

Proprietary process technology

XSBR

Carboxylated Styrene Butadiene Rubber latex





Versalis proprietary process technologies available for licensing



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Our company

Versalis - the petrochemical subsidiary of Eni - is a dynamic player in its industry sector facing the multifold market needs through different skills.

With a history as European manufacturer with more than 50 years of operating experience, Versalis stands as a complete, reliable and now global supplier in the basic chemicals, intermediates, plastics and elastomers market with a widespread sales network.

Relying on continuous development in its production plants as well as in its products, strengthening the management of the knowledge gained through its long industrial experience, Versalis has become a worldwide licensor of its proprietary technologies and proprietary catalysts. The strong integration between R&D, Technology and Engineering departments, as well as a deep market expertise, are the key strengths for finding answers to customers requirements.

Our commitment to excellence, in quality of our products and services, makes our company an active partner for the growth of customers involved in petrochemical business.

Through engineering services, technical assistance, marketing support and continuous innovation, our knowledge is the key strength to customize any new project throughout all phases.

Customers can rely on this strong service-oriented outlook and benefit from a product portfolio that strikes a perfect balance of processability and mechanical properties, performance and eco-friendliness.

Introduction to Versalis XSBR technology

Styrene-butadiene carboxylated latices are among the most worldwide used elastomers, employed in a large variety of applications which significantly contribute to our standards of living as well as in enhancing our quality of life.

The range of products achievable by the Versalis proprietary technology covers some fields of application like paper industry (sheet offset, web offset and board), adhesive, textile (felts and backcarpet) and synthetic grass backing.

Key features of Versalis XSBR production technology are:

- process design advanced features in polymerization, stripping and blending sections;
- great attention to environmental issues in design of each process stage;
- wide range of products grades coupled with a real process know-how which enables meeting the specific needs of the customer.

Versalis can always provide appropriate solutions to different client's needs thanks to its capabilities and experience in the following fields:

Research & Development

The presence of a strong R&D team, established in Ravenna since the early 70s, qualifies Versalis as an outstanding owner of know-how in the field of elastomers. Reliable and updated facilities (pilot plants, synthesis and analytical labs, equipment for elastomer

processing), allow Versalis to continuously up-to-date the technology in order to support the elastomers business in a very competitive and demanding market scenario. Additional services are then available for potential licensees, such as technical assistance, training, development of analytical methods, site assistance for start-up and follow up, development of tailor made products on demand.

Process design & operational experience

Process design is flexible and able to face different conditions and constraints. Any project is individually evaluated to offer the best solution, tailored to specific customers needs. Thermal and fluidodynamic analysis (CFD) can be applied to the design of key equipment, such as reactors and agitators.

The design takes also advantage of the Versalis' long-term manufacturing experience. New technological solutions are first tested in production plants and the acquired experience transferred to the licensed technology, in order to reach not only the best process performances, but also a safe and reliable plant arrangement.

Mechanical design

Versalis Engineering Dept. has been working in close coordination with the Process Dept. since a long time. This fact has allowed to develop unique and well sound engineering solutions for critical equipment, that guarantee the best results in terms of mechanical reliability and process performances.



Versalis XSBR technology allows to provide a fairly broad range of economically feasible capacities: up to 10 kt/y per reaction unit with a plant size that can be freely adjusted simply increasing the number of slots up to 30, 50 or more kt/y capacity.

Wastes and emissions

Due to the high monomers conversion (>99%) the XSBR Plant does not require any recovery section. If the XSBR Plant is close to an e-SBR Plant (emulsion Styrene Butadiene Rubber), unreacted monomers can be recycled to this Plant to be blended with the

monomers mixfeed to reactors. In case of stand alone Plant, unreacted monomers are stored to be sent OSBL to disposal. Process vents are collected and sent to flare or other OSBL systems.

Industrial applications

Versalis owns XSBR production facilities in its production site of Ravenna (Italy) with a capacity of 32 kt/y (dry base). The plant started first production of XSBR polymers in 1981 and was then continuously modified and the capacity was improved up to the present capacity.

Main process parameters

	per MT of dry XSBR
Raw Materials (Butadiene, Styrene, Acrylates)	950-1,010 kg
Electricity	0.2 MWh
Low pressure steam	1.8 MT
Demi water	3.5 m ³

The Europrene® XSBR latices portfolio

Versalis XSBR technology is able to manufacture many grades of polymers through a hot emulsion polymerization process. Fields of application are primarily in the coating paper industry (sheet offset, web offset and board printing paper) and in the textile industry (carpets, thermoforming, footwear tips and felts). Also important are the paper impregnation for masking tapes, adhesives and synthetic grass fields.

Changing the polymer composition (% of styrene, butadiene and other acrylic monomers) and different

surfactant mixture, is possible to obtain latices of:

- different polymer transition temperature (T_g) from very soft to very hard;
- different particle dimensions;
- different colloidal stability;
- different field of application (from textile to paper coating).

Versalis XSBR latices are mid viscosity latexes (100+1000 mPa*s) with a solid content of about 50%.



Process description

The XSBR latexes (styrene-butadiene carboxylated latexes, also known as 'CBX') process is based on an emulsion polymerization reaction in semibatch ('seed polymerization') reactors. The monomers are 1,3 butadiene, styrene, acrylonitrile (in some cases) and small amounts of acrylic co-monomers that confer adhesive properties to the product (acrylamide and acrylic acid). Emulsion polymerization process involves free radical reactions with unsaturated monomers. Free radical polymerization is carried out in a heterogeneous emulsion process.

The final product looks like a white liquid that can be identified as a suspension in water (ca. 50%) of the polymer emulsion. Acrylic monomers (acrylic acid, acrylamide and acrylonitrile) are received from OSBL and stored in dedicated tanks installed into a thermostatic building to prevent freezing or overheating of the monomers. Preparation/feeding tanks and equipment for the preparation of water solutions of acrylic mixtures are also placed in this thermostatic room. Surfactants are stored in dedicated tanks from which the chemicals are sent to the preparation/feeding area.

The semibatch polymerization reactions are carried out in stainless steel reactors equipped with agitator and a heating/cooling system (jacket, internal coils) which uses alternatively chilled water, cooling water or steam to control the temperature in the various stages of reaction. After the polymerization, the monomers conversion is approx. 99%. Latex is transferred into a stripping column for the recovery of unreacted monomers.

The reactor immediately starts a new cycle of production. The batch stripping is performed in vessels which runs under vacuum to remove the residual monomers. A condenser on the top of the stripping column allows to recover unreacted monomers (mainly styrene) and process water.

Latex, quite free of residual monomers, is transferred from the bottom of the stripping column to the storage tanks. Storage tanks are fitted with vertical agitator to mix latex with additives and antibacterial agents added in this phase. To prevent the presence of coagulum in the finished product, latex is pumped to a set of vibrating screens which remove large part of the solid particles.

After this mechanical screening, latex is stored in dedicated plastic storage tanks, ready to shipping. Due to their specific end-uses, the latexes could require a second stage of filtration.

Versalis strongly believes that its XSBR emulsion technology is capable of achieving the following tasks:

- reasonable capital investment costs;
- sustainable variable and maintenance costs;
- high monomers yield;
- low utilities requirements;
- low environmental impact;
- good quality constancy and reproducibility;
- high reliable assembly;
- high flexibility in terms of product mix.

Process design advanced features

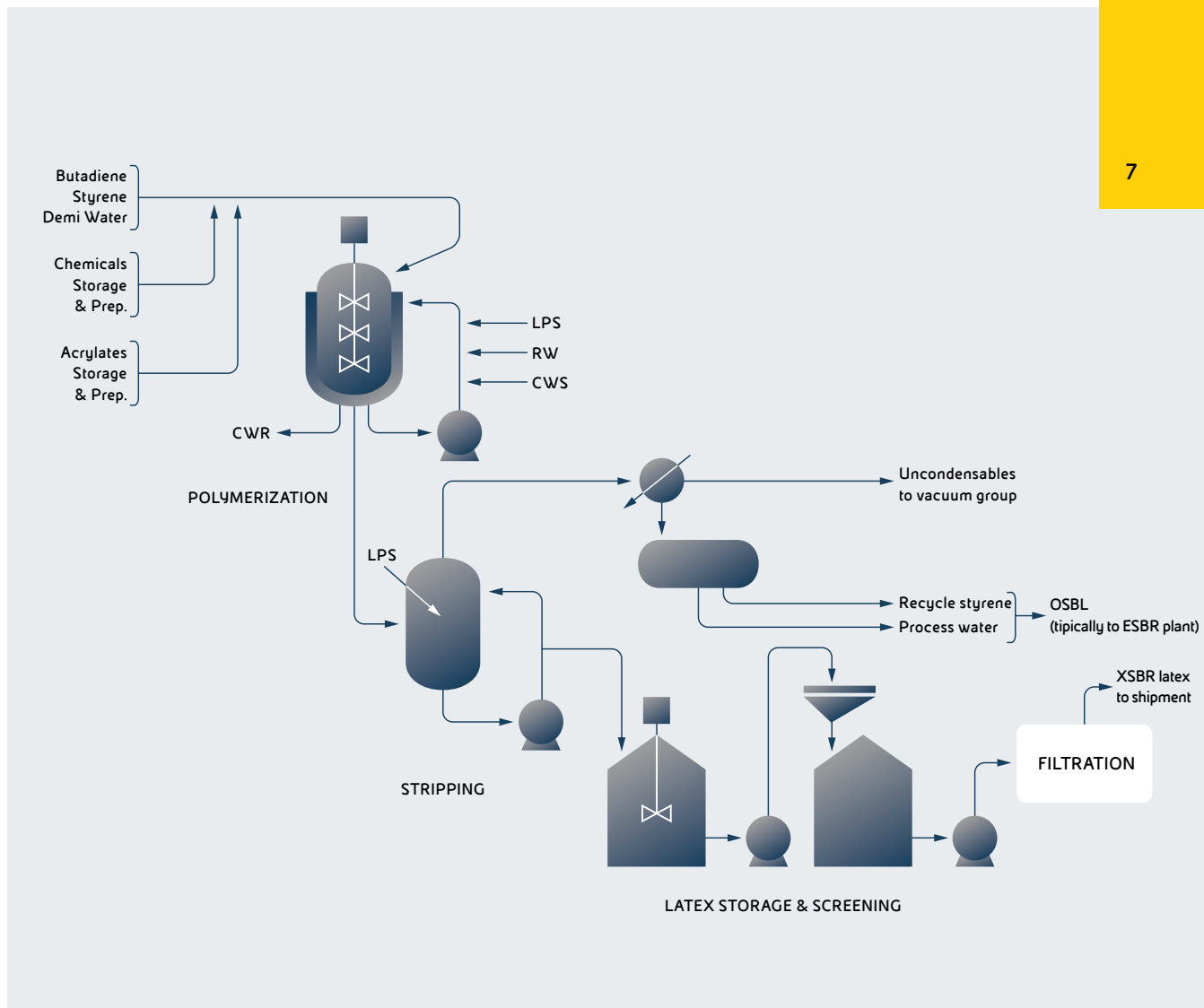
- The plant configuration is very compact; the plant size can be tailored by increasing the number of polymerization trains (each train, based on a reactor and a stripper, is able to produce up to 10 kt/y of product on dry base - about 20 kt/y of latex).
- If the XSBR Plant is integrated with an e-SBR Plant, very interesting synergies can be achieved: unreacted monomers can be recycled to the e-SBR Plant, monomers run tanks and waste water pre-treatment can be shared, many chemicals storage tanks are also shared, with a significant cost saving.
- Semibatch polymerization allows to better control the reactors temp rise and the quality of the latex is enhanced;
- High reliability and less downtime due to design of heating/cooling system (reactors internal coils, jacket and agitation).





fig.1

XSBR • process scheme



Proprietary process technologies portfolio

Biotech

PROESA® 2G Ethanol and Cellulosic Sugars

Phenol and derivatives

Cumene (with PBE-1 zeolite based proprietary catalyst)*
Phenol, Acetone, Alkylphenylstyrene*
High selectivity Cyclohexanone
Acetone hydrogenation to Isopropyl Alcohol*
Isopropyl Alcohol to Cumene**
Ammoximation (with Titanium silicalite based proprietary catalyst TS-1)

DMC and derivatives

Dimethylcarbonate (via Carbon Monoxide and Methanol)*
Diphenylcarbonate*

Proprietary catalysts

Titanium silicalite
PBE-1 Zeolite
PBE-2 Zeolite

Styrenics

Ethylbenzene (with PBE-1 and PBE-2 zeolite based proprietary catalyst)
Styrene
GPPS
HIPS
EPS suspension polymerization
ABS continuous mass polymerization
SAN

Polyethylene

LDPE
EVA

Elastomers

Emulsion-SBR
HSL Latices
Solution-SBR
TPR
LCBR
HCBR
NBR
Carboxylated latices
EP(D)M

* Co-licensing in cooperation with Lummus Technology (a McDermott International Company).

** Close to commercialization.





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