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# NEW TECHNOLOGIES TO PRODUCE HIGH QUALITY FERTILIZERS EFFICIENTLY WITHOUT ENVIRONMENTAL IMPACT (a)

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## 1. Summary

The international fertilizer market scenario and the applicable legislation have been continuously forcing producers to be more competitive, producing at lower cost, achieving better product quality and reducing plant emissions. That tendency resulted on more strict requirements on the ITBs issued for grass root plants or revamping of existing units.

In spite of the licensors efforts to satisfy costumer goals, available technologies were not ready to fulfil at the same time objectives that very often require opposite corrective actions.

To overcome such difficulties Incro S.A has carried out a continuous research, which has crystallized on the development of two new processes that yield a high quality product, with the minimum production cost, basically thanks to the use of the cheapest combination of raw materials available at any time, and avoiding the emission problems normally associated with the use of a particular combination of raw materials.

First process is designed to treat any kind of liquid effluent and it particularly fits on granulation plants using only solid raw materials. It is based on the use of an Incro's patented evaporation unit that concentrates the liquid effluent to the extent required to recycle it to granulation area.

Second process is based on the use of a new generation of pipe reactors (X-PR), designed to operate with diluted phosacid and/or sulphuric acid, scrubbing liquid and ammonia, without any corrosion / erosion problems. For operating with diluted phosacid and sulphuric acid, the process fits to any compound fertilizer granulation plant where phosacid concentration cost has to be saved or when the concentration unit is not available. If operating only with sulphuric acid, it is suitable for solids granulation plants where no phosacid is available. X-PR process improves granulation and evaporates most of the water used in the scrubbers, avoiding any liquid effluent treatment.

## 2. Introduction

Incro's background

Incro S.A. was founded in 1975 by S.A..Cros (Spanish fertilizer producer, presently known as Fertiberia) and Intecsa-Uhde (international engineering company belonging to Dragados Y Construcciones and Krupp-Uhde), becoming a leading licensor with more than 70 licensees on the fertilizer field.

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S.A.Cros installed its first factory in Spain in 1817. In 1988, through several acquisitions and joint ventures S.A.Cros formed the Ercros group, which included Ert, Fosforico Espagnol and Enfersa companies. Recently, capital investment by the Villa Mir Group has consolidated the fertilizer division under the name of Fertiberia, controlling 60% of the Spanish fertilizer market.

Intecsa is a Spanish engineering company founded in 1965 by Dragados Y Construcciones, the largest Spanish contractor. In 1990 the German engineering group Krupp-Uhde became co-owner of the company, promoting international contracting.

In the last 25 years, Incro S.A., using its own skilful personnel and the human resources of its mother companies, has successfully completed more than 70 fertilizer projects, mainly using its pipe reactor technology and quickly becoming one of the leader companies in that field.

The large number of licensees in Spain and other locations has ensured a rich and continuous feedback of information, which together with the support of Fertiberia and the installation of two pilot plants have allowed Incro to improve the existing processes, as well as to develop new ones.

Pilot plant in Fertiberia production facilities

## 3. New Project Requirements

Over the past years, the international fertilizer market scenario and the applicable legislation have been continuously forcing producers to be more competitive, producing at lower cost, achieving better product quality and reducing plant emissions. That tendency resulted on

more strict requirements on the ITBs issued for grass root plants or revamping of existing units.
New received ITBs require the technology to be:

- Flexible to adapt to the current cheapest raw materials.
- Capable of producing high quality fertilizer with those combinations of raw materials
- Environmentally friendly under any circumstances.

More specifically, two types of ITBs were received:

A) Some ITBs request to produce NPK grades using only diluted phosphoric acid, since:

- Final product cost must to be lowered thanks to the savings on phosacid concentration cost.
- No phosphoric acid concentration unit is available
- There is a capacity limitation on the phosphoric acid concentration unit. In this case costumer prefers to use the concentrated acid for high P2O5 grades production, increasing their production capacity, while using diluted one for other grades whose production capacity is not seriously affected by the phosacid concentration.
- Costumer who only concentrates phosphoric acid for export purposes. For their NPKs production only diluted phosphoric acid is employed, in order to improve plant economics.
- Low S prices promote the use of large quantities of sulphuric acid and ammonia instead of solid ammonium sulphate or urea. Additionally, some producers using by-product solid ammonium sulphate from other manufactures may experienced shortage of supply and increased prices.

In above cases the recommended technologies were:

<u>Conventional slurry process</u>
This process, based on the use of a conventional pre-neutralizer, can produce NPKs with an acceptable final product quality, but with all the disadvantages related to the slurry high water content, high recycle ratio, increased utilities consumption and larger moisture content in final product.

<u>Pipe reactor process (co-neutralization)</u>
This process takes advantage of the combined reaction of diluted phosphoric acid and sulphuric acid with ammonia. The larger reaction heat is used to evaporate the water contained in the phosphoric acid, producing slurries with lower water content than in the previous case. Although conceptually it was right, this process was not widely implemented due to the erosion / corrosion problems that reduced pipe reactor life.

B) Other manufacturers may not have phosphoric acid / nitric acid at all, because:

- No acid supply available nearby or plant location makes shipment unpractical or very expensive. Sometimes the installation of adequate storage facilities can be the limiting factor, due to the large required investment.

- There are no plans to install additional acid production facilities, just the NPK granulation plant.
- There are alternative cheaper P2O5 sources, like MAP, TSP…nearby or within the same company. Price of those solid raw materials has experienced a continuous decline in recent years.
- The environmental problems related with the gypsum disposal discourage many producers from installing phosphoric acid production facilities, or in some limit cases even to shut down existing ones.

For the above scenarios, the only alternative was to design a steam granulation plant. This kind of plant was very common a long time ago, but compared with slurry plants it has several disadvantages, like:

Poor product quality. With this process granulation takes place at lower temperatures and higher moisture. Therefore the final product has a higher moisture and lower hardness. Urea or ammonium nitrate melts have been used to overcome that problem, but the higher temperatures in the granulator require lower water input from the scrubbing system, thus creating problems to recover all the liquid employed on it.

Final product caking. Higher moisture and lower hardness on final product promote caking.

High final product cost, frequently due to the cost of using intermediate products as raw materials and the large consumption of utilities.

Scrubbing liquid treatment. In those plants dust emission from plant equipment is recovered in the scrubbing system using water, which should be later advanced to the granulation section. The quantity of water required to keep dust solubility within the safe limits normally exceeds the required amount for a good granulation / drying. This is particularly true on urea or ammonium nitrate based grades. Additionally, unexpected overflows, cleaning operations, etc…also create a liquid effluent that after collection in the sump tank should be reintroduced to the process.

Several approaches were made to solve the problem like:

Installation of bag filters. Its aim is to reduce the number of air streams arriving to the scrubbing system, thus reducing the quantity of dust in the scrubbing liquor. Main disadvantages are the high installation cost, the large size and its related layout impact and the filters plugging tendency. Hot air addition helps to palliate the problem, but when manufacturing urea or ammonium nitrate based grades, thus that is not a definite solution.

Scrubbing liquid treatment. Its objective is to treat the part of the scrubbing liquid not fed to the granulator, or to reduce the total quantity till the amount to be fed to the granulator. Several treatments have been adopted, like scrubbing solution settlement, filtration…; recovering the clean water and reusing the settlement or filter cake. None of them is completely satisfactory, due to handling difficulties of the solids, the requirement of solids drying and the fact that the filtrate is saturated on nutrients, thereby reducing washing efficiency.

## 4. Incro's Approach to the New Requirements

To overcome such difficulties Incro S.A has carried out a continuous research, which has crystallized on the development of two new processes that yield a high quality product, with the minimum production cost, basically thanks to the use of the cheapest combination of raw materials available at any time, and avoiding the emission problems normally associated with the use of a particular combination of raw materials.

### 4.1 New pipe reactor X-PR process

The initial idea was to use our pipe reactor technology background, modified to be adapted to the new employed raw materials.

The idea was not new. In 1976 Incro S.A designed a pipe reactor, made of teflon, to work with those raw materials (diluted or concentrated phosacid, sulphuric acid and ammonia) in addition to its conventional pipe reactor version operating with phosphoric acid and limited quantities of sulphuric acid. In late 70's and early 80's that PR was successfully installed in three units, although it showed larger erosion and later corrosion than the conventional version.

In spite of that, producers managed to run the plant continuously and satisfactorily, although with periodical reparation work / replacement of the pipe reactor. During next ten years additional research was delayed because most costumers that contacted Incro had concentrated phosphoric acid available.

Recently, under the new circumstances, research was resumed and a completely new pipe reactor was designed. Its new mixing head and distribution tube allows it to operate with diluted phosacid based scrubbing liquid and large quantities of sulphuric acid, avoiding the corrosion and erosion problems of former design.

This new technology was also found to be suitable to be applied in those factories without phosacid supply, but with availability of some sulphuric acid and ammonia. In this case the scrubbing liquid consists of water plus small quantities of sulphuric acid. After washing, the resulting liquor will be fed to the X-PR, where the water will be evaporated thanks to the reaction with ammonia and concentrated sulphuric acid.

After two industrial applications; one in our own facilities for 40 tph NPK and the other in a licensed unit, using a new 10 tph X-PR installed in parallel with the existing PR, a 35 tph X-PR was licensed for a completely new 250,000 tpy NPK plant to be built in Vizag – India for Coromandel Fertilizers Ltd. The plant was designed to fit the requirements of X-PR and to optimise its performance. Start-up was successfully performed on July 2000.

### 4.2 Incro's atmospheric evaporation technology

After ten years of licensing activities in the fertilizer field, Incro S.A realised that general purpose scrubbing system vendors were not ready to give full satisfaction to the particular needs of the fertilizer industry. Consequently in the 80´s Incro developed its own gases and liquids effluent treatment systems.

On the 90's Incro was increasingly involved in environmental projects in Spain and France, after developing an efficient and economical system to eliminate waste liquids of difficult standard treatment.

Initially this technology was checked using two pilot scale portable plants temporary installed on the effluents site, one of them in a fertilizer plant of Incro's mother company Fertiberia. After successful trials that technology has been applied to many industrial projects, not only fertilizers, but also food factories, farms, municipality solid wastes treatment units…, being both the process, as well as the equipment, patented by Incro.

Recently Incro built a third pilot plant, specially designed to treat effluents from fertilizer plants.

This evaporation technology is very appropriate to be installed in those NPK plants where no sulphuric acid and ammonia are available, or where there is a strong limitation on the quantity of them to be used.

In this case the scrubbing liquid will be basically constituted by water, which after washing will be sent to a package unit for its concentration (up to one third of its original volume). The concentrate will be fully recovered in the granulation section.

After checking its performance, this technology was installed in one of Fertiberia plants. Recently, same technology has been supplied, along with Incro's NPKs production basic package, for a new 300,000 tpy NPK granulation plant built in Malaysia for Petronas -Nafas.

## 5. Incro's New Pipe Reactor (X-PR) Process

### 5.1 X-PR process description

The main process flow diagram (see, Drawings 1&2) does not greatly diverge from an Incro's plant designed to operate with the traditional pipe reactor, main differences being the following ones.

- Pipe reactor has a completely different design to allow operation with diluted or concentrated phosphoric acid and / or sulphuric acid, plus ammonia.
- Granulator internals have been slightly changed to implement the new pipe reactor, as well as to provide the best distribution for the larger slurry quantity.
- Granulator fan has been over designed to be able to remove the large amount of steam released from the X-PR inside the granulator drum.
- Scrubbing system has been designed to accommodate the larger fumes volume.
- The large amount of ammonia employed allows installing a larger open circuit chiller for the cooler air.

## 5.2 X-PR process advantages

The major advantages are:

### 5.2.1 Advantages compared with steam granulation processes

- These are numerous advantages of a slurry granulation compared with a steam granulation, namely, better product quality (size, moisture, hardness, shape…), much lower utilities consumption, lower production cost.

### 5.2.2 Advantages compared with conventional preneutralizer slurry granulation

- These are the typical advantages on recycle ratio, utilities consumption, product quality derived from the use of a pipe reactor instead of a conventional slurry process, based on the use of a preneutralizer.

### 5.2.3 Advantages compared with traditional pipe reactor processes

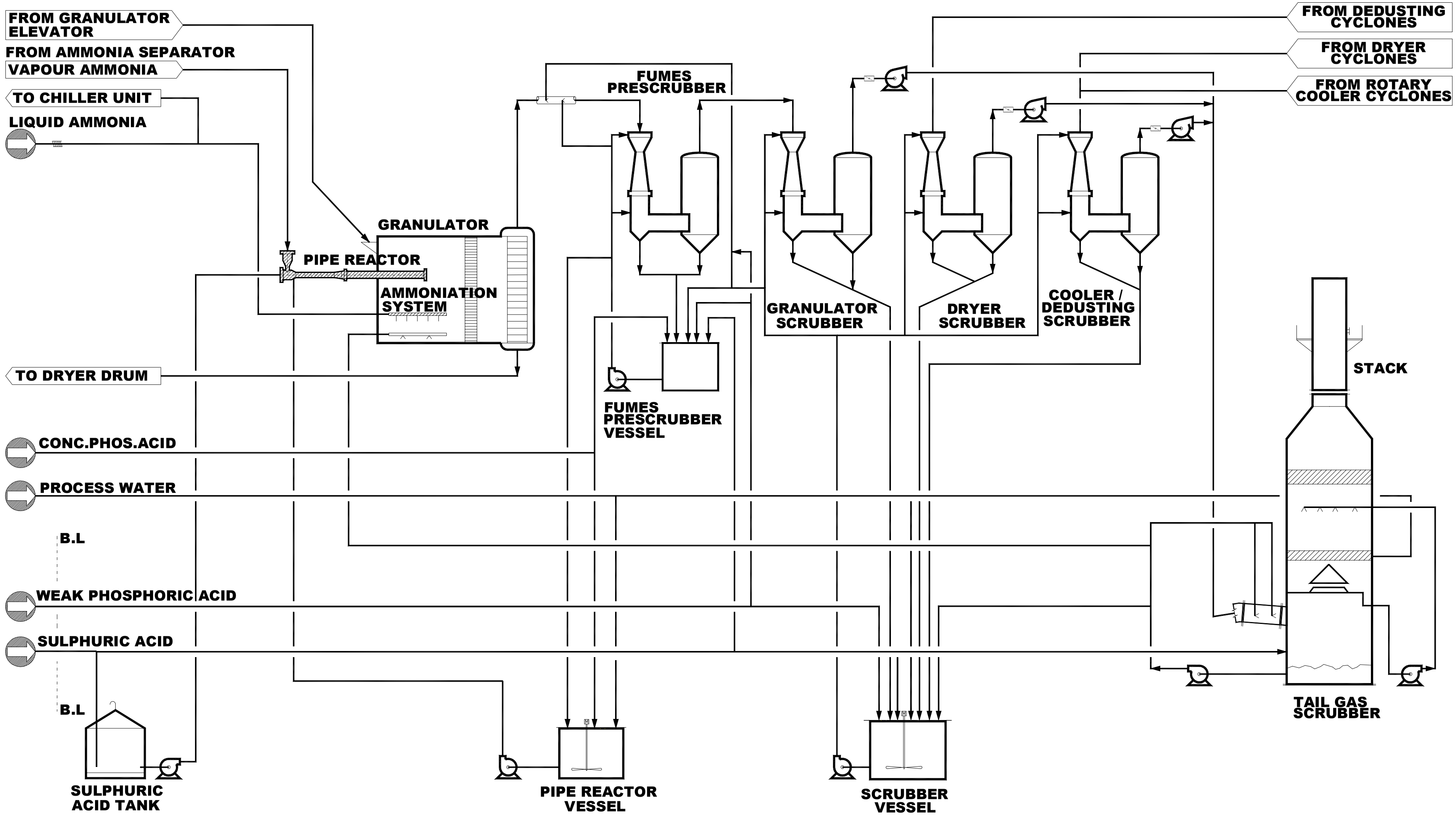
- The new X-PR can be operated with diluted / concentrated phosacid in combination with large sulphuric acid quantities, or it can be operated only with sulphuric acid, avoiding the traditional erosion / corrosion problems associated with the use of such raw materials.
- Above mentioned capability provides the required flexibility to produce many different NPK grades with a multiple combination of raw materials.
- Flexibility allows decreasing production cost, by using the cheapest combination of raw materials and by reducing utilities consumption (steam for phosacid concentration).
- Thanks to the X-PR design, ammonia losses are practically the same as the traditional pipe reactor, using only concentrated phosacid, in spite of the larger heat involved in this combined reaction and the larger quantity of ammonia fed to the X-PR.
- It has been observed that using X-PR, product quality, mainly size, has improved. When producing a slurry mainly containing ammonium sulphate, the use of a PN or a conventional PR, has a tendency to produce a more irregular granulation, with some lumps and fines / powder, resulting in larger recycle ratios and increased cyclones / scrubbing system duty. The new Incro's X-PR achieves a better reaction efficiency and slurry distribution that results in larger on-size fraction at granulator discharge.
- The same PR is capable of producing DAP/MAP/NPKs with same efficiency and without any modification, resulting in added flexibility to the plant.

## 5.3 Licensee Details

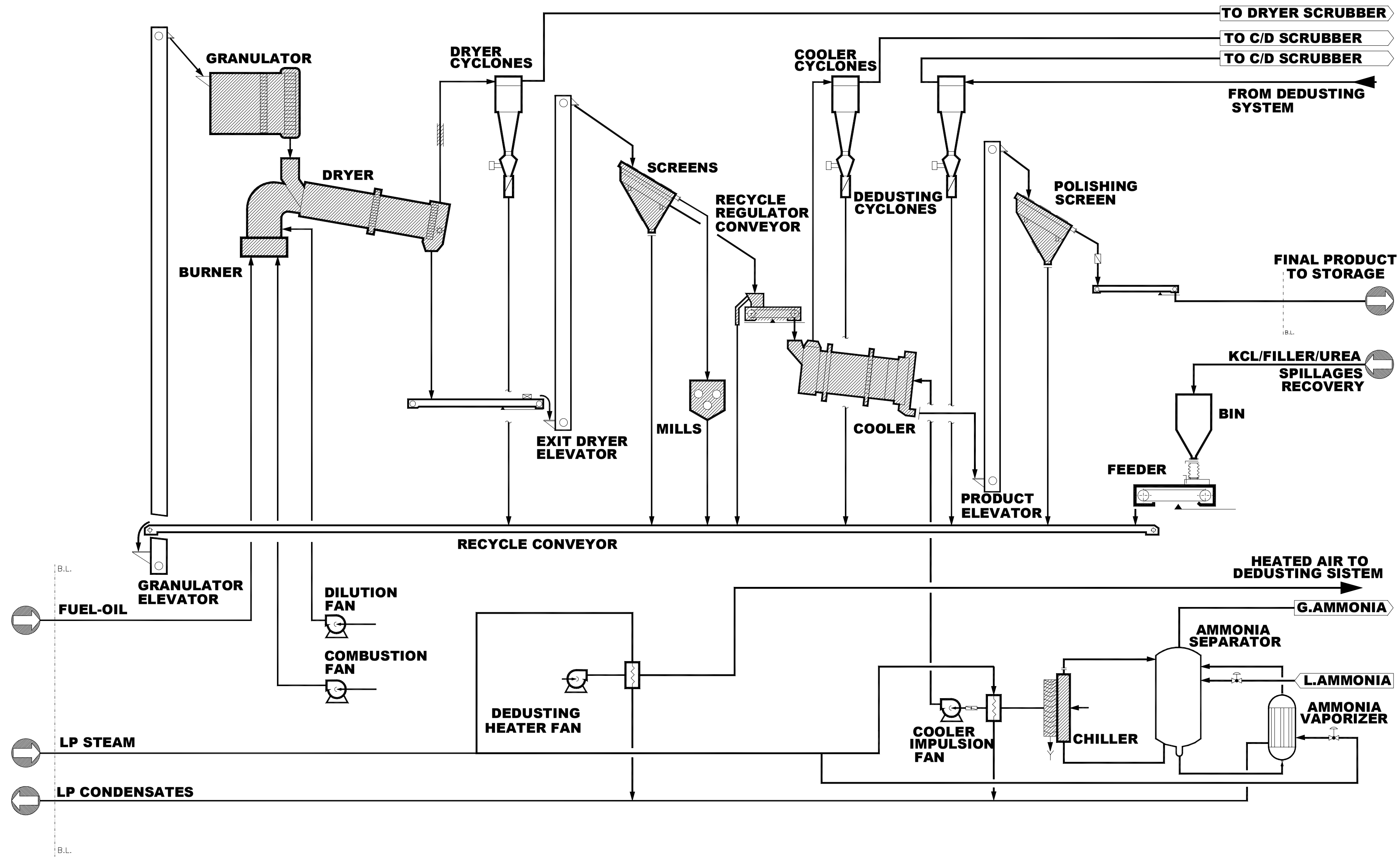
### 5.3.1 Introduction

The X-PR technology developed in our own facilities and tested in an old reference plant, was installed in a new 750 tpd NPK plant located in Vizag, India, for Coromandel Fertilizers Ltd. (CFL). The project was executed by CFL, Uhde-India and Incro, was successfully commissioned in July 2000.

NPK Plant of Coromandel Fertiliser Ltd. Vizag, India




Drawing 1. X-PR Process. Liquid Section process flow diagram.




Drawing 2. X-PR Process. Solids Section process flow diagram

### 5.3.2 Main design features

CFL is one of the Indian leading fertilizer manufacturers and this project was the third NPK granulation plant in their complex. CFL is part of the Murugappa Group, which among other businesses has a NP20.20.0 production facilities. Consequently, when they issued this new ITB they already had large experiences and a very skilful staff. Their main requirements for the new project were:

- Technology based on the use of a pipe reactor
- Capability to produce NP20.20.0 and NP16.20.0 with only diluted 26% P2O5 phosacid, 93% sulphuric acid and ammonia and NPK14.35.14 with the addition of some 46% P2O5 concentrated phosacid
- Flexibility to produce other NPKs and DAP without modifications.
- Product quality that satisfies not only Indian FCO requirement, but is also above the one of available local product, mainly regarding size.
- Low ammonia and dust emissions
- Clean environment within the production building

Incro decided that X-PR technology was the best alternative to produce requested grades, using the available raw materials, and with better quality and lower emissions.

Main design features of the plant are as follows:

- The process is based on the use of a X-PR installed inside the granulator. This pipe reactor is where the reaction between the diluted phosacid scrubbing liquid, the sulphuric acid and the vapour ammonia takes place.
- The rest of ammonia is introduced, in liquid state, through the Incro ammonia sparger, that consists of a four arms sparger that introduces the ammonia deeply into the solids bed.
- There are two screening steps; the first consisting of two double deck screens that receive all the product discharging from dryer; and a second polishing screen consisting on a single deck unit that screens only the quantity required to satisfy the final product quantity requirement.
- There is a recycle regulation through the recycle regulator belt conveyor that reduces polishing screen and cooler duty and increases their performance.
- An open circuit ammonia chiller was installed to cool down the rotary cooler air. This chiller uses the ammonia to be fed to the PR. An ammonia evaporator was installed to evaporate the rest of ammonia that is not vaporized in chiller.
- Hot air injection was supplied for the dedusting system suction points, to keep the relative humidity low enough to prevent dust to become wet and sticky.
- A very complete three steps scrubbing system was provided. The first washing step includes a low pressure drop washing unit for the granulator (including pipe reactor) fumes. In this scrubber most of the ammonia is recovered. A second scrubbing step includes three similar venture scrubbers for the cooler and dedusting gases, dryer gases and fumes from previous granulator pre-scrubber. The three scrubbers share a common tank, using a more diluted phosacid and consequently operating at higher molar ratio, since the main objective is dust recovery with minimum fluorine losses. A final two steps tail-gas scrubber for all gases is also included. First step consists on a low pressure drop

duct scrubber, whereas the second step is a low pressure drop packed tower. It uses process water to achieve an efficient recovery of fluorine and the removal of the remaining dust and ammonia. A demister is also installed to prevent droplets entrainment by exhaust gases.

- The plant was equipped with a Distributed Control System (DCS) to control and monitor all the plant parameters. Package equipment was controlled by Programmable Logic Controllers (PLC).

### 5.3.3 Test results

- **20.20.0 Production**

A performance test was successfully carried out on July 2000, with the following results.

| PARAMETER | GUARANTEED | OBTAINED |
|---|---|---|
| Average capacity tpd in 22h | 750 | 772 |
| N % wt | 19.4-20.6 | 19.4 |
| P2O5 % wt | 19.4-20.6 | 20.3 |
| H2O % wt | 1 max | 1 |
| 1-4 mm | 90% min | 90-96 (less 1 mm, nil) |
| Ammonia consumption kg/t | 246 | 245.2 |
| P2O5 consumption kg/t | 205 | 204.4 |
| H2SO4 consumption kg/t | 429 | 428.0 |
| Fuel-oil consumption kg/t | 8.0 | 5.4 |
| Power consumption kWh/t | 45 | 48 |

Main process parameters were as follows :

| | |
|---|---|
| Production rate : 35 tph | Maximum average rate : 37 tph (108%) |
| Maximum daily capacity : 837 t (112%) | Recycle rate : 3-3.5 |
| pipe reactor temperature : 155 -165 ºC | pipe reactor pressure : 4 – 5.5 kg/cm2 |
| NH3 separator vapour temp. : 8 – 13 ºC | Phosacid liquor to X-PR : SPG 1.3 N/P 0.4 |
| Granulator bed temperature 100 – 105 ºC | Dryer product outlet temp.: 92 – 97 ºC |
| Dryer inlet air temperature: 120 –125 ºC | Dryer outlet air temperature : 80 – 85 ºC |
| Tail Gas pH : 4 – 5 | Crushing strength : 2 – 2.8 kg/cm2 |

- **14.35.14 Production**

A performance test was successfully carried out on July 2000, with the following results.

| PARAMETER | GUARANTEED | OBTAINED |
|---|---|---|
| Average capacity tpd in 22h | 850 | 872 |
| N % wt | 13.4-14.6 | 13.5 |
| P2O5 % wt | 34.4-35.6 | 35.2 |
| K2O % wt | 13.4-14.6 | 13.8 |
| H2O % wt | 1-1.5 | 0.9-1.5 |
| 1-4 mm | 90% min | 95-99 (Less 1 mm, nil) |
| Ammonia consumption kg/t | 174 | 172.1 |
| P2O5 consumption kg/t | 357 | 356.7 |
| Potash consumption kg/t | 236 | 233.6 |
| Fuel-oil consumption kg/t | 8.0 | 5.1 |
| Power consumption kWh/t | 41 | 44.7 |

Main process parameters were as follows :

| | |
|---|---|
| Production rate : 40 tph | Maximum average rate : 44 tph (114%) |
| Maximum daily capacity : 955 t (112%) | Recycle rate : 3-3.5 |
| pipe reactor temperature : 125 -140 ºC | pipe reactor pressure : 2.5 - 4 kg/cm2 |
| NH3 separator vapour temp. : 7 – 8 ºC | Phosacid liquor to X-PR :SPG 1.5, N/P 0.5 |
| Granulator bed temperature 92 – 95 ºC | Dryer product outlet temp.: 90 – 95 ºC |
| Dryer inlet air temperature: 135 –140 ºC | Dryer outlet air temperature : 80 – 85 ºC |
| Tail Gas pH : 4 – 5 | Crushing strength : 3 - 3.5 kg/cm2 |

- **Scrubbing system performance**

| | Guaranteed | Obtained |
|---|---|---|
| Ammonia at stack, ppm | Less than 50 | 21-34 |
| SPM at stack, ppm | Less than 50 | 30-40 |
| Fluorine at stack, ppm | Less than 10 | 1.4-2.0 |

## 6. Incro's Atmospheric Evaporation Technology

### 6.1 Introduction

Incro's Atmospheric Evaporation Technology is specially recommended for any kind of Iiquid effluent of difficult treatment using standard techniques.

The process, as well as the equipment, is protected by the patents nr. 8901329 and 9300242 acquired by Incro. The process has been homologated in several countries, France and Spain among them.

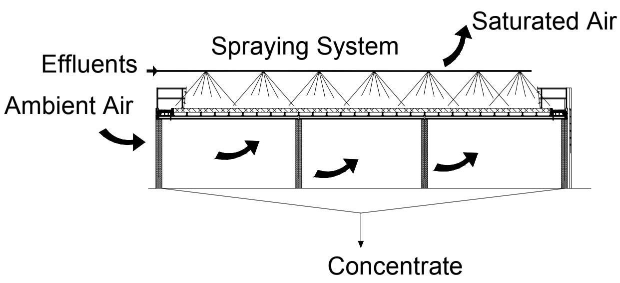
### 6.2 Process description

The liquid effluent treatment by means of atmospheric evaporation is based on the capacity of non-saturated air for absorbing water.

The main characteristic of this process is the transference of water from the effluent to the air stream that takes place in the two fluids interface. The most important parameters in this phenomenon are the contact surface and the temperature and relative humidity of air.

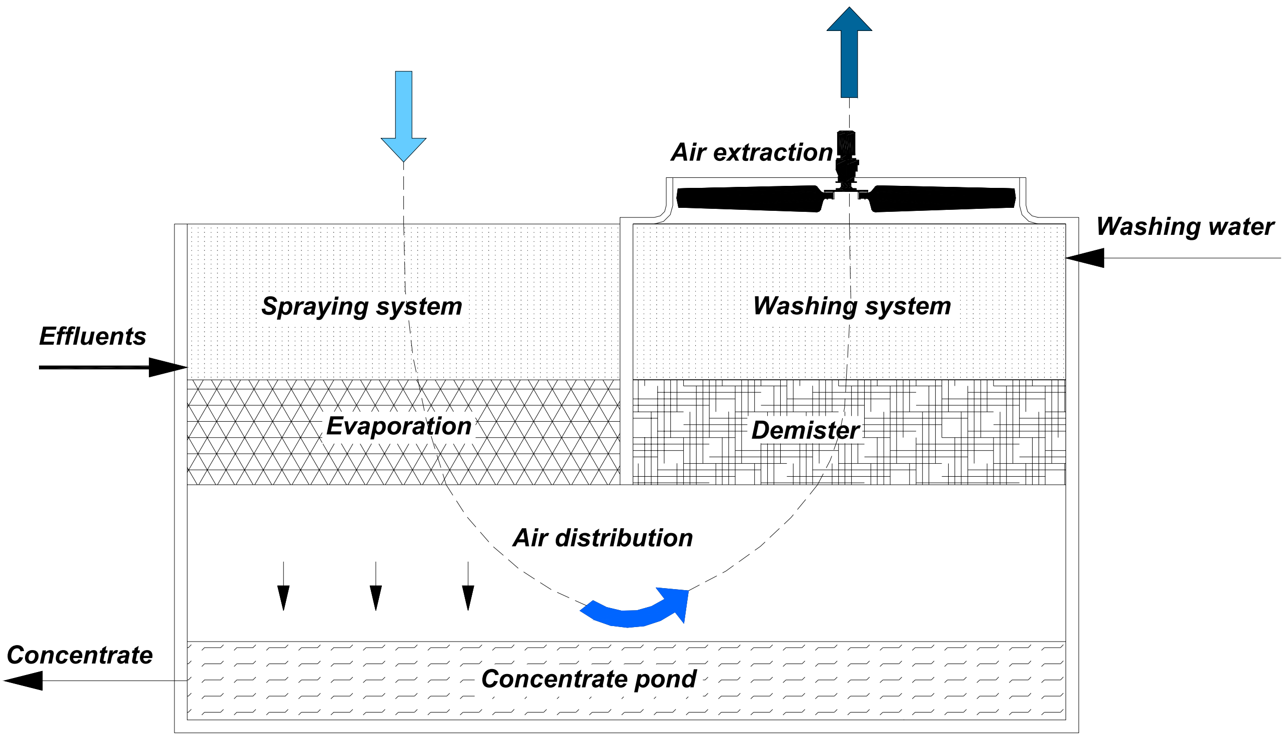
An special "Atmospheric Evaporation Panel (AEP)" has been developed in order to reach a high specific surface with a very low pressure drop. It consists of an air/liquid surface of contact made up of 3D-cells, specially designed to have a strong resistance to be plugged with the heavy charged liquids they have to handle. These "AEPs" are resistant to chemical attack (normally made of high density polyethylene, although some other materials have also been used).

The initial systems were designed as natural evaporation systems that use renewable energies, sun and wind, for the evaporation. Power was only required for the waste water circulation. These systems were successfully installed in many licensed plants but their performance was closely related to the wind speed and the exhaust gas was containing some entrained droplets.

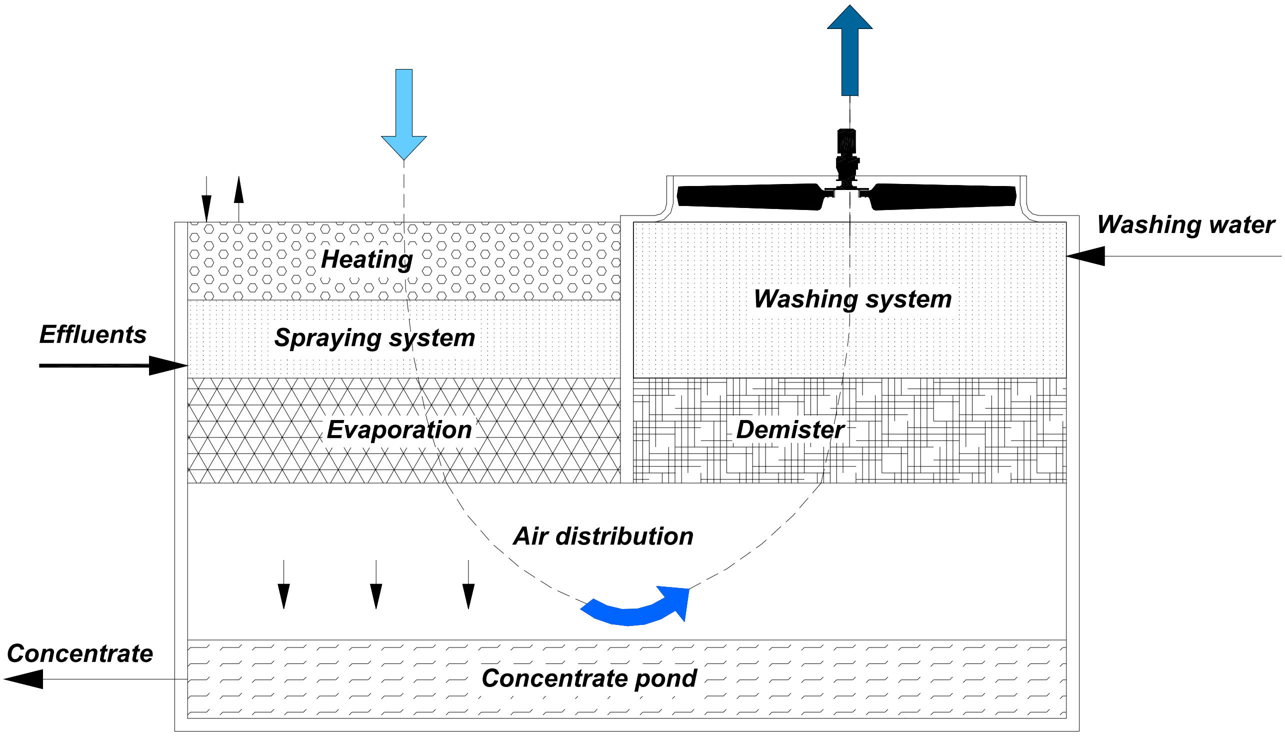



As experience was gained, two new closed mechanized systems with droplets separation systems were designed: EM and EMC-systems.

EM-systems (Mechanized Evaporation) use mechanical energy from efficient axial fans in order to avoid the wind dependency. "AEPs" are encapsulated in a civil work building. A final demister is installed to prevent droplets entrainment. Washing system for AEPs and demister is installed, all the operations being controlled by a PLC.




EMC-systems (Heated Mechanized Evaporation) are enhanced EM-systems that use any residual thermal energy (steam, hot water…) by means of heat exchangers. These systems are practically independent of atmospheric conditions. They are especially suitable for cogeneration plants and dumps with biogas production.



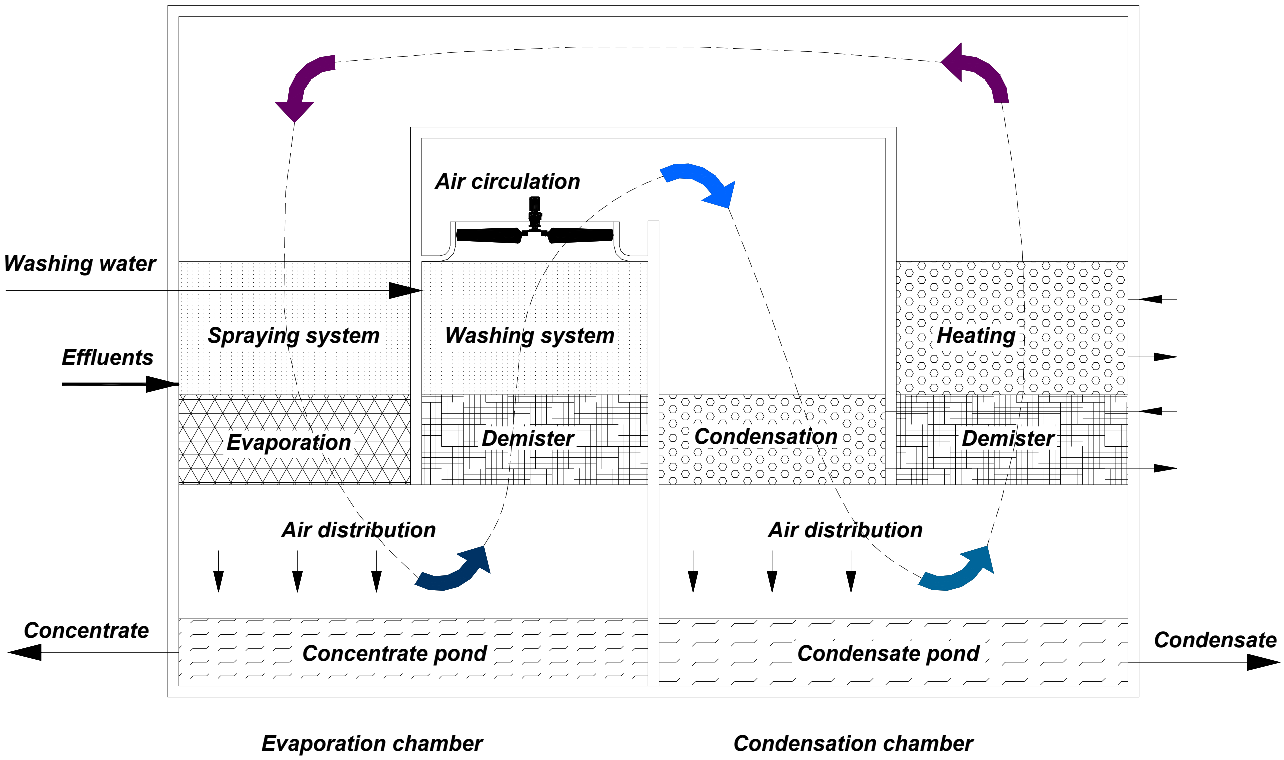

ECO-System: Evaporation-Condensation

Recently, Incro, S.A. has developed a new process of evaporation-condensation based on its EMC system. This process, initially designed for seawater and brines to produce desalinated water, it is also suitable to treat any type of effluent when water must be recovered. This is of particular interest in those areas where water supply is scarce or when no gas effluent is allowed.

The ECO system consists of two modules: an evaporation chamber and a condensation chamber.

The evaporation chamber is similar to the module of EMC system.

ln the condensation chamber the wet air stream leaving the evaporator is partially condensed. In some applications the same feeding is used as a cold source. The air stream, once it has been desiderated in the condensation chamber, is recirculated to the evaporation chamber so that, the air flows in a closed circuit and therefore there are no emissions to the atmosphere.




## 6.3 Technology advantages

### 6.3.1 Operation and maintenance

Incro S.A. atmospheric evaporation plants are completely automatic; they do not use chemical reagents and require low maintenance. The plant operates without any personnel, all the operations being controlled by a PLC, which takes care of the normal operation as well as the periodical cleanings. Therefore the operating cost is very low.

### 6.3.2 Environment

lncro, S.A. plants are environmentally friendly.

There are no liquid effluents because the concentrate produced by evaporation is reused in the granulating section, in other cases for composting (manure and municipal refuse lixiviate) or to many different applications.

Gas emissions comply with the most stringent international regulations. Particles and droplets are removed on demisters. In the ECO configuration gas emission is completely avoided, since the gas stream is in a closed circuit.
In the ECO configuration water is obtained through gas condensation. This water can be again re-used into the process. The quality of the water could be even similar to distilled one, excluding the presence of volatile substances.

Incro's atmospheric evaporation technology has been tested and eventually approved by the French and Spanish authorities as a suitable technology to treat liquid effluents. In France its installation is also subsidized with a 30% of total investment.

#### 6.3.3 Capacity

Incro S.A. systems are modular. Any effluent flow can be treated just by changing the number of evaporator modules.

### 6.4 Research

Incro owns three portable pilot plants: one for evaporation and two flexible plants for evaporation or evaporation-condensation. They are simply set up in the field and allow Incro to obtain, with high accuracy, the design parameters to treat any liquid disposal. At the same time they allow for a continuous research and development.

Incro's evaporation-condensation pilot plan

## 7. References

Because evaporation is not a chemical, but a physical process it is applied to any kind of waste, regardless of the chemical composition or concentration.

Currently, there are more than 40 licensed plants that have been working for more than 10 years in the chemical industry (fertilizers, explosives, petrochemical, colouring matters), the food industry (olive oil, olive, wine, champagne...), salt mines, dumps and farms in Spain, France, Dominican Republic, ltaly and Malaysia.

Four EMC modules for salts solution. 75000 m3py. Inquevap, Huesca (Spain)

This process has been applied twice into fertilizer plants, for Fertiberia in Cartagena, Spain and for Petronas-Nafas in Malaysia.

The Fertiberia plant was equipped with an E-system, which was capable of reducing the 2 m3/h liquid effluent from the scrubbing system to 0.5-1 m3/h concentrate. The system was equipped with a pond and the concentrate recovered at different rate depending on the manufactured NPK.

The Petronas plant has been designed to evaporate 22000 m3/year of water from the liquid effluent generated in the scrubbing system of fertilizer plant, being all the concentrate recovered into the granulation section (granulator and/or pug-mill). Due to the hot and humid ambient conditions in Malaysia heat application is absolutely required to evaporate the water from the effluent. Consequently an EMC-system has been installed, using residual heat. The EMC-system has been located on the NPK production building roof, not only to save land, but also to minimize the transfer distance for the concentrate. This plant is due to be commissioned next year.