IDRECO S.P.A.
VIA PIETRO NENNI, 15
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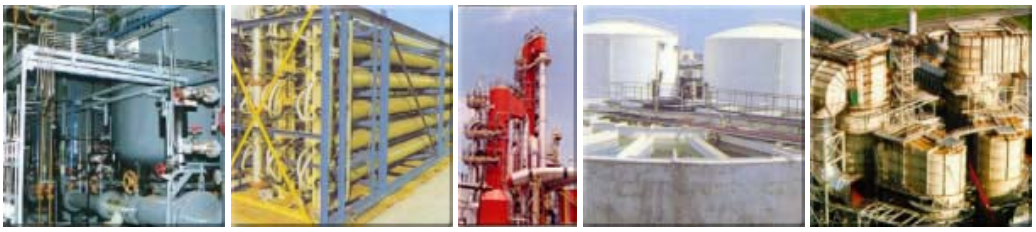
TO CONTACT US: info@idreco.com

THE SCIENCE OF A PURE ENVIRONMENT



The increasing power requirements and continuous use of resources contribute directly to environment pollution. Helping to alleviate this situation has remained our goal since our inception in 1976.

IDRECO has been providing exact solutions: study and project formulation, supply of equipment, technical services and supervision, turnkey project installations concerning air and water treatment and recovery, and conversion and reutilization of various waste products.

Our extensive investment in research and development, togheter with our widespread experience and technologies make IDRECO a worldwide leader. Our organizations and operative staff in Europe, Asia and North & South America have succesfully completed numerous installations designed for the safeguard of the environment, be it water, air, land or energy.

At IDRECO, we work to protect the delicate equilibrium existing between economic growth and this environmental safeguard.

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COMPANY PROFILE

IDRECO was created in 1976. Since the beginning its main field of activities has been the protection of the environment with particular attention to the design and the supply of complete turn key installations for municipal waste water and industrial water treatment.

Then, in the 80ies, IDRECO, having a very well developed and organised water treatment department, created a new division, dedicated to air pollution control, which is now capable of designing supplying any kind of industrial plants for the treatment of polluted air and flue gas, such as:

- Desulphurization plants
- Denitrification plants
- Electrostatic precipitators
- Fabric filters
- Integrated gas cleaning system

In other words IDRECO owns all the technologies for a complete gas cleaning line of power stations and municipal waste incinerators of any size.

Today IDRECO S.p.A. is present in the world market of industrial installations for:

- Potabilization
- Primary and Waste Water Treatment
- Sugar and food products treatment
- Flue gas treatment and purification

Recently IDRECO has become involved in the field of district heating, industrial and municipal waste incineration.

During the last decade IDRECO has also created a few ancillary companies, operating in complementary fields, and has acquired a company manufacturing industrial boilers and incinerators (DEL MONEGO S.r.l.) and has established branches and local companies in the USA, South America and Far East.

Hence today IDRECO has become an integrated group of companies, technically led by IDRECO S.p.A.

In 1996 IDRECO has received from ICIM, certification institute belonging to CISQ and EQ Net, the UNI EN ISO 9001 Certificate.

IDRECO Group

The set up of the IDRECO Group is:

COMPAGNIE TERREBONNE S.A.. is the holding company for the strategic and financial coordination and leadership of the activities of the entire group.

IDRECO S.p.A. provides the technological support to all the companies of the group.

DEL MONEGO deals with design supply and installation of: dryers, calcinators, incinerators for any kind of industrial, municipal and toxic waste (gas, sludge, liquids); industrial boiler for cogeneration plants.

INTERWAT S.r.l. deals with supplies of specific chemical products and filtering elements applied in the energy and potabilization fields.

IDRECO USA Limited, and **ECO ELC S.A**. Buenos Aires, are the affiliated companies for the promotion and local operations in their or connected countries.

IDRECO TECHNOLOGIES

IDRECO S.p.A. has developed and optimised original technologies and industrial processes for the following applications through accurate research in the laboratory, pilot plants and industrial installations:

- Chemical Physical treatment for liquid industrial effluents
- Ion exchange systems for industrial waters
- Membrane systems for brackish and sea water desalination and filtration
- Condensate treatment for nuclear and fossil fired power station
- Radioactive liquid and solid waste treatment
- Potabilization
- Sugar syrup and food treatment
- Biological liquid and solid waste treatment
- Ion exchange SUPREX resin, powdered and bead type
- Filtering elements
- Flue Gas filtration, desulphurization and denitrification
- Rotary Kiln Incinerators
- Fixed Heart Incinerators
- Multiple Heart Incinerators
- Ash Handling
- Limestone, coal and various materials handling

The description of the various technological processes and the relevant main characteristics of the various installations are shown and detailed in the catalogues and pamphlets.

Moreover IDRECO has several cooperation agreements with some important companies regarding the treatment of hazardous, industrial and hospital wastes. In this field IDRECO is capable to supply:

- Composting plants
- MSW pre-sorting and comparting plants
- MSW incineration plants with grate and rotary kiln technology
- Industrial and sludge incineration plants with fluidized bed and rotary kiln technology
- Electric and thermal energy recovery from incineration plants

---

IDRECO REFERENCE LIST

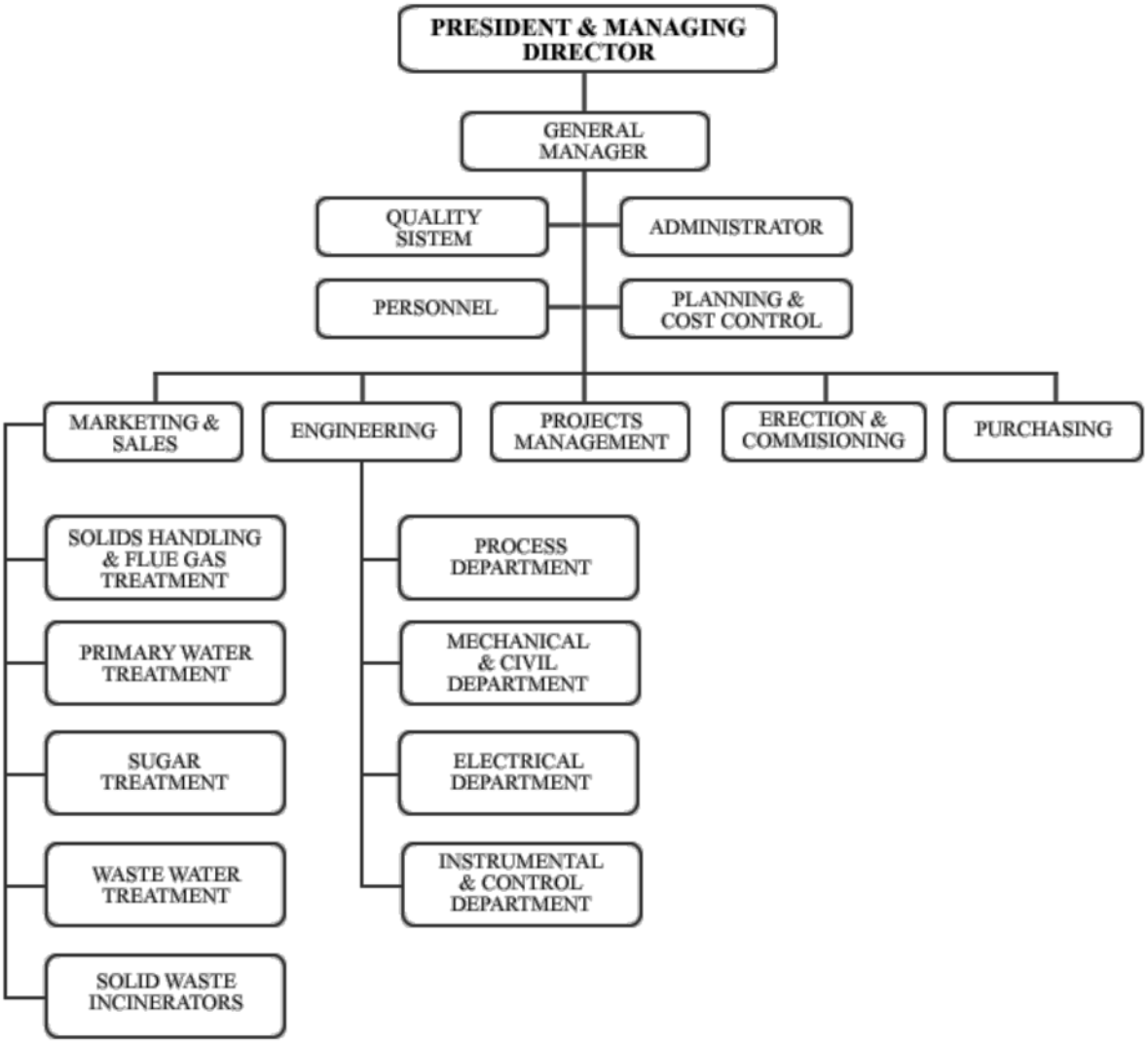
During about two decades of activity IDRECO has supplied several plants for each technology all over the world.

Complete information on the above and details can be seen in the company's Reference List section.

IDRECO set-up and organisation

The organisation is typical of a main contractor engineering company and is shown in the Organization Chart page.

ORGANIZATION CHART



CISQ is a member of

IQNet

THE INTERNATIONAL CERTIFICATION NETWORK

www.iqnet-certification.com

IQNet, the association of the world's first class certification bodies, is the largest provider of management System Certification in the world. IQNet is composed of more than 30 bodies and counts over 150 subsidiaries all over the globe.

ICIM

www.icim.it

CERTIFICATO n. / *CERTIFICATE No.* **0592/5**

SI CERTIFICA CHE IL SISTEMA DI GESTIONE PER LA QUALITA' DI
WE HEREBY CERTIFY THAT THE QUALITY MANAGEMENT SYSTEM OPERATED BY

IDRECO S.p.A.

UNITA' OPERATIVE
OPERATIVE UNITS

Sede e Unità Operativa
Via Pietro Nenni, 15 - 27058 Voghera (PV)
Unità Operativa
Via Prati Nuovi, 23 - 27058 Voghera (PV)
Italia

E' CONFORME ALLA NORMA
IS IN COMPLIANCE WITH THE STANDARD

UNI EN ISO 9001:2008

Sistema di gestione per la qualità conforme alla norma ISO 9001
valutato secondo le prescrizioni del Regolamento Tecnico RT-05.

PER LE SEGUENTI ATTIVITA'
FOR THE FOLLOWING ACTIVITIES

EA: 18 - 28

Progettazione ed installazione di impianti di: trattamento acque primarie e di scarico, trattamento emissioni gassose, trattamento fluidi di processo, trasporto ceneri, materiali in polvere e granulati. Progettazione e produzione di essiccatori rotanti a riscaldamento diretto e indiretto. Produzione di resine a scambio ionico ed elementi filtranti.

Design and installation of plants for: water and waste water treatment, gaseous emission treatment, process effluents treatment, ash, limestone, coal and various material handling. Design and production of direct and indirect heat rotary dryer. Production of ion exchange resins and filtering elements.

La presente certificazione si intende riferita agli aspetti gestionali dell'impresa nel suo complesso ed è utilizzabile ai fini della qualificazione delle imprese di costruzione ai sensi dell'articolo 40 della legge 163 del 12 aprile 2006 e del D.P.R. 5 ottobre 2010 n. 207.

Riferirsi al Manuale della Qualità per l'applicabilità dei requisiti della norma di riferimento.
Refer to Quality Manual for details of application to reference standard requirements.

Il presente certificato è soggetto al rispetto del regolamento per la certificazione dei sistemi di gestione per la qualità delle aziende.
The use and the validity of this certificate shall satisfy the requirements of the rules for the certification of company quality management systems.

Data emissione	Emissione corrente	Data di scadenza
First issue	*Current issue*	*Expiring date*
21/10/1996	30/04/2013	29/04/2016

ICIM S.p.A.
Piazza Don Enrico Mapelli, 75 – 20099 Sesto San Giovanni (MI)

CISQ è la Federazione Italiana di Organismi di Certificazione dei sistemi di gestione aziendale.

CISQ is the Italian Federation of management system Certification Bodies.

FEDERAZIONE CISQ

www.cisq.com

ACCREDIA
L'ENTE ITALIANO DI ACCREDITAMENTO

SGQ N° 004A
SGA N° 005D
SCR N° 006F
PRS N° 082C
SSI N° 008G
PRD N° 004B
ISP N° 046E

Membro degli Accordi di Mutuo Riconoscimento EA, IAF e ILAC
Signatory of EA, IAF and ILAC Mutual Recognition Agreements

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MAIN CONTRACTING

(FGD Brindisi 2 x 640 MW Units)

Through the various members of its worldwide group, IDRECO participates in all aspects of environmental protection, starting with research and development of new technologies and extending to the complete implementation of projects in both the private and public sectors. Over 100 engineers form the IDRECO Group.

Their extensive and well seasoned experience guarantee our capability to smoothly handle turnkey projects, and other technical undertakings designed to safeguard the environment.

The widely used term "prime contractor", describes quite amply our international experience. IDRECO has what it takes to handle & manage large orders for air, and water treatment recovery, conversion and reutilization of many types of waste products, and energy products, and energy production from various sources.

WATER TREATMENT SYSTEMS

The treatment of water for industrial and municipal uses is one of the main concerns in our society, considering that technological processes as well as the life on the entire planet dependent on the quality of this resource.
The IDRECO Group invests heavily in research and development facilities and activities, forever seeking out new technologies. We offer the most up-to-date technologies to incorporate into plants which treat water for industrial and municipal uses such as :

Water Pre-treatment Systems

- Filtration
- Clariflocculation
- Sludge dewatering

Water Treatment Systems

- Ion exchange
- Reverse Osmosis
- Ultrafiltration
- Condensate Polishing with Mixed Beds and/or Filtering Elements (Decorex)
- Production of Ion Exchange Resins and Filtering Elements
  click here

Here some photos of our installations. For complete reference list click here

Dual Media Filters

Clariflocculation

Degassing and Filtration

Demineralization

Demineralization with degasser

Regeneration system for demi units

Reverse osmosis skid

Reverse osmosis skid

Condensate polishing system

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FLUE GAS CLEANING


FGD MELNIK


FGD SULCIS


FGD BRINDISI


FGD MAE MOH


FGD FUSINA

FGD - FLUE GAS DESULPHURIZATION **Photo of WFGD built in China**
DENOX - FLUE GAS DENITRIFICATION

People's lives and healt are directly influenced by the air that is available for them to breathe. If we do not control the gaseous emissions for industrial and municipal sources in a short time, our planet will be covered with a very dangerous grey cloud.

The utilization of air pollution control systems such as desulphurization, denitrification and particulate reduction plants, and any other required technologies is becoming increasingly more necessary.

In response to customer specifications of all types, IDRECO can apply its extensive technical know-how, and managerial capacities to the goal of solving client's environmental problems while obtaining maximum productive results with minimal operating and capital costs.

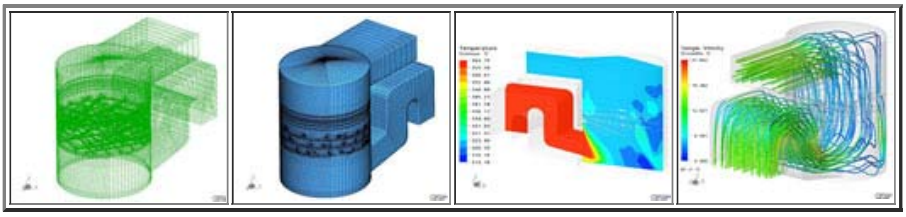
Through continuing technological updating, IDRECO is able to offer applications of the smallest dimensions to purify and guard the air we breathe.


FGD SHAJIAO C 3D BIRD VIEW


DENOX FIUME SANTO PLANT


DENOX FIUME SANTO MODEL

FGD - FLUE GAS DESULPHURIZATION



Idreco FGD (Flue Gas Desulphurization) plants are based on the wet limestone technology with production of gypsum, which is readily usable by manufacturers of gypsum based products.
The limestone wet process has become the most popular process for flue gas desulphurization; Idreco has the experience and the know-how for the design and the construction of complete FGD plant.

PROCESS DESCRIPTION

Flue gas ducts connect flue gas system to absorber and from absorber to stack.
A series of dampers are foreseen to intercept flue gases and eventually to by-pass the absorber.
In order to compensate the additional pressure drops, at the FGD plant inlet flue gases pressure is increased by means of a booster fan.
After the flue gas cleaning a reheating system for clean gases is required before they enter the stack.
The demand for the energy will be withdrawn from the raw gas by a Ljungstrom gas-gas heater (regenerative heat exchanger).

The absorber consists of a vertical cylindrical vessel, with a flue gas inlet and outlet opening. The part of the absorber between the gas inlet and gas outlet is called ‘’the gas section" which may be subdivided in "the spray section" and in "the mist eliminator section". The part of the absorber below the gas inlet contains the absorber slurry and is called "the sump".

In the spray section, the flue gas to be treated is brought in intimate contact with a fine spray of limestone slurry droplets, as produced by the slurry spray banks, equipped with spray nozzles in sufficient quantity to ensure complete coverage of the absorber cross-sectional area and fed by slurry recycle pumps.
The SO2 is absorbed to a large extend in the slurry droplets and react with the limestone present in the slurry to form gypsum $(CaSO_4{*}2H_2O)$, as described in the following reaction:

$$SO_2(g) + CaCO_3(s) + \tfrac{1}{2}O_2(g) + 2H_2O(l) \rightarrow CaSO_4{*}2H_2O(s) + CO_2(g)$$

The process absorbs also other acid gases like HCl, HF and removes the fly ash present in the flue gas.

In order to obtain nearly 100% oxidation of sulphite to sulphate, the absorber is provided with an oxidation air injection system for the injection of a certain flow of oxidation air, supplied from a compressor system.

Above the spray section, the mist eliminator section is installed for the separation of the entrained slurry droplets from the ascending flue gas flow; the droplets fall down to the sump.

The slurry in the sump consists of an aqueous solution of dissolved salts in which approximately 10 to 15 wt% solids are suspended. In order to keep these solids suspended in the slurry, the sump is provided with side entry agitators.

The produced gypsum must be removed from the absorber, otherwise the gypsum would accumulate in the absorber, leading to an absorber slurry with a high concentration of suspended solids.

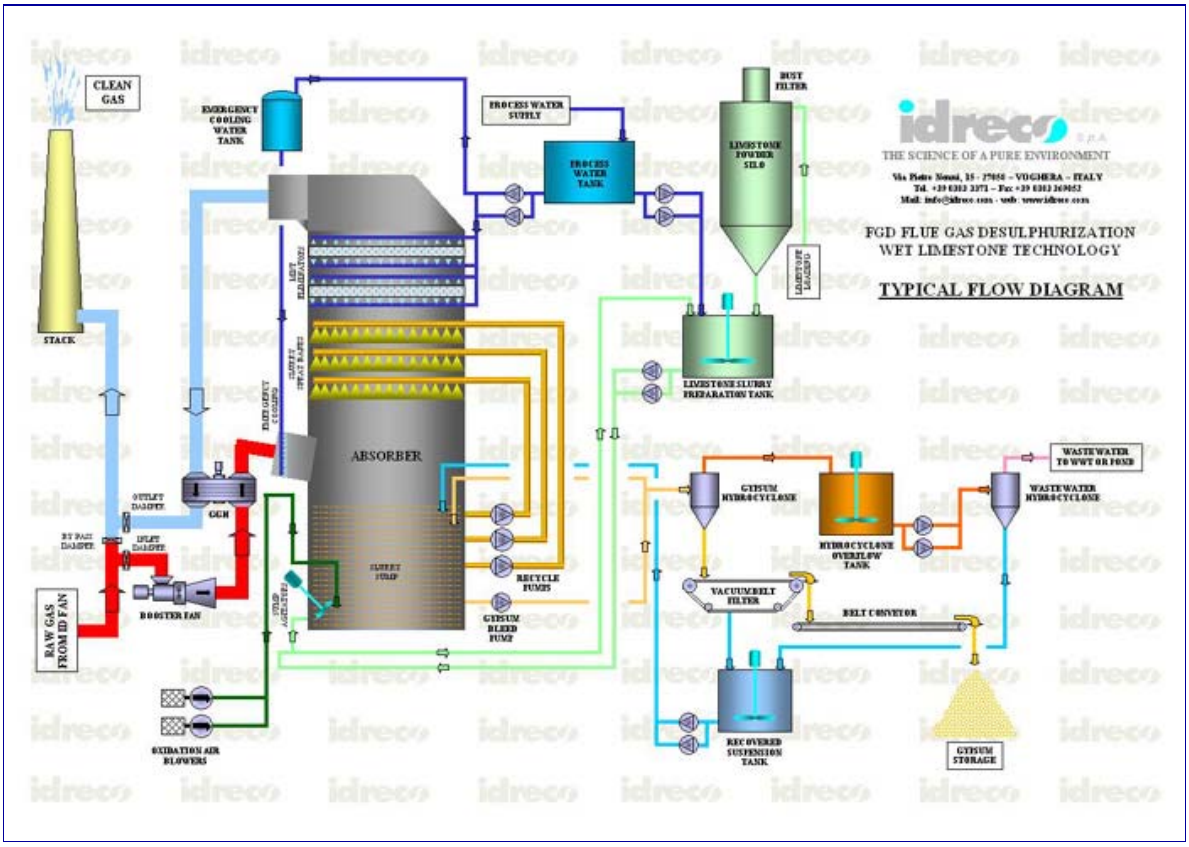
The bleed system consists essentially of an absorber bleed pump and a gypsum cyclone battery, supplied with absorber slurry by the absorber bleed pump.

The underflow of the cyclones flows to the mechanical dewatering (vacuum belt filter or centrifuge) that produces dry commercial gypsum with a maximum water content of 10%.

Most of the cyclone overflow flows back to the absorber together with the filtrate of the dewatering section. A part of this collected overflow is pumped to the 2nd hydrocyclone. The overflow of this hydrocyclone, containing a small quantity of solids, is sent to disposal as waste water for the purpose of discharging fly ash, inerts of the limestone and chlorides; the underflow, containing larger particles of limestone and gypsum, is recovered to the absorber.

MAIN CHARACTERISTICS OF FGD

- High removal efficiency (> 96%).
- Limestone consumption closely approximating stoichiometric requirements
- Reduced space requirements due to compact construction
- Scrubbing tower complete with integral absorption, oxidation, crystallizing and mist separation stages
- Low residual moisture in effluent gas by optimal location of the demister
- High gypsum purity in the final product as a result of high oxidation efficiency



WFGD Plants in China which passed the trial tests – Last update: June 2006:
目前在中国通过考核测试的湿法脱硫工厂 — 最新日期: 2006年6月

Hengshui (衡水) - Hebei (河北)
WFGD 2x300MW + W.W.T.

Shajiao C (沙角C) - Guangdong (广东)
WFGD 3x660MW

Shajiao A (沙角A) - Guangdong (广东)
WFGD 1x300MW + 3x200MW + W.W.T.

Yue Yang (岳阳) – Hunan (湖南)
WFGD 2x300MW + W.W.T.

Liu Zhou (柳州) – Guangxi (广西)
WFGD 2x200MW

Wangtan (黄滩) – Hebei (河北)
WFGD 2x600MW + W.W.T.

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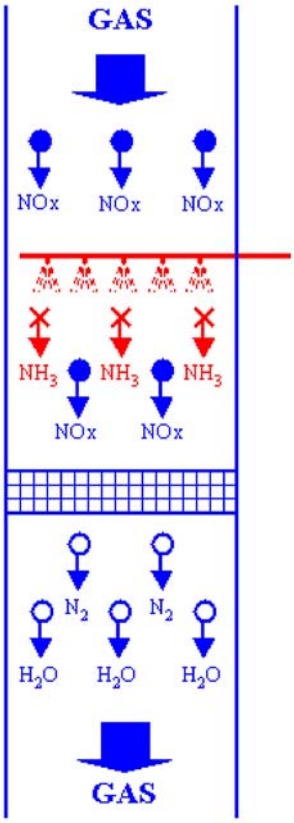
DENOX - FLUE GAS DENITRIFICATION

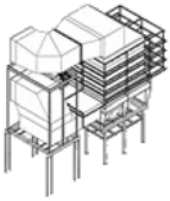


THE DENOX PROCESS

The most effective process to date for flue gas NOx removal in power plants is known as selective catalytic reduction (SCR). It operates at temperatures of between 300 °C and 400°C on the reaction principle that is shown in Fig. 1 and may be summarized by the following equations:

$$4NO + 4NH_3 + O_2 \rightarrow 4N_2 + 6H_2O$$
$$6NO_2 + 8NH_3 \rightarrow 7N_2 + 12H_2O$$

Before the flue gas enters the reactor, ammonia is added in the form of a NH3 / air mixture, which promotes the reduction of nitrogen oxides when the gas comes into contact with the catalyst.
The DENOX unit can be installed downstream of the boiler between the economizer (feed water pre-heater) and the combustion air preheater and is known as the “high-dust” configuration.
When the unit is located downstream of the electrostatic precipitator this result is the so-called “low-dust” configuration. In this configuration the DENOX unit may be also installed downstream of the desulphurisation system. This result is the so-called “tail-end” configuration.



THE DESIGN

Taking into account the Customer specifications and the amount of space available in each case, the size of individual reactors is optimised with the aid of pilot plant tests and with computational fluid dynamic models. The criteria of particular importance include the thorough mixture of NH3 and NOx molecules in the reactor hood and a constant gas flow in the vertical part of the reactor.
The key design parameter in a reactor of this type is the so-called space velocity (SV). This is a measure of the residence time of the flue gas mixture (at STP) within the catalyst volume.
Calculation of the space velocity takes into account the following factors:

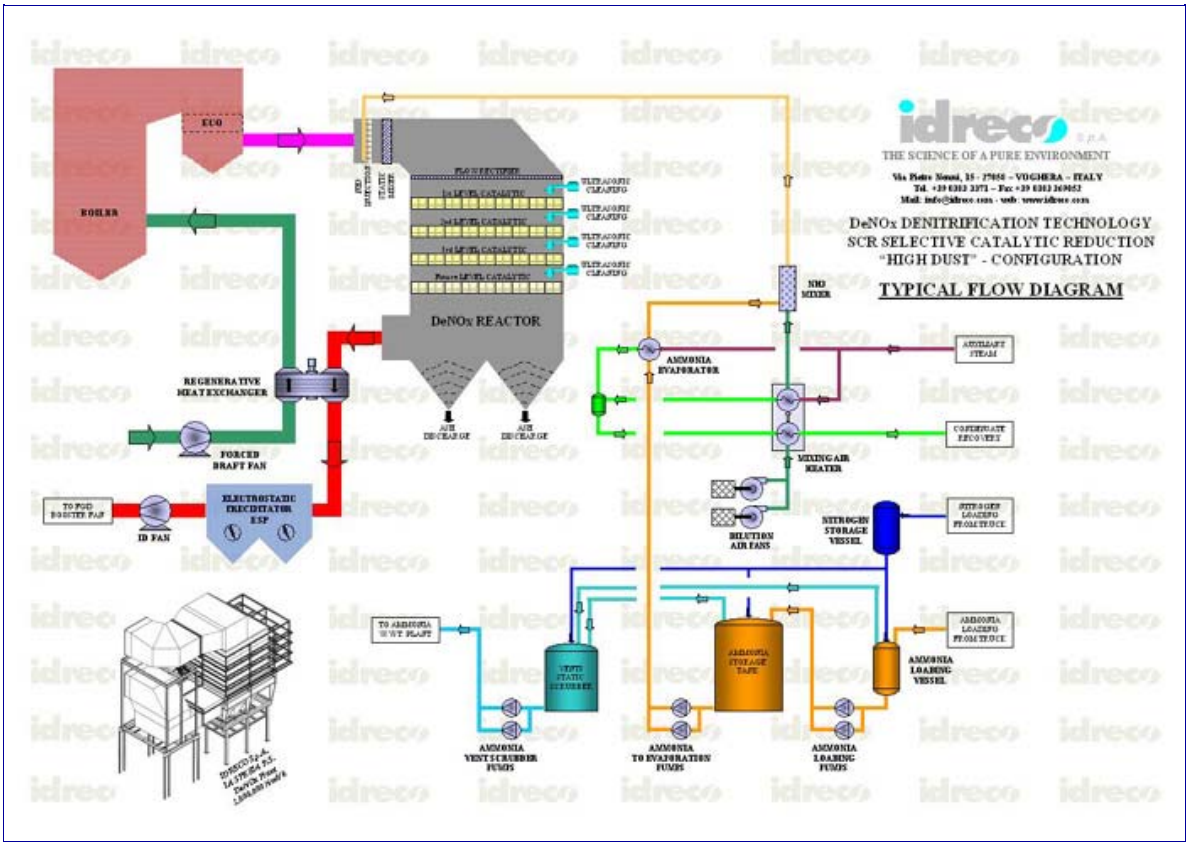
- Efficiency of the DENOX reaction
- Temperature
- Allowable ammonia slip
- Flue gas analysis
- Dust analysis

The SV is used in calculating the amount of catalyst required per unit time for a given volume of flue gas. In coal-fired power plants, the SV is normally between 1000 and 3000 per hour whereas for oil – and gas – fired boilers it will be higher, resulting in a smaller quantity of catalyst being required for the NOx reduction.

thereby raising the effective service life of the catalyst. In this way, it is possible to extend the time between complete replacement of the catalyst.
The catalyst composition and cells number or pitch can be varied to accommodate individual requirements.
Used catalyst can either be disposed of, or recycled to recover useful materials.
The ammonia storage tanks may be either above or below ground as required, the ammonia being vaporized in heat exchangers of either the water bath or the tube bundle type.
Safety aspects, including sprinkler systems, ground slabs and the disposal of gaseous and liquid residues, are also taken into consideration.

ADVANTAGES OF THE CATALYST

- Approximate stoichiometric operation due to high catalyst activity.
- Low pressure drop and avoidance of dust accumulation.
- Low SO2 to SO3 conversion rate due to the high selectivity of the catalyst.
- Honeycomb ceramic catalyst elements, higher mechanical stability.
- High resistance to temperature change.
- High resistance to erosion.
- Easy handling of catalyst modules due to their sturdy construction. Individual catalyst elements are then stacked together to form units or modules that are generally arranged in the reactor in discrete layers. As a result of the high packing density, it is possible to achieve an optimum catalyst-to-space ratio.



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WASTE TREATMENT SYSTEM

The continuous growth of consumption generates enormous quantities of liquid and solid wastes therefore the industrial world needs to address not only the ecological aspect of this situation, but also its economical impact.

IDRECO has not avoided solving this problem.

In recent years, great improvements have been made in the know-how for waste water treatments, incineration of municipal and industrial wastes. We offer the most up-to-date technologies to incorporate into plants which treat wastes such as :

Waste Water Treatments

- Filtration
- Clariflocculation
- Sludge dewatering
- De-oiling
- ZLD Zero Liquid Discharge

Waste Treatments for solids, liquids and gas

- Rotary incinerators - click here to visit our Del Monego website
- Static incinerators - click here to visit our Del Monego website

Here some photos of our installations. For complete reference list click here


Sludge thickener


Grid and oil removal basin


sludge settling and evaporation basins


Municipal waste watertreatment


Static incinerator for gas


Static incinerator for liquids


Rotary incinerator for solids

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DRYERS and CALCINERS

In 1993 IDRECO S.p.A. acquired Del Monego a company designing and supplying dryers, calciners and incinerators since 1935. These industrial equipment and complete plants have been therefore sold in the recent years as part of the IDRECO line of products named “IDRECO-Del Monego”.

The wide production of dryers of IDRECO-Del Monego technology allows to propose, for each type of product
to be treated, the most suitable thermal dryer such as :

- **Direct Rotary Dryers** which can use as heating media:

  flue gases, for sand, clay, mineral products treatment;
  hot air, produced by heat exchangers, for the drying of plastic material and heat sensible products and which cannot come in direct contact with flue gases.

- **Indirect Rotary Dryers** which are internally contained to a refractory furnace which is crossed by flue gases, for carbon black drying.
- **Steam Tube Rotary Dryers** for melamine and soya bean.
- **Flue Gas Tube Rotary Dryers** for drying of dusty materials with initial low moisture, such as talcum and carbon.

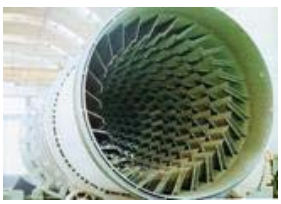
When it is requested to heat material up to high temperatures, also higher than 1000 °C, rotary calciners are used. They are classified as:

- **Direct Calciners** where the material, in direct contact with combustion gases, normally in counter-current way, is brought up to 1200 – 1300 °C. The main applications are: clay calcining, metal catalyst production, activated carbon regeneration.
- **Indirect Calciners** where the material is heated up to 1100 °C by combustion gases which cross a furnace. Indirect calciners are used when the product cannot come in direct contact with combustion gases and when it is requested to operate in a controlled atmosphere. The main applications are: molecular sieve, alumina, silica gel.

For complete reference list click here and for Del Monego web site click here
Here some photos of our installations.


Direct rotary dryer


Direct rotary dryer


Direct rotary dryer


Indirect rotary dryer


Indirect rotary dryer


Indirect rotary dryer 14”x 85”


Steam tube rotary dryer


Activated carbon regeneration


Direct calciner for borax

SUGAR TREATMENT

MOLASSES DESUGARISATION WITH CHROMATOGRAPHIC COUPLED LOOP SEPARATION PROCESS

THIN JUICE SOFTENING - CARBOSOFT PROCESS

THIN JUICE SOFTENING - NRS PROCESS

ION EXCHANGE SYSTEMS FOR SUGAR JUKE PURIFICATION AND LIQUID SUGAR PRODUCTION

Together with the undertaking towards solving the most complex and significant environmental problems, IDRECO has become a principal supplier of systems and processes of the food industry.

As a result of years of research, study, and numerous different installations, IDRECO is now one of the world leaders in the supply of turnkey plants for treating sugar juices, producing liquid sugar and improving the quality and quantity of crystal sugar production.

Special process for maximum sugar recovery from molasses without generating any type of waste.

Our process technologies bring to the market some innovative ecological benefits. With the use of special procedures, all the wastes produced are utilized as fertilizers or concentrated protein for animal feeding.
The technologies and processes available from IDRECO are also applied to agricultural feeding, biotechnology and increasing agricultural production.
From IDRECO one more step to a sweeter future.

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MOLASSES DESUGARISATION WITH CHROMATOGRAPHIC COUPLED LOOP SEPARATION PROCESS

PROCESS DESCRIPTION

The system is designed to continuously process molasses in order to produce an enriched sugar fraction and a raffinate fraction. The process used by IDRECO is the most improved and up-dated molasses separation process, and consists of the following operations:

Diluted molasses is passed through a pretreatment step (MOLASSES FILTRATION) before it enters the chromatographic separator section, which consists of two stages In the **first stage,** the "Crossover non sugars fraction" (BETAINE rich) and the "Upgrade fraction" are separated.
Both fractions are to be concentrated. The concentrated "Crossover non sugars fraction" can be sold as such or mixed with the raffinate fraction and is sold as a by-product.
The concentrated "Upgrade fraction" is processed in the **second stage** which produces the Extract (sugar fraction) and the Raffinate (non-sugar fraction).
The described system needs an amount of condensate (or water free of divalent cations) for the dilution of the incoming molasses, and for the chromatographic separation process purposes.

The molasses to be treated will have the following characteristics:

- Dry substance: 80%
- Purity: 60%
- Total hardness: 3 meq / % dry substance max.
- Invert sugar: 1,3 % dry substance max.
- Betaine: 5 % dry substance max.Each of the Process Steps is described below:

Dilution
The molasses syrup is pumped from the day storage tank and diluted with condensate. It is then heated to an higher t t f 85 °C

Filtration

After dilution the molasses is filtered through a precoat filter. The filtered solution is then pumped through check filters with 5-10 micron bags to the degasser.

Degassing

The molasses is reheated to 85 °C and passed through a degasser, which is connected to the surface condenser of the evaporation system.

Chromatographic Separation

After degassing, the molasses solution is pumped to the first stage column. In this stage the "Crossover non sugars fraction" is separated from the "upgrade fraction". The two streams are then concentrated in the evaporation system.
The upgrade solution is check-filtered and then directed to the second stage.
The remaining non-sugars are excluded during the chromatographic process and the enriched sucrose fraction is recovered at a concentration of about 35 - 37 °Bx.
The recovered extract and raffinate fractions are then concentrated.
The concentrated "Crossover " fraction can then be combined with the concentrated raffinate fraction.
The condensate outflows from both above-mentioned concentrations are returned to the system to be used as process water. For this purpose, the condensate streams are mixed with softened make up water, filtered and finally degassed before being used as eluant water.
Make up water can either be condensate or softened water. Alternatively to softened water, factory condensate may be used as make-up water.

Product Quality

Extract:	Dry substance 29-32%.
Overall sugar recovery:	82% (this is the crystal sugar recovered in a 3 boiling system from the crystallization
Raffinate:	of the extract).
	Dry substance: 4.5
Color removal:	90 % or greater (based on material balance shown below).

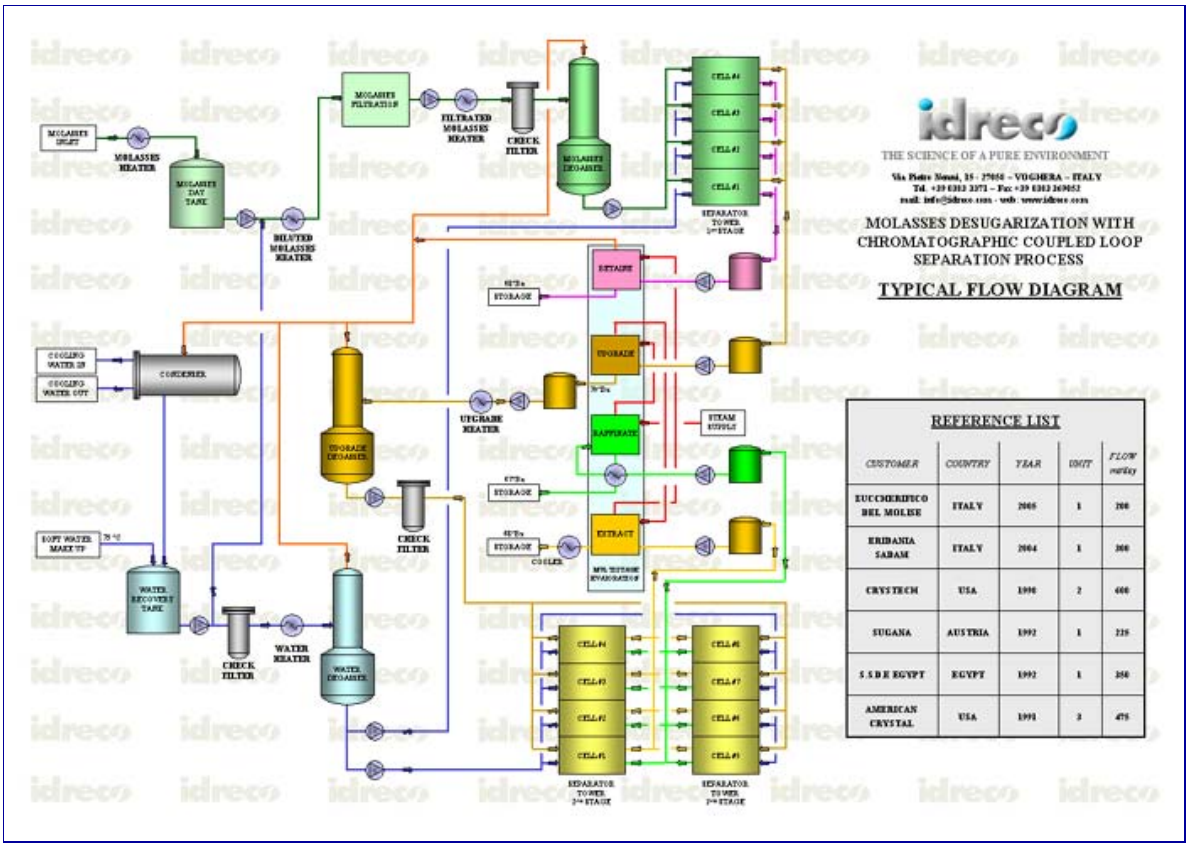
The overall sucrose recovery of 82% is based on an elution water to feed ratio of 6.25 to 1 (volume to volume), assuming a feed molasses RDS of 80%. The only measurements used to determine the overall recovery would be the recovery of extract sugar across the separator and the extract purity. Overall recovery (OR) is based on a secondary molasses (molasses remaining after crystallizing sugar from extract) purity of 60% and will be calculated according to the following formula:

$$OR = R \times \left[1 - \frac{(100 - Qe) \times 60}{(100 - 60\ ) \times Qe}\right]$$

Where:

R= The recovery or percent of the sugar in separator feed that remains with the extract fraction.
Qe= The true purity of the extract.
The above formula gives the various combinations of separator recoveries R and extract purities (Qe) that will meet the overall recovery of 82%. The color removal is based on material balance of exiting materials.
% Color elimination (CE) is calculated as follows:

$$CE = \frac{(raffinate.solids * .ICUMSA) + (CNS.solids * .ICUMSA) * 100}{(extract.solids * ICUMSA) + (raffinate.solids * ICUMSA) + (CNS.solids * ICUMSA)}$$



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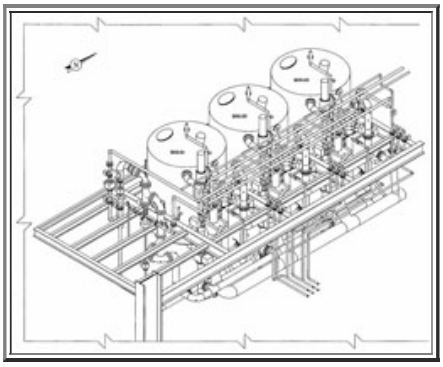
THIN JUICE SOFTENING - CARBOSOFT PROCESS



CARBOSOFT PROCESS DESCRIPTION

The system is designed to reduce the hardness in the thin juice coming from beet or cane.

The softener uses a weak cation exchange resin in the sodium form.

The system incorporates a three-cell design with two cells being exhausted on thin juice simultaneously. These are staggered with respect to exhaustion so that both do not require regeneration at the same time. The third cell is being regenerated or is in standby.

The high resin capacity and the fast flow rates makes it possible to process the entire factory stream with a very small installation compared to other processes using strong cation exchange resins.

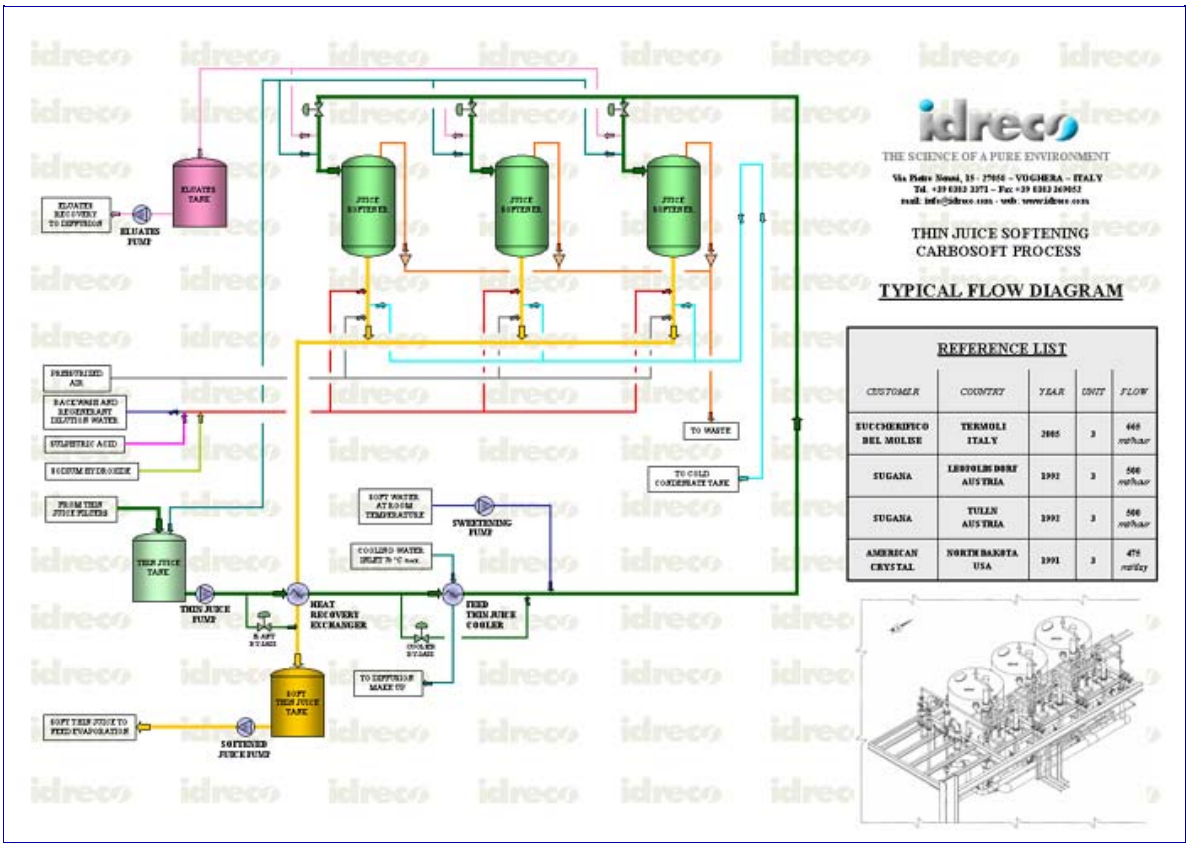
The exhaustion cycle length varies with the hardness concentration. A minimum cycle length of eight hours is necessary to properly turn around a cell and preserve the continuous operation.
The cycle is so dimensioned, that the cell is removed from service before a hardness leakage takes place, at this time the next cell is placed on line.
During the sweetening-off step the juice is pushed across the resin and delivered to the evaporation plant.
The cut-off point is determined by volume totalizing of treated thin juice. As a result very little water is being send forward to the evaporators.
The regeneration is carried out counter-current to the juice flow.
Sulfuric acid is the regenerant of choice so it can be recycled to the diffuser.
Since the calcium sulfate formed during regeneration is only sparingly soluble, care must be taken to insure that the solubility of this product is not exceeded. To prevent this from happening the acid concentration must be below 0.5% and the flow rate should be kept high enough.
A relative disadvantage here is that a large volume of spent regenerant is produced. However, it can all be used back in the process, but must be metered into the diffuser supply at a rate which gives the desired quantity of pressing aid or pH to the diffuser supply.

The weak Cation exchanger system can be regenerated very efficiently with only 110% regenerant on capacity to give complete conversion to the hydrogen
form. Sulfuric acid may be used to adjust the pH of the diffuser supply water. Therefore any excess regenerant reduces this requirement and is not wasted.

Following regeneration a rinse step takes place.
After the rinsing step the resin is put in the sodium form by up-flow percolating the resin bed with a 2% NaOH solution

The system works very well and produces a thin juice with an average of less
than 2% of hardness inlet value when the cells are exhausted to the point of leakage.

The major advantage of this softening process is that the molasses produced from the treated juice are of excellent quality, as far as decalcification is concerned, for further processing in an ion - exclusion plant without any further softening.



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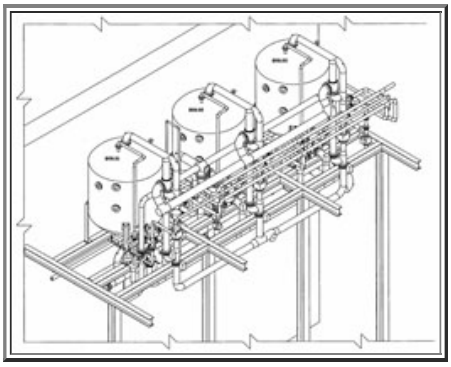
THIN JUICE SOFTENING - NRS PROCESS



NRS PROCESS DESCRIPTION

The system is designed to reduce the hardness in the thin juice coming from beet.

The softener uses a strong cation exchange resin in the sodium form.

The system incorporates a three-cell design with two cells being exhausted on thin juice simultaneously. These are staggered with respect to exhaustion so that both do not require regeneration at the same time. The third cell is being regenerated or is in standby.

The exhaustion cycle length varies with the hardness concentration. A minimum cycle length of eight hours is necessary to properly turn around a cell and preserve the continuous operation.

The cycle is so dimensioned, that the cell is removed from service before a high leakage hardness will appear compared to that designed, at this time the next cell is placed on line.

The cut-off point is determined by volume totalizing of treated thin juice.

The regeneration phase includes all operating steps, which do not produce decalcified thin juice.

All regenerating steps are done in an up-flow mode and use soft thin juice drawn from the product surge tank.
The regeneration sequence includes first an air - scouring step of the resin, followed by a backwash with soft juice, with the purpose of loosening the resin mass and freeing it from foreign matter.
The backwash stream is collected in a buffer tank, from which it is continuously pumped to the filters after the second carbonatation.

The resin is then cooled to 35 oC with cold soft juice.
The resin is then regenerated up-flow with 35 oC cold soft thin juice containing
40-50 g/l NaOH (as 100%).
This is followed by a thorough displacement of the regenerant with 35 oC cold thin juice.

The calcium-saccharate containing spent regenerant is collected in a buffer tank and from there it is continuously transferred to the lime milk preparation system.

The regeneration is completed by an up-flow rinsing of the resin bed performed with 80 °C hot soft thin juice. This operation has the purpose of washing away the sodium hydroxide and heating up the resin bed.
A l t l d th ti

The outflow of the rinsing step is split between the regenerant collecting tank to first carbonatation and the backwash-collecting tank to the second filtration.