CRYSTALLIZATION

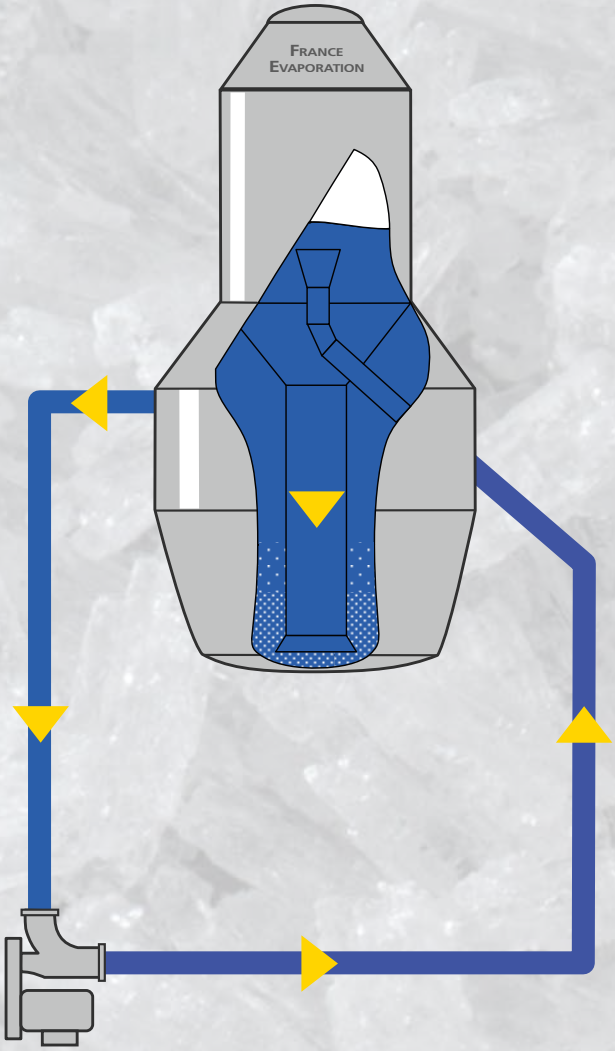
Crystal clear solutions

Discover our exclusive IFC® technology

- HIGHER MEDIUM CRYSTAL SIZE
- NARROWER SIZE DISTRIBUTION
- LESS FINES

- CHEMICALS
- SALTS AND MINES
- FERTILIZERS
- AGRI-FOOD
- WATER AND WASTE TREATMENT
- PHARMACEUTICALS AND COSMETICS

France évaporation



OSLO (fluidized bed)

THE PROCESS

The crystals are fluidized at the bottom of the crystallizer using an external axial pump which contains the mother liquor in the upper part and returns them to the crystallizer.

This efficient technology requires frequent cleaning inherent to its operating principle (clogging by precipitation of the central tube linked to the supersaturation without the presence of crystals).

ADVANTAGES

- **Production of very large crystals**
- **Good size distribution**

DISADVANTAGES

- **Careful operating required**
- **Very frequent cleaning required**
- **Size of the installation is greater than on DTB or IFC® technologies for the same particle size**

IFC®: INDIRECT FORCED CIRCULATION

PERFORMANCE OF THE OSLO - FLEXIBILITY OF THE DTB

The OSLO technology was the first to solve the problem of crystal breakage and attrition in forced circulation. In fact, in this process, no crystals pass through the pump: the magma is fluidized by the mother liquor.

Very efficient, OSLO crystallizers produce the largest crystals and have the best particle size distribution. However, they are very difficult to operate.

The DTB technology comes close to the performance of the OSLO, with a low-energy internal pump, and required baffles for the fines destruction. It is much easier to operate than the OSLO.

Our IFC® technology, based on a Crystal Evap Consult patent, combines the performance of both systems: the crystals do not pass through the circulation pump and keep a great operating flexibility.

IFC®: high performance crystallization technology

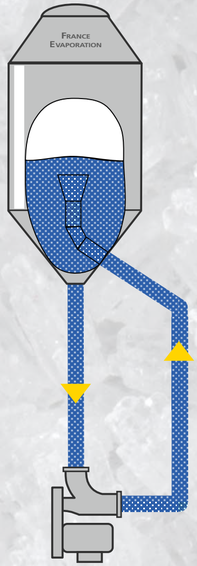
The patented IFC® technology allows the deployment or evolution of **very high performance crystallizers,** both in terms of quality of the crystals and of energy efficiency of the installations.

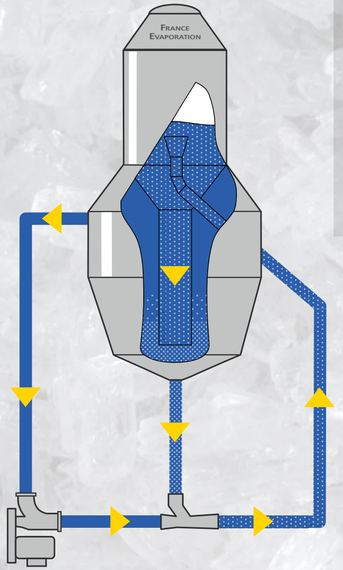
The IFC® technology solves the problems of clogging observed with the OSLO and contact between the crystals and the agitator in the DTB.

Forced circulation

THE PROCESS

Forced Circulation is the most widespread continuous crystallization technology as it is the simplest, oldest and most economical.
The homogeneous mixture of crystals in the crystallizer is circulated by an external pump. The significant contact between the crystals and the pump's impeller limits the size of the crystals (important secondary nucleation). This type of crystallizer is suitable for production without size constraints.
Forced Circulation is used in many industries, including ZLD (zero liquid discharge) units.





ADVANTAGES
- **Low investment**
- **Easy to manage**
- **Compact**

DISADVANTAGES
- **Small crystal size**
- **Significant production of fines**
- **Very large particle size distribution**

Draft Tube (DT) or Draft Tube Baffle (DTB)

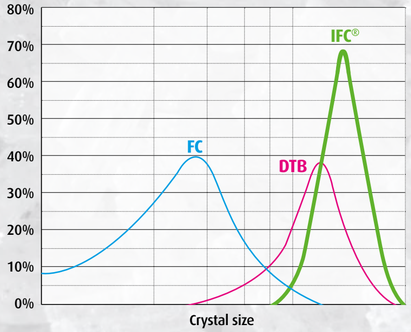
THE PROCESS

The draft tube crystallizers (DT or DTB) ensure the homogeneous mixture of the crystals with an internal axial pump.
The energy supplied by the pump is much lower than that deployed by Forced Circulation, which significantly reduces attrition and breakage of the crystals, with a significant reduction in secondary nucleation.

ADVANTAGES
- **Larger crystals than those obtained through Forced Circulation (FC)**
- **Better particle size distribution compared to forced circulation (FC)**

DISADVANTAGES
- **Particle size performance inferior to the OSLO or IFC®**
- **Risk of higher energy consumption than FC, OSLO or IFC®**

SIZE AND AVERAGE DISTRIBUTION BY TECHNOLOGY



HOW IT WORKS

The crystals naturally move towards the mixer located underneath the crystallizer.
The mother liquors from the crystallizer tranquil zone are circulated to transport crystals on the top of the crystallizer.

COMPARISON OF THE CRYSTALLIZATION TECHNOLOGIES

	CF	OSLO	DTB	IFC®
Secondary nucleation	High	Low	Medium	Low
Distribution of crystal size	Spread out	Tight	Average	Tight
Average crystal size (D50)	Small	High	Average	High
Production of fines	Significant	Low	Average	Low
Cycling problem	None	Significant	To be managed	Managed
Required cleaning frequency	Low	High	Low	Low
Investment	Low	High	Average	Average
Operating cost	Low	Average	High	Average

BETTER QUALITY CRYSTALS

Unlike OSLO technology, a significant quantity of crystals is transferred to the supersaturation zone at the top of crystallizer, which eliminates clogging problems and permits the growth of the crystals.
The absence of secondary nucleation has several advantages:
- **The average size of the crystals obtained is much greater compared with Forced Circulation technology and slightly greater compared with DTB**
- **The size distribution of the crystals is closer with the D50**
- **The production of fines is very low, which avoids the use of crystal recycling facilities**

ECONOMIC BENEFITS

For a comparable investment in DTB technology, IFC® benefits from a reduced operating cost.

EXAMPLES

- Sodium sulphate Na_2SO_4: D50 > 350 µm with IFC® for D50 <250 µm with other technologies
- Very tight crystal size distribution of ammonium sulphate $(NH_4)_2SO_4$. For a D50 of 2.5 mm, 25% of crystals smaller than 1.8 mm for the DTB as against less than 15% with the IFC®

A comprehensive expertise in crystallization

In chemistry, biochemistry, thermal and mechanical engineering, France Evaporation gathers a complete team of engineers specializing in crystallization processes. This is your guarantee of an expert approach to your requirements.

15 years of experience

Our teams have been designing, producing, installing and monitoring crystallization facilities for over 15 years. They have accumulated extensive experience in several industries:

- **Chemicals**
- **Salts and mines**
- **Fertilizers**
- **Agri-food**
- **Waste and water treatment**
- **Pharmaceuticals and cosmetics**

Comprehensive services

France Evaporation works on your whole projects, using a tried and tested methodology which is precise and comprehensive:

- **Facility auditing**
- **Project engineering**
- **Industrial design**
- **Test units / Pilot units**
- **Sourcing**
- **Production monitoring**
- **Installation and start-up**
- **Facility monitoring and upgrade**

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