Phenol & Acetone

Proprietary process technology

eni

polimeri europa

POLIMERI EUROPA PRODUCTION TECHNOLOGIES FOR LICENSING

Licensing

Proprietary process technologies

Phenol and derivatives
PBE-1 Zeolite catalyst based Cumene *
Phenol, Acetone, Alphamethylstyrene *
Isopropyl Alcohol Acetone hydrogenation *
Isopropyl Alcohol to Cumene *
PBE-1 Zeolite catalyst
TS-1 Titanium silicalite catalyst based Ammoximation

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

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.

NOW AVAILABLE

Introduction to Polimeri Europa Phenol & Acetone process

Polimeri Europa started a phenol plant in Mantova in the 1960s via cumene hydroperoxidation. In 1970 the plant reached the capacity of 100 kt/y, which was doubled in 1979. Today the plant has a capacity of 300 kt/y and several substantial improvements has been introduced, as the extractive distillation to improve phenol quality, the tar catalytic cracking to enhance the overall process efficiency and the use of reactors models of the oxidation and cleavage reactions to minimize by-products formation together with new mechanical design solutions aiming to approach the intrinsecally safe conditions.

A second phenol plant is run by Syndial (a subsidiary of Eni SpA) in Porto Torres since late 1960s, basically with the same cumene hydroperoxidation technology of Mantova plant, however, in a few sections with different technological applications, as the extractive distillation in the acetone purification.
The Porto Torres plant in 2000 was revamped to 180 kt/y, exploiting the oxidation and cleavage reactors models and introducing in each section the most efficient technology obtained from Porto Torres and Mantova experience.

The knowledge so acquired allows Polimeri Europa to make flexible and advanced technological proposals to build new phenol plants and to revamp the existing ones with the following process features:

- very low raw material consumption (only 1.330 kg per kg of phenol);
- high phenol purity more than 99,99% wt (both phenol and acetone are suitable for bisphenol A – polycarbonate grade applications);
- proprietary intrinsecally safe low-medium pressure oxidation reactors (designed to enhance selectivity to CHP and to minimize reactor volume);
- proprietary cleavage reactors with very low CHP hold up (designed to ensure low selectivity to impurities);
- very low CHP hold up in concentration section;
- no external effluent treatment required apart from water;
- operating experience of a more than 40 years phenol producer is made available to be transferred with proper training to licensees.

Any licensee of the Polimeri Europa Phenol & Acetone process technology can enjoy the unmatchable synergy of the Polimeri Europa cumene process technology based on proprietary PBE-1 zeolite based catalyst.

TECHNICAL DATA

Product purity and material balance

Pure – Hyper pure Phenol quality
Phenol (dry)
Water
Alphamethylstyrene
Total organic impurities (no cresols)
Cresols

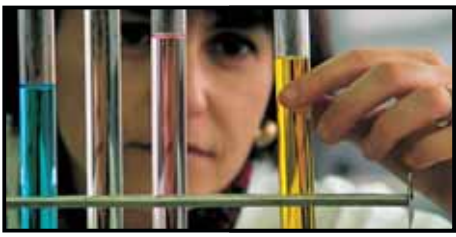
Acetone quality
Acetone (dry)
Water
Benzene
Methanol
Permanganate test

Phenol plant material balance
Raw materials
Cumene
Minor chemicals
Product
Phenol
By products
Acetone
Heavies
Process water

Process economics

Phenol plant utilities consumption
Steam import (18 bar g)
Steam import (5 bar g)
Cooling water
Electricity

(1) Hyper pure phenol requires 2,670 kg



99.96-99.99% wt min	
300 ppm wt max	
100-10 ppm wt max	
200-60 ppm wt max	
120-60 ppm wt max	
99.8% wt min	
0.2% wt max	
10 ppm wt max	
200 ppm wt max	
180 min min	
MT per MT Phenol	
1.309	
0.019	
1.000	
0.626	
0.053	
0.493	
per MT Phenol	
1,900 kg [1]	
880 kg [2]	
250 m^3	
190 kWh	

[2] Hyper pure phenol requires 410 kg

Investments estimation

A 200 kt/y ISBL phenol unit has an estimated investment cost of 120 million Euro (NWE basis).

Wastes and emissions

The process produces liquid wastes as the process water with organics and salts content (normal bio-treatment is suitable) and heavy organics that can be sent to a power station or to an incinerator.
The plant emissions are mainly from the cumene oxidation section as exhaust air (an activated carbon recovery treatment of organics allows the controlled discharge to atmosphere); minor emissions are from the vacuum pumps and the plant can be provided with a vent recovery network, for continuous and non-continuous vents, connected to a combustor in order to lower all the plant emissions to a negligible amount.

Industrial applications

In 1995 a phenol plant in East Germany was revamped from 60 to 160 kt/y.
In 2000 the Syndial Porto Torres plant has been revamped from 100 to 180 kt/y.
The Polimeri Europa Mantova plant is operating at a 300 kt/y capacity.

Process description

Cumene Oxidation to Cumene Hydroperoxide

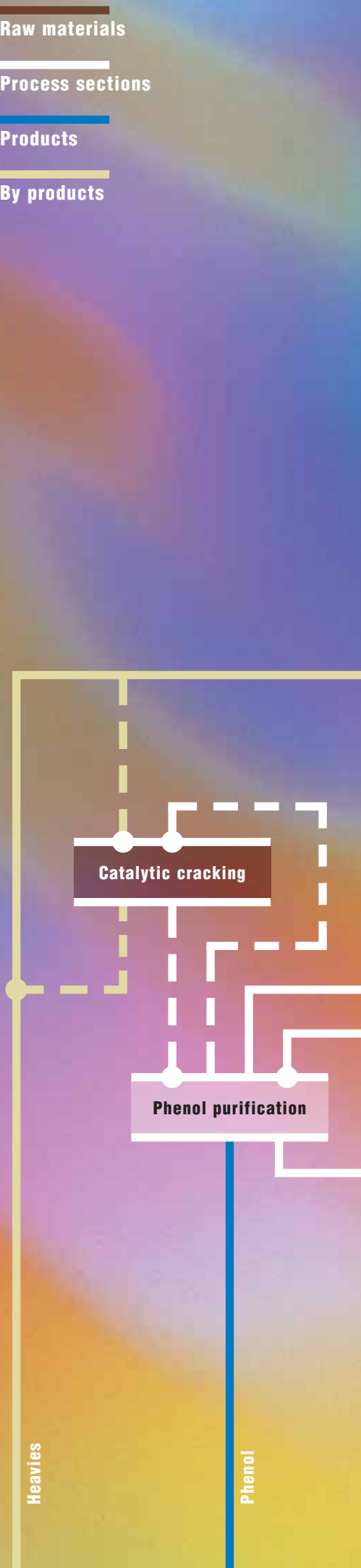
The cumene oxidation is in liquid phase with air at medium pressure and temperature around 100°C. It is a free radical chain reaction, initiated by the presence of small amounts of CHP. The by-products production, like dimethylphenylcarbinol, acetophenone, dicumylperoxide, methanol, formic and acetic acids, is enhanced with CHP concentration and temperature increases, therefore these two parameters are carefully controlled and optimisation criteria are employed in order to maximise CHP selectivity in the proprietary natural recyrculation reactors.
The acidity is neutralised to avoid CHP cleavage and phenol formation even in limited concentration (tenths of ppm), which would trap the radicals and reduce the oxidation efficiency.

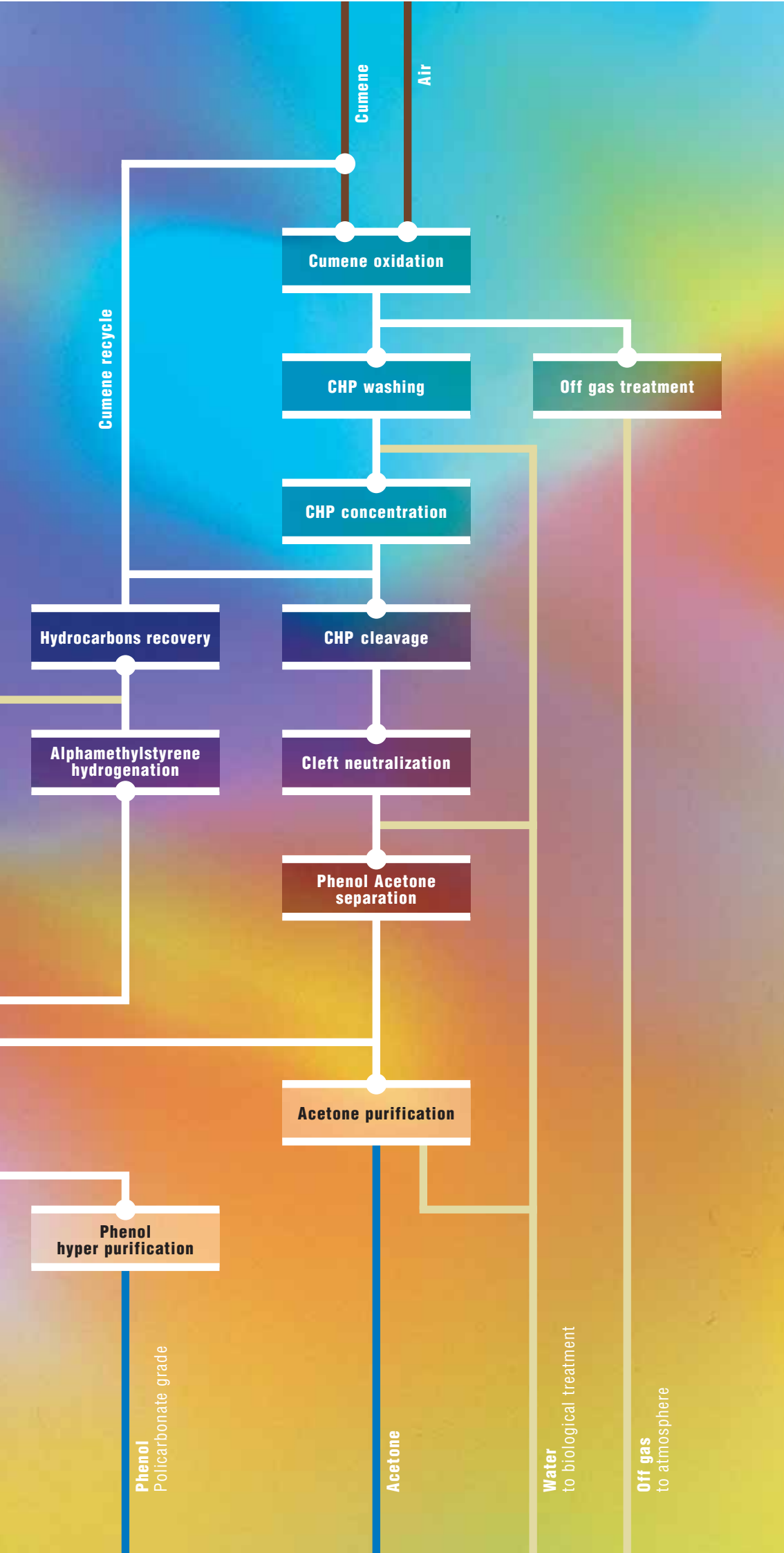
Cumene Hydroperoxide Concentration and Cleavage to Phenol & Acetone

After the CHP concentration section designed with few pump needs and very low CHP hold up, the solution is cleft in presence of small amount of acid catalyst to give phenol and acetone at temperature around 60°C.
Beside the main reaction, other side reactions occurr such as cleavage of dicumylperoxide, the dehydration of dimethylphenylcarbinol to alphamethylstyrene, the addition of dimethylphenylcarbinol to phenol to form cumylphenol, the coupling and dehydration of acetone to mesityloxide. The reaction parameters, like temperature, acid, water concentration and residence time, have to be well controlled with the aid of proprietary reactor models, to maximise the reaction efficiency.

Distillation section

After neutralisation of the cleft product, acetone and phenol are purified in separate sections, by phisical and extractive distillation. Alphamethylstyrene can be purified or recycled via hydrogenation to cumene.
High capacity phenol plants/lines (200 kt/y) can be implemented with a catalytic cracking section in order to minimize the amount of heavies produced.




Cumene
Air
Cumene oxidation
Cumene recycle
CHP washing
Off gas treatment
CHP concentration
Hydrocarbons recovery
CHP cleavage
Alphamethylstyrene hydrogenation
Cleft neutralization
Phenol Acetone separation
Acetone purification
Phenol hyper purification
Phenol
Policarbonate grade
Acetone
Water
to biological treatment
Off gas
to atmosphere

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Responsible Care

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