

Desmet Ballestra Detergents, Surfactants, Soap & Chemicals

Alkoxylation Technology

State of the Art Plants for Production of Nonionic Surfactants



Detergents
Surfactants
Soap &
Chemicals

desmet ballestra

Science behind Technology

www.desmetballestra.com

DBI Detergents & Surfactants Activities



Since its foundation in 1960, Desmet Ballestra SpA has been the global leader in the design and supply of Chemical plants for the production of detergents and surfactands.

Desmet Ballestra is the technology supplier of all major surfactant and detergent manufacturers worldwide. During the course of its 50 years history, the company has implemented more than 1600 plants in more than 120 countries, making Desmet Ballestra the benchmark brand in the supply of technologies for the detergent and surfactant and industry:

- Sulphonation plants up to 200,000 t/year capacity
- Spray dry towers up to 250,000 t/year capacity
- Alkoxylation plants up to 200,000 t/year capacity

The mission of Desmet Ballestra is to build stable, long-term relationships with its customers offering a full range of services and technical support so to enable them to face the increasing challenges of the today's surfactant industry.

To this aim Desmet Ballestra is in the position to offer to its customers:

- Availability of modern, efficient pilot plant facilities in which to test new raw materials, verify performances and apply the findings to industrial-scale plants with minimal cost

- A very efficient Spare Parts department structured to answer in real time to the customer needs minimizing maintenance cost and production losses
- A dedicated Technical Assistance department structured to assist customers in troubleshooting evaluation of plant performances, preparation of plant maintenance plans, personnel training and studies for plant revamping and technological updating

The integration of Ballestra in the Desmet Ballestra Group has substantially enhanced the Ballestra presence in the world markets and its capability to offer cost competitive plants with a strong local back-up management.

Resources and capabilities

- 300 managers, engineers and qualified personnel
- R&D Centre with laboratories and full scale pilot plants
- ISO 9000 Certification
- Capability to manage up to 300,000 engineering hours per year
- 3-D computer design
- Capability to supply all the range of services from feasibility studies to turn-key projects
- Global sourcing of equipment and materials
- Project financing



Alkoxylation Technology

Science behind Technology

www.desmetballestra.com

State of the Art Alkoxylation Technology



Desmet Ballestra has developed, over decades of experience, safe, cost effective, flexible know-how for the design and supply of alkoxylation plants for the production of non-ionic surfactants using all main raw materials as:

- Fatty alcohol
- Nonylphenols
- Fatty amines
- Fatty acids
- Alkyl-amides
- Castor oil
- Glycerides

Desmet Ballestra know-how covers the design and operation of the alkoxylation plant from the ethylene and propylene oxide handling up to the final products flaking and finishing.

The alkoxyated products can contain in the molecule a number of moles of ethylene oxide and/or propylene oxide ranging from one to hundreds. These are used for a wide range of application such as:

- Detergent and cosmetic industry
- Fiber treatment
- Wastewater treatment
- Leather industry
- Oil drilling and recovery
- Industrial lubrication
- Textile auxiliaries
- Polymerization aids

Desmet Ballestra also offers extensive know-how on products formulation, application and marketing.

Desmet Ballestra technology has been applied in several plants installed worldwide, some in operation since more than 20 years.

Alkoxylation capacity of the plants ranges from pilot plant size up to more than 200,000 Tons per year.

Layout of the plant can be optimized to meet specific client requirements.

Desmet Ballestra S.p.A is also able to offer customized and optimized designs for preassembled and skid-mounted plants, aimed to cost effective and time saving solutions.

“Enhanced Loop Reactor” Technology

The “Enhanced Loop Reactor”, is the most advanced reaction system for alkoxylation processes.

Thanks to the newly conceived double-acting gas-liquid mass transfer, the new “Enhanced Loop Reactor” features several outstanding advantages and better cost effectiveness with respect to the other technologies available on the market.

The reactor is equipped with one or two external circulation loops (depending on production requirements), provided with heat exchangers for reaction heat removal and temperature control.

The circulation through the two loops can be started separately. One of these loops is designed to start-up batches with a small amount of chain starter, making it possible to attain a very high growth ratio (up to 1:80) in a single operation cycle.

This allows to extend the production mix, avoiding dedicated intermediate storages, to improve the final product quality and to reduce production time of high molecular weight adducts.

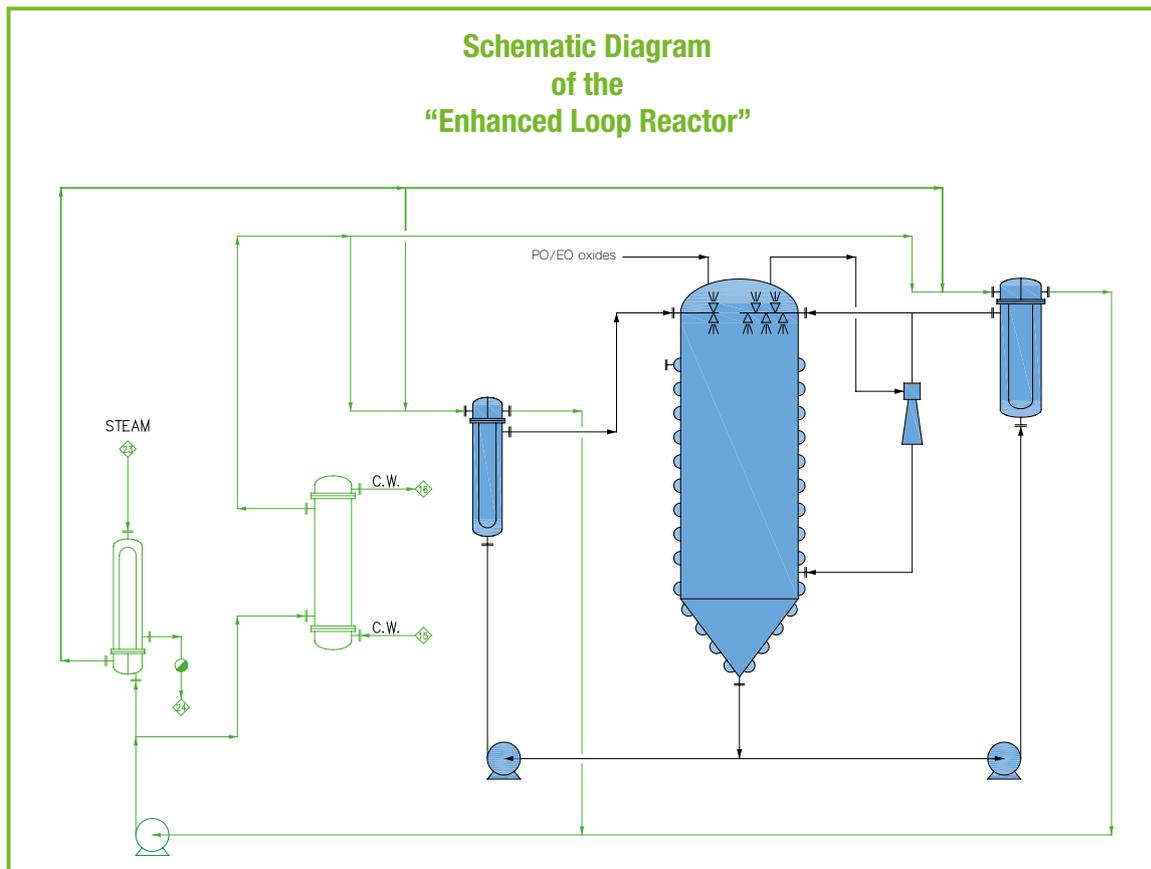
EO/PO addition is performed by spraying the oxides in the gas phase in the upper portion of the reactor in order to avoid any possibility of backflow of the catalyzed liquid reaction mixture to the storage tanks of the ethylene and propylene oxides.

EO/PO mass transfer in the liquid phase takes place by means of a very efficient double acting system both in the upper zone of the reactor, where the recirculated liquid is sprayed in the atmosphere rich of EO/PO, and in the lower zone of the reactor, where a special gas-liquid mixer injects the atmosphere rich of ethylene/propylene oxide from the top of the reactor, so that the absorption and reaction of the alkylene oxides is carried out in either the higher zone or the lower zone of the reactor.

The entire process, from the charge of raw material and catalyst to final product neutralization, can be efficiently carried out inside the reactor, without the need for pre-treatment and post-treatment units.



“Enhanced Loop Reactor” Technology



Enhanced Loop Reactor distinctive features

- Circulation system by means of pumps with high flow rates and efficient agitation through a gas-liquid mixer that allows a high homogeneity of reaction mass and accurate temperature control
- Low operating pressure due to the extremely high efficiency of the double acting mass transfer
- Very high reaction rates ($>1,000 \text{ Kg EO/h/m}^3$)
- Largely sized cooling circuit that permits to have at any time a remarkable allowance over the generated heat of reaction
- Highest production flexibility with the ability to manufacture high growth ratio products (up to 1:80) in a single step
- Very fast post-reaction phase with reduction of EO amount in the final product to less than 1 ppm, without the need for vacuum stripping
- Reaction of vertical type, volume of the reaction circuits reduced at minimum, elimination of dead zones, that makes fast and easy the drainage and cleaning limiting the need for washing only for production switch between different product families
- Manufacture of high-quality products with a very low content of impurities and byproducts

“Enhanced Loop Reactor” Technology

Safety of operation

“Enhanced Loop Reactor” technology is characterized by inherent safety features which renders hazardous conditions very unlikely:

- No rotating or moving parts in contact with the alkylene oxides in the gaseous phase, thereby avoiding the risk of hot spots or electrostatic charges formation
- Alkylene oxides feed in the gaseous phase, excluding any possibility of the extremely dangerous backflow of catalyzed liquid in ethylene and propylene oxide storage tanks, even if the protective systems preventing the backflow aren't operating or are misoperating
- Continuously washed gaseous phase and fully wetted reactor walls in order to avoid oxides accumulation in the vapour phase as well as the formation of hot spots



Ancillary Units

ETHYLENE OXIDE STORAGE & HANDLING

Unloading

All the operations of ethylene oxide unloading from road tanker or rail tanker are performed by means of centrifugal-type pumps in order to minimize the venting of the ethylene oxide storage tank during the transfer operation.

Storage

The ethylene oxide storage tanks are pressurized with nitrogen to maintain the EO vapour space in the non-decomposable region by controlling pressure and temperature.

Transfer

The transfer of ethylene oxide to the reactor is made by means of centrifugal-type pumps.

Ethylene oxide feeding is made under mass-flow control and its dosing rate is accurately controlled through the measurement of pressure and temperature inside the reactor.

EFFICIENT EXHAUST GAS TREATMENT

Desmet Ballestra has developed a safe, efficient gas scrubber system specifically designed to cope with the most stringent environmental regulations, thus ensuring the control of gas emissions even in the event of an emergency.

“Conventional Stirred Reactor” Technology

Enhanced Loop Reactor technology is the first choice for making the vast majority of ethylene and propylene oxide derivatives, having tangible advantages in terms of capital and operating costs, safety and product quality. However conventional stirred reactor technology is still the right solution for applications where it is necessary to carry out alkoxylation reaction on viscous liquids or on slurries with high solid content.

The Desmet Ballestra stirred reactor technology allows the production of the widest range of alkoxyated products thanks to the special design of its reactor.

It has been applied in several plants installed worldwide, with up to 12 reactors operating in parallel and making different products.

Considerable effort has been paid to improve the safe operation of stirred ethoxylation reactors by adopting the most appropriate process and design solutions.



Detergents
Surfactants
Soap &
Chemicals

desmet ballestra

— Alkoxylation Technology —

Science behind Technology

www.desmetballestra.com

Active Safety

The control of the process parameters and the overall safety of the plant operation are accomplished by:

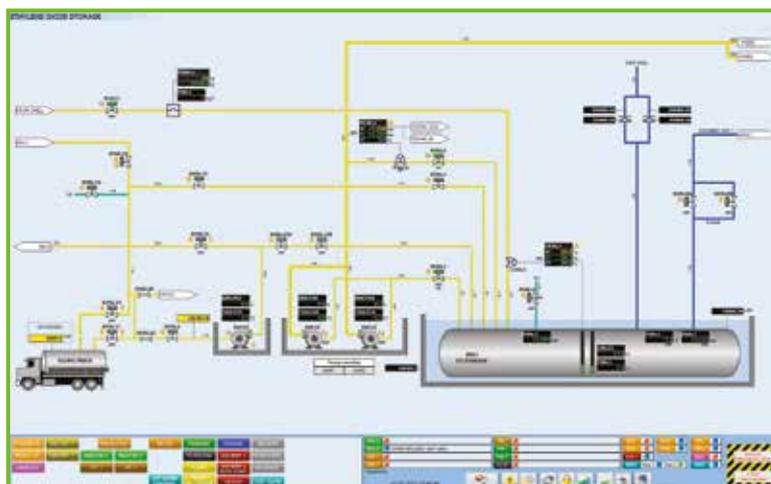
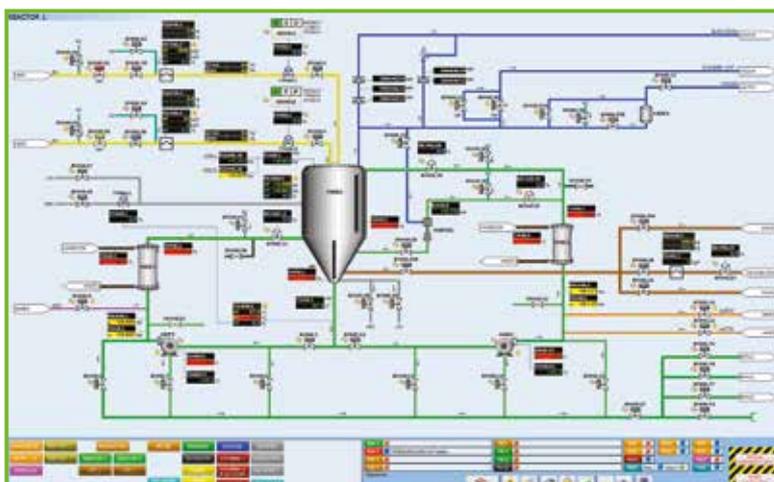
- Extended field-instrumentation for continuous measurement of operating conditions.
- Extended and redundant instrumentation designed to cope with any potentially hazardous situation.
- Dedicated “control philosophy” and configuration flexibility of the Computer Control System.
- Independent fail-safe PLC processor used as ESD to manage the critical interlocks.
- Efficient and extended fire-fighting network.
- Ethylene oxide gas detectors in the critical points of the plant and relevant alarm system.

The process instrumentation is critical to obtain safe and reproducible plant operation.

Process instrumentation is interfaced with a dedicated computer control system capable to log all the data coming from the plant and to provide close control to maintain the pre-set operating figures.

The system’s hardware and software are specially conceived to offer flexibility and wide range of configuration possibilities (i.e.: product recipes, sequence and timing of batch steps etc.).

Both hardware and software can be developed according to specific request in order to be compatible with the systems that may be already available at the client’s site.



Alkoxylation Plants References List

ENHANCED LOOP REACTOR TECHNOLOGY

Company	Country	Status	Capacity
NICCA Chemical	Japan	in operation	10 t/batch
Tianjin Angel Chemical	China	in operation	12 t/batch
Zavod Sintanolov	Russia	in operation	8 t/batch
Erca/Emery	Netherland	in operation	2 x 15 t/batch
Shandong Haoda Chemicals	China	in operation	3 x 28 t/batch
Jangsu Sailboat Petrochemical	China	in operation	3 x 28 t/batch

CONVENTIONAL ALKOXYLATION PLANTS

Company	Country	Status	Capacity
Shanghai Surfactants Co.	China	shut-down	9,000 t/y
DAC	Italy	shut-down	50,000 t/y
Nanjing Surfactants	China	in operation	18,000 t/y
Sasol Chimica	Italy	in operation	80,000 t/y
Arak Petrochemical	Iran	in operation	30,000 t/y
Lanitex	Russia	shut-down	30,000 t/y
PCC Exol SA	Polonia	under construction	6,000 t/y



Detergents
Surfactants
Soap &
Chemicals

desmet ballestra

— Alkoxylation Technology —

Science behind Technology

www.desmetballestra.com

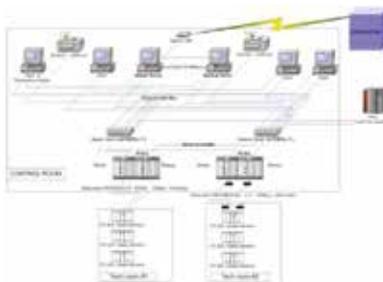
Automation Services

Automation

desmet ballestra



Centralised Supervision



Ballestra ethoxylation plants are controlled by:

CCS: Computerized Control Systems based on PLC+O.S.+ SCADA co-resident client server

D-CCS: Distributed CCS based on distributed PLC, distributed I/O, distributed Operator Stations SCADA in Client/Server architecture

Centralized Control System:

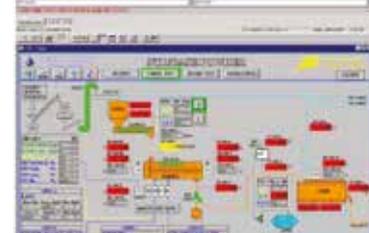
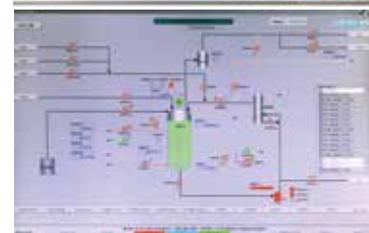
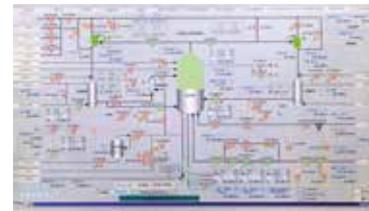
A D-CCS with Centralized Control Room/s, distributed Shop Floor O.S. and dedicated Servers.

DCS: Distributed Control Systems (proprietary)

- Fully redundant Operator Station
- PLC and I/O redundancy available
- User-friendly Operator Interface through mimic screen layout for safe, easy command and Control
- Password protection
- Data-entry validation
- Interlocking and alarming
- Event Logging
- Real time trend
- Historical trend
- Sequencing
- Recipe management
- Control-loop algorithm
- Balance of material
 - Production
 - Utilization
 - Historical
 - Logs
 - and more

Achievements:

- Reduced cost of plant management
- Reduced need for skilled operators
- Increased productivity and quality
- Increased total system availability (high MTBF low MTTR)
- More complete information for operators
- Increased connectivity with ERP
- Easy future expansion ensured
- Fast R.O.I.



Detergents
Surfactants
Soap &
Chemicals

desmet ballestra

Alkoxylation Technology

Science behind Technology

www.desmetballestra.com



Detergents
Surfactants
Soap &
Chemicals

desmet ballestra



Worldwide Leadership
Technical Innovation
Research and Development
Project Management



Quality Workmanship
Customer Service
Export Expertise
Turnkey Contracting

SURFACTANTS

Anionics

Sulphonation/Sulphation
Vacuum Neutralization
Drying

Nonionics

Ethoxylation/Propoxylation
Alkanolamides

Amphoteric & Cationics

Betaines
Esterquats
Aminoxides

DETERGENTS

Powder

Spray Drying Tower
NTD (non tower/agglomeration)

Liquids

Batch / Continuous

ORGANIC

CHEMICAL PLANTS

LAB
Polyether-Polyols
...and many more

INORGANIC

CHEMICAL PLANTS

Sulphuric Acid
Phosphoric Acid
P-based fertilizers
...and many more

SOAP

Continuous saponification of Oils & Fatty Acids
Neutral Oil pretreatment and refining
Glycerine recovery
Vacuum Spray Drying
Complete laundry and toilet soap finishing lines
Flow pack soap packaging lines



Alkoxylation Technology

Science behind Technology

www.desmetballestra.com

The Desmet Ballestra Group

Worldwide close to you

desmet ballestra



www.desmetballestra.com

Desmet Ballestra S.p.A. - Via Piero Portaluppi, 17 - 20138 Milano - Italy - Ph.: +39 02 50831 - Fax.: +39 02 58018449 - E-mail : mail@ballestra.com