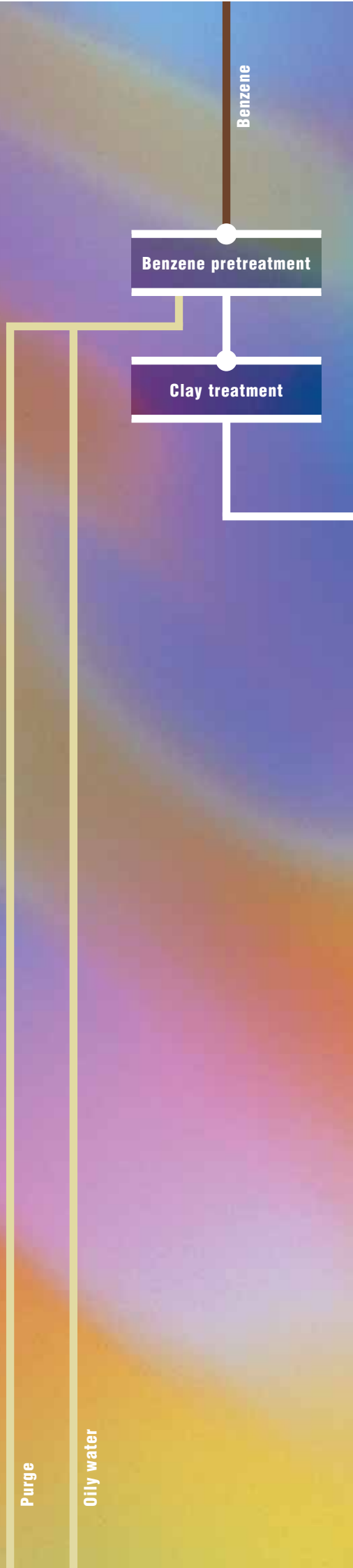
Process description

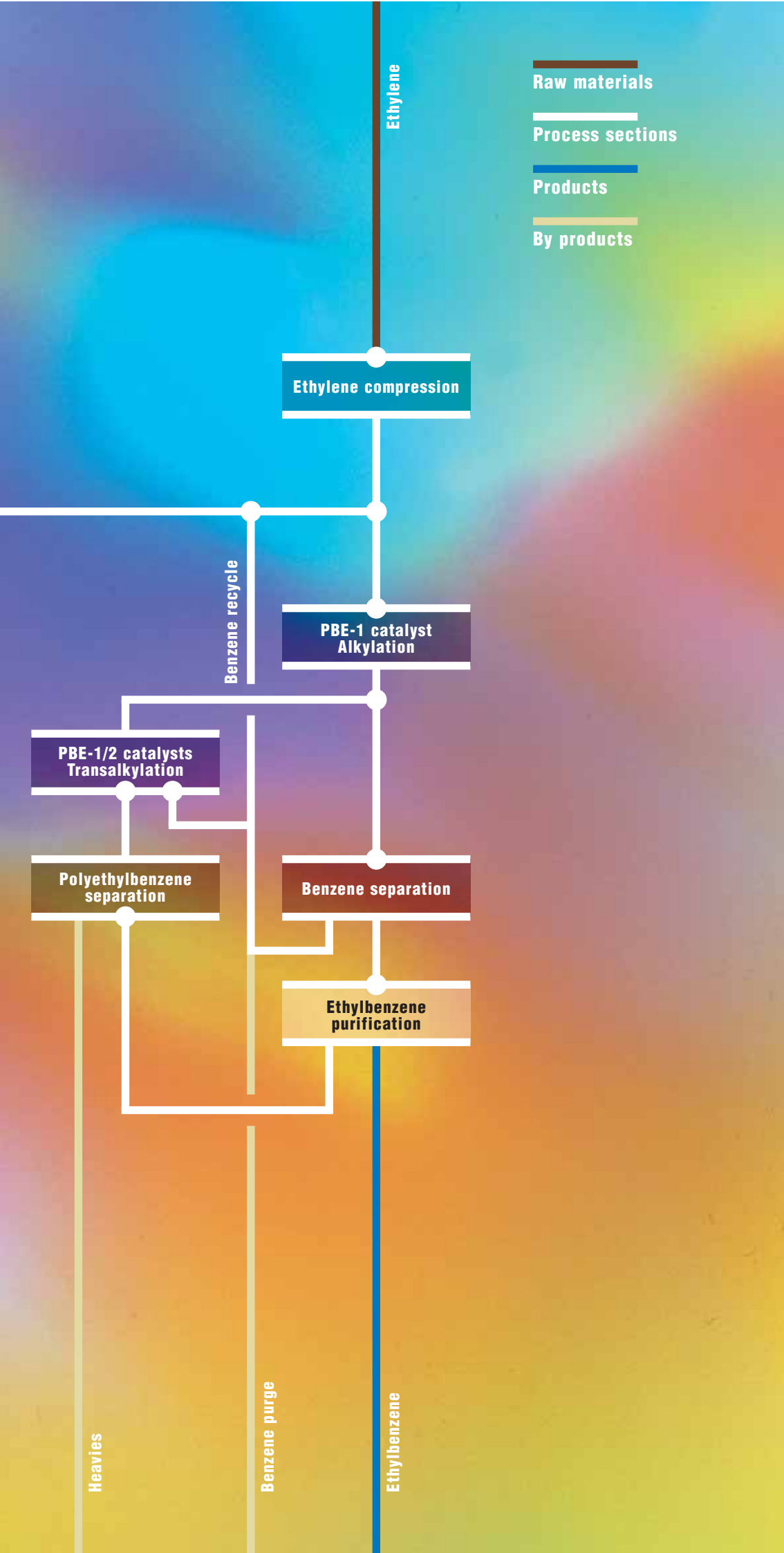
The fresh benzene feeds a pre-treatment section, where a drying column and a clay bed are used to remove oxygen and possible harmful impurities (catalyst poisons) as well as water. Then, treated benzene enters in the distillation section where is pumped to the reaction sections with recycled benzene.

In the alkylation section, the reaction of ethylene with benzene takes place in liquid phase in one or more fixed bed reactors with multibed arrangement. Due to reaction exothermicity, external intra-bed refrigerators are required, with complete heat recovery. The alkylation effluent, which consists mainly of unconverted benzene, ethylbenzene, diethylbenzene and other by-products feeds the distillation section.

In the transalkylation section, the diethylbenzene produced in the alkylation and separated in the distillation section, reacts with excess benzene to produce additional EB. The benzene/diethylbenzene mixture is first preheated and then sent to a dedicated fixed bed reactor, where the isothermal reaction takes place in liquid phase. The transalkylation effluent, which consists mainly of ethylbenzene, unreacted benzene and diethylbenzenes, and by-products such as diphenylethanes and higher boiling components, feeds the distillation section.

The distillation consists of a 3 columns train. From the first one, the benzene is removed from the top to be recycled back to reaction sections. From the top of the second column is separated pure EB. In the third column, operated under vacuum, is carried out the separation of heavier by-products. Transalkylable polyethylbenzenes (mainly diethylbenzene) are removed from the top of the column, while high boiling by-products (Flux oil) are extracted from the bottom.





Raw materials

Process sections

Products

By products

Ethylene

Ethylene compression

PBE-1 catalyst Alkylation

Benzene recycle

PBE-1/2 catalysts Transalkylation

Polyethylbenzene separation

Benzene separation

Ethylbenzene purification

Heavies

Benzene purge

Ethylbenzene

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Responsible Care



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