

**PBE-1
zeolite based**

Proprietary
catalyst



polimeri europa

POLIMERI EUROPA CATALYSTS NOW AVAILABLE FOR LICENSING AND SALES

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



General information

PBE-1 catalyst is a high-performance composite material specifically designed for industrial cumene and ethylbenzene synthesis in fixed bed reactors. PBE-1 catalyst is the result of long-term research within Eni associated with direct Polimeri Europa (former EniChem) experience in both cumene and ethylbenzene industrial production.

Applications

PBE-1 is the catalyst of choice in zeolite based Polimeri Europa Cumene and Ethylbenzene Technologies through benzene alkylation with respectively propylene and ethylene. Benzene is first alkylated with the olefin forming the monoalkylated product (cumene or ethylbenzene).

A small amount of dialkylated by-products are fully recovered in a separate transalkylation step with benzene forming additional cumene. PBE-1 catalyst is equally effective for alkylation and transalkylation reactions carried out in liquid phase as well as in mixed phase. It allows both recycle and once-through reactor mode operations. PBE-1 catalyst can effectively replace other zeolite based catalysts in both cumene and ethylbenzene applications affording superior performances in terms of lower impurities formation and higher catalyst lifetime.

PBE-1 industrial catalyst can be fully regenerated by coke burning in proper conditions without any zeolite structural damage (as proved by XRD techniques).

Up to five reaction/regeneration cycles have been tested at pilot plant scale showing unchanged catalyst structure and performances as well as stable Al state into the zeolite (as proved by Al-MAS-NMR and FT-IR spectroscopy). Both in-situ or ex-situ industrial regeneration are possible for PBE-1 catalyst. Based on an economic stand-point and thanks to the extremely long lifetime of every reaction cycle, ex-situ regeneration, which inherently allows a better control of coke burning conditions, is preferred for PBE-1 catalyst. This in turn allows industrial reactors in carbon steel with a consistent investment saving.

Main physical properties

Physical form	Extrudate
Nominal diameter	2.1 mm
ABD	500 kg/m ³

Packaging

Packed in 200 liters steel drums with internal polyethylene liner.

EXTRAZEOLITE AND ZEOLITE PROPERTIES

PBE-1 is a beta zeolite based catalyst displaying unusual and unrivalled performances in industrial cumene and ethylbenzene synthesis thanks to its unique combination of extrazeolite properties (given by binder selection and forming procedure) and zeolite properties (given by the specific features of the zeolite contained into the catalyst).

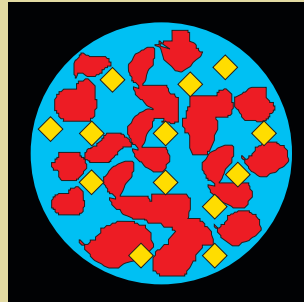


EXTRAZEOLITE

Catalyst pellet

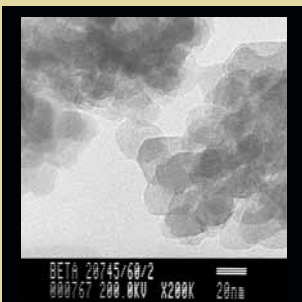


Inside catalyst pellet

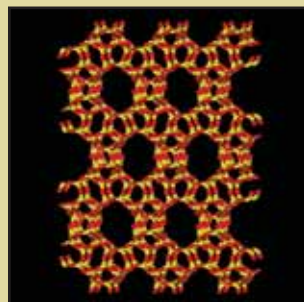


- Zeolite particle
- Binder particle
- inter-particle mesoporosity

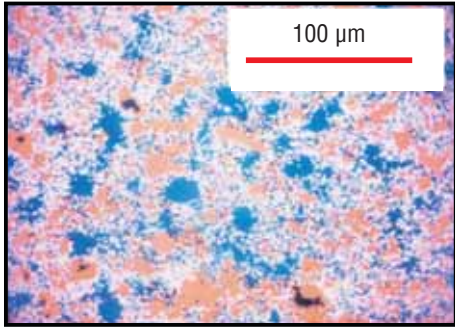
Beta Zeolite crystals



Model Beta Zeolite structure



PROPERTIES



● Zeolite and ● binder dispersion in catalyst particle

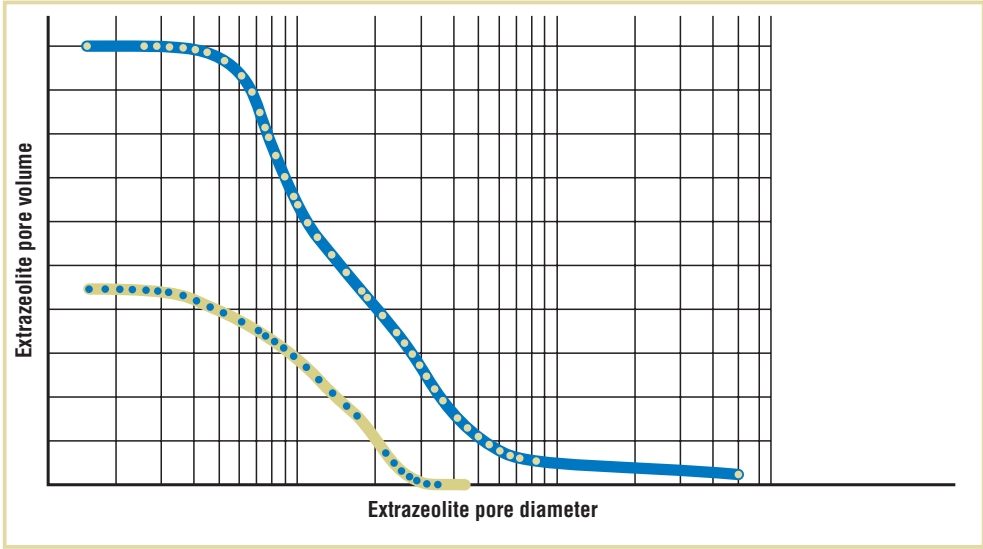
Extrazeolite porosity

PBE-1 catalyst deactivation rate is the lowest one ever seen in a zeolite based catalyst for cumene and ethylbenzene synthesis. This is due, beside to the specific features of the beta zeolite, to the extrazeolite porosity provided by the proprietary forming procedure. The resulting unusually high and well distributed extrazeolite porosity allows optimal diffusion of reactants and products through the catalyst particle, avoiding consecutive reactions responsible for coke precursors formation.

Catalyst Forming procedure

Thanks to the proprietary forming procedure beta zeolite is highly dispersed into the PBE-1 catalyst matrix giving incomparable high strength and negligible loss on attrition to the catalyst particle. Mechanical properties of the catalyst ensure very low and constant pressure drop as well as a negligible fine production during loading and unloading operations for several reaction/regeneration cycles in industrial cumene and ethylbenzene synthesis.

Extrazeolite pore size distribution



Proprietary zeolite based catalyst forming procedure

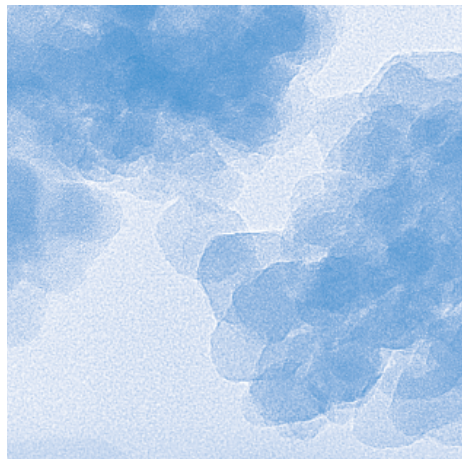
Conventional zeolite based catalyst forming procedure

ZEOLITE PROPERTIES

Zeolite morphology

Zeolite morphology is also a peculiarity of PBE-1 catalyst. The small dimension of zeolite crystals together with their uniform distribution allow faster diffusion of reactants and products into and out of the zeolite crystals leading to better performances in terms of monoalkylation selectivity as well as negligible formation of recognized coke precursors.

Zeolite crystals



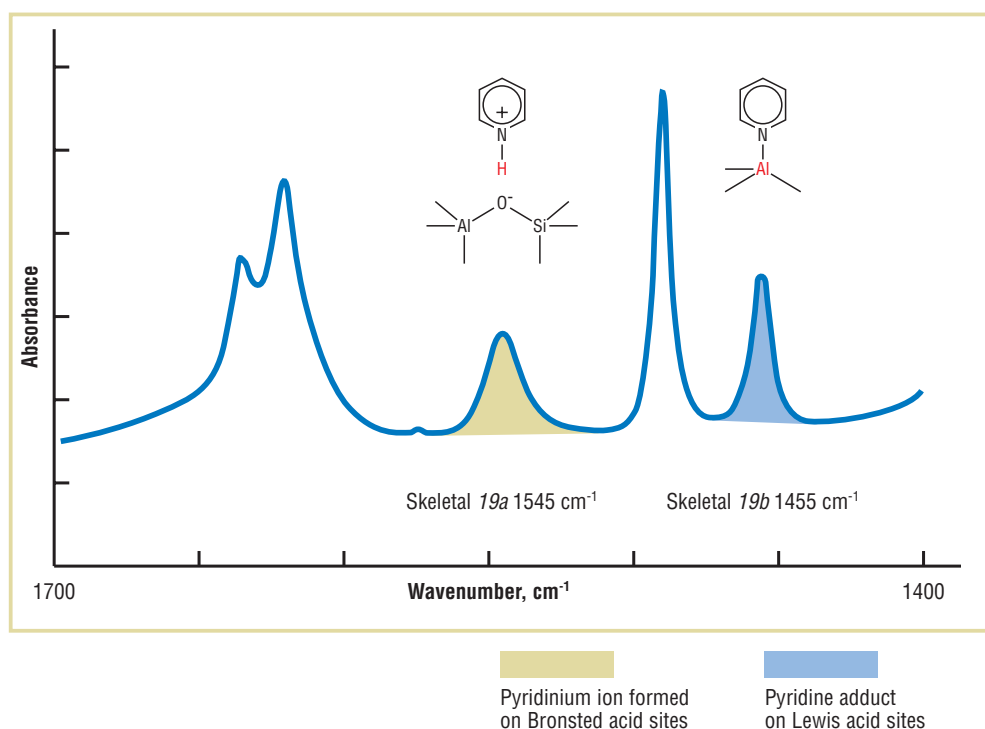


Zeolite Acidity

The overall amount of acid sites as well as their distribution between Bronsted and Lewis types into the beta zeolite (BEA) structure are peculiar in PBE-1 catalyst. The combined effects of acid sites amount and distribution leads to an unusually high activity and selectivity to cumene and ethylbenzene in both alkylation and transalkylation reactions.

These unique acid properties give to PBE-1 catalyst an incomparable tolerance to all poisons normally present in benzene and propylene feedstocks as directly proven through pilot plant experiments with doped feedstocks. Both acid sites amount and distribution in the zeolite are strictly regulated by specifications in PBE-1 catalyst production and carefully controlled by FT-IR titration after adsorption/desorption of pyridine probe molecule.

Acid sites titration by FTIR-spectroscopy of adsorbed Pyridine



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Responsible Care



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