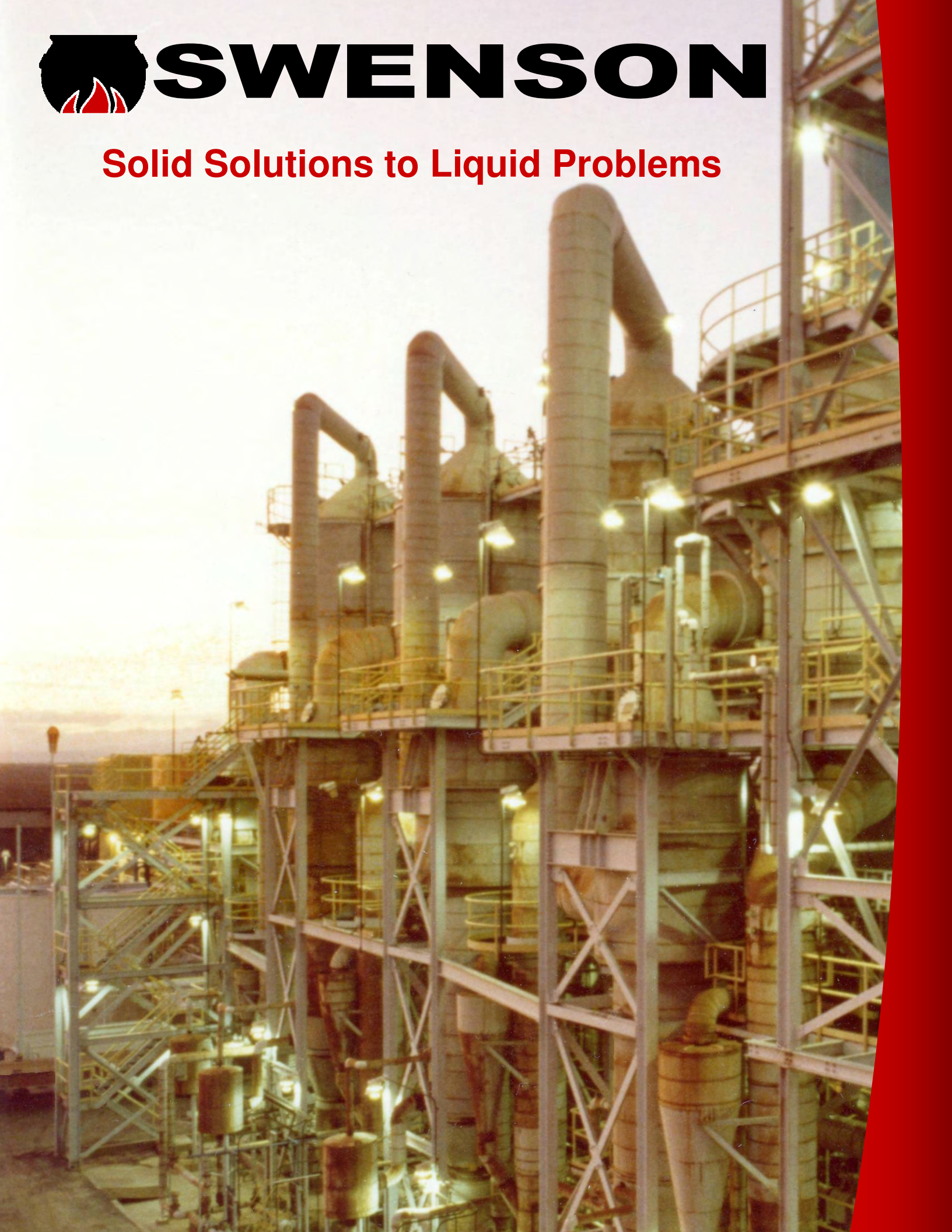
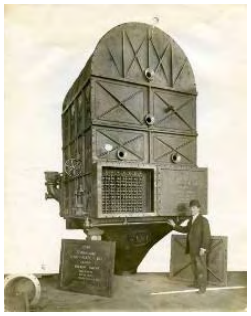
SWENSON

Solid Solutions to Liquid Problems



SWENSON is a global leader in the design and supply of chemical process equipment for separation. We specialize in designing and installing innovative systems to convert liquid solutions into dry solids using evaporation, crystallization and drying.



Thousands of evaporators, crystallizers, dryers and other process equipment have been installed around the world and bear the SWENSON name.

Swenson equipment is designed and fabricated to provide optimum results under customer-specified operating conditions. Each project is unique and requires its own unique process design solution.

In some cases, it is essential to analyze the feed stream at our Swenson Test Center in Harvey, Illinois. There, we are able to perform preliminary test runs in specialized glassware or in pilot equipment. In other cases, we have designed and installed pilot plants for use by customers.

For every installation, Swenson engineers combine their years of expertise with proprietary design and operating data and state of the art software modeling to develop innovative, dependable solutions for our clients.

We have the capability to handle project scopes ranging from process development, engineering studies and packages to equipment supply as individual components, modules, complete systems and turn-key installations.

We have long-established relationships with strategic suppliers and partners to execute projects with local coordination and global sourcing.

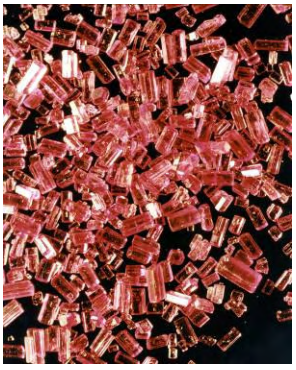
TEST CENTER

Swenson has long recognized that the information available through testing is crucial to the success of the ultimate full-scale application and has maintained test facilities for over 90 years.

Our test center, located in Harvey, Illinois, is equipped for laboratory analysis, bench-scale process development in glassware, research and development as well as pilot scale operation. We can perform feasibility testing of virtually any product in either laboratory or pilot scale and have worked with more than 700 different compounds.

Pilot facilities include a rising film and falling film evaporator, three forced-circulation evaporative crystallizers and two draft tube baffle crystallizers.

The test center also maintains a variety of dryers for testing purposes. These include a steam tube dryer, a fluid bed dryer, a suspension (flash) dryer, a mixed-flow spray dryer, a parallel-flow spray dryer, and a rotary air swept dryer.



The test center is equipped with everything necessary to turn a liquid feed into a dry solid. Operational tests are designed so that the test product will resemble the final product as closely as possible for customer evaluation.

Using these test results Swenson engineers can assist customers in making knowledgeable decisions and recommend the appropriate equipment. Your solutions may be tested in these various models, the results compared, and the best design offered for the required product characteristics.

EVAPORATORS

An evaporator is used to evaporate a volatile solvent, usually water, from a solution. In some applications this results in the precipitation of crystals, which are usually separated from the solution with cyclones, settlers, wash columns, elutriating legs, filters or centrifuges. The desired product can be the concentrated solution, the precipitated solids, or both.

Swenson designs three general types of evaporators:

The Rising-Film long-tube vertical evaporator is commonly used to concentrate many non-scaling types of liquor. Liquor enters the bottom of the tubes and is heated to boiling. The expansion of the vapor carries the liquor out the top of the tube.

The Falling-Film long-tube vertical evaporator is preferred for heat-sensitive liquors. A film of liquor flows down the inside of a tube and is circulated to maintain the required flow.

For applications where precipitates are formed during evaporation, a Forced Circulation evaporator is the best choice. The liquor in a Forced-Circulation evaporator is pumped through the tubes to minimize tube scaling when precipitates are formed during evaporation. A variety of designs are available to meet the needs of particular applications.

MULTIPLE EFFECT (ME)

The multiple-effect configuration combines two or more evaporator bodies to conserve steam. Process vapor from the first-effect vapor body is condensed in the second-effect heat exchanger, which provides energy for evaporation in the second-effect vapor body (and so on for additional effects). Vapor from the last effect flows to a condenser.

MECHANICAL VAPOR RECOMPRESSION (MVR)

Increasing energy costs have justified the increased use of mechanical recompression evaporators. Vapor from an evaporator is compressed (with a positive-displacement, centrifugal or axial-flow compressor) to a higher pressure so that it can be condensed in the evaporator heat exchanger. Only the difference in enthalpy needs to be supplied and no condenser is needed. Mechanical recompression is most practical with large heat-transfer areas and low boiling-point elevation liquors.

THERMAL VAPOR RECOMPRESSION (TVR)

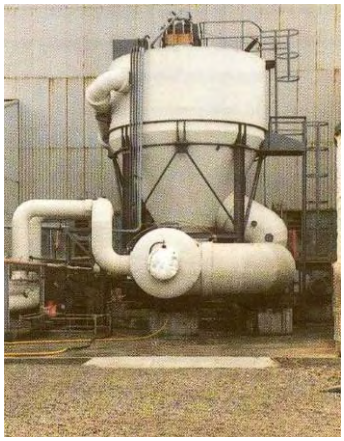
To reduce energy consumption, a portion of the vapor from an evaporator is compressed with high pressure steam in a thermocompressor so it can be condensed in the evaporator heat exchanger. The resultant pressure is intermediate to that of the motive steam and the water vapor. The remaining vapor is condensed in the next-effect heat exchanger or a condenser.

CRYSTALLIZERS

Swenson designs a wide range of crystallizers for the chemical process industries.

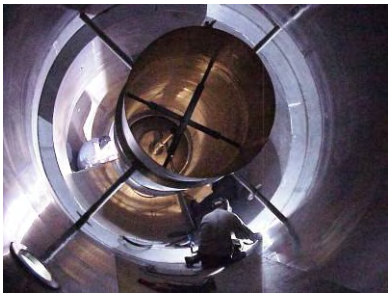
For feeds where high rates of evaporation are required, where there are scaling compounds, where crystallization is achieved in inverted solubility solutions, or where the solution is of relatively high viscosity, the Forced Circulation (FC) Crystallizer is the best choice.

For special cases requiring very low operating temperatures only achieved by extraordinarily high vacuum, the Batch Vacuum Crystallizer is still a good choice, costing less to operate than a continuous vacuum crystallizer.



For operation at temperatures below which it is not economically possible to use vacuum equipment, or with solutions with very high boiling point elevations, the Surface-Cooled Crystallizer using a shell and tube exchanger is supplied.

The Draft Tube Baffle (DTB) crystallizer is the most successful of the crystallizers designed to make the large, uniform crystals required for fertilizer and similar applications where superior filtration, centrifugation, washing, drying, and storage characteristics are required. This Swenson design is the result of years of ongoing research and development as well as proven plant operation in many installations.

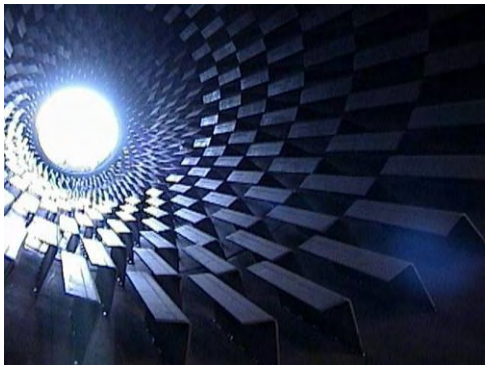


This crystallizer includes a baffle section surrounding a suspended magma of growing crystals from which a stream of mother liquor is removed containing excess fine crystals. These fines can be destroyed by adding heat, water or unsaturated feed solution. The magma is suspended by means of a large, slow-moving propeller circulator which fluidizes the suspension and maintains relatively uniform growth zone conditions. The operating slurry density within the crystallizer can be raised to any convenient value by regulating the slurry underflow rate and removing the remaining mother liquor from the baffle section.

DTB Crystallizers are capable of producing large singular crystals with a narrow crystal size distribution. They are well suited for reactive crystallization, where a solid phase crystalline material results from the reaction of two components. The reactants are mixed in the draft tube of the DTB unit where a large volume of slurry is mixed continuously with the materials to minimize the driving force (supersaturation) created by the reaction.

DRYERS

Swenson designs Rotary, Spray, Fluid-Bed, and Flash Dryers and Coolers. The type of dryer best suited for a particular application depends upon both the feed characteristics and desired product characteristics. With this extensive product line Swenson can provide expert solutions for a wide variety of drying problems.



ROTARY DRYER

Used for fairly free flowing feeds, with a narrow to wide particle size distribution and for both small and large size particles. Wet and pasty materials can be dried when the feed is back-mixed with dry product. Air flow can be parallel or counter current to the solids flow.

ROTARY STEAM TUBE DRYER

The Steam Tube Dryer is a rotating cylinder containing rows of steam tubes designed to transfer heat from the steam to the material being dried. Together with radial flights, the tubes serve to agitate the material and to provide uniform mixing and drying.

The thermal efficiency of the dryer is very high and heat loss through the cylinder wall is minimal, because the steam tubes are completely enclosed by the dryer.

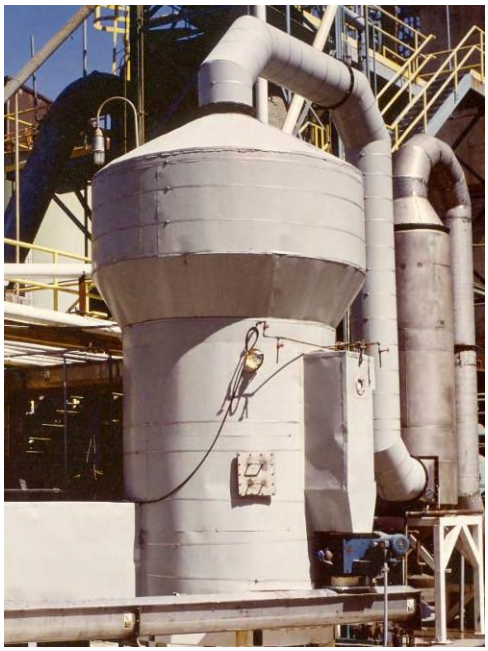
ROTARY COOLER

Used to cool hot material discharging from a dryer. Air flow is typically counter current to solids flow.

SPRAY DRYER

Spray dryers atomize the feed and contact warm air. They can be configured for parallel, reverse, or mixed-flow operation. Used when the feed is a solution or slurry the product produced is generally a fine powder. The exhaust gases can be scrubbed and recycled for closed loop operation.

FLUID BED DRYER



The Fluid Bed Dryer provides optimum heat transfer efficiency. Used for drying fairly free flowing feeds with a fairly narrow particle size distribution and medium size particles. A fluid bed dryer can be provided with multiple zones to match the drying operating conditions with the material drying characteristics.

FLUID BED COOLER

Used for cooling fairly free flowing materials, with a fairly narrow particle size distribution and medium size particles. Air flow is perpendicular to solids flow. Fluid bed coolers can be provided with internal cooling coils can be provided for additional heat removal. The fluid bed cooler can be the final zone of the fluid bed dryer.

FLASH DRYER

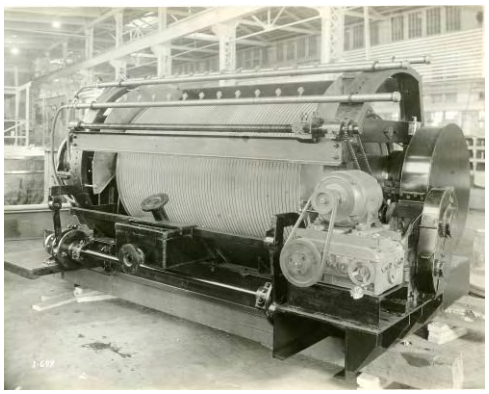
The Flash Dryer is suitable for drying a wide variety of materials. The product is dried in a hot gas stream which pneumatically conveys the material through the body of the dryer. The product is in intimate contact with the gas stream for a short time which is ideal for removing free moisture from the surface of the material being dried. Flash dryers can be easily adapted for closed-cycle operations.

AUXILIARY EQUIPMENT

Swenson can provide all necessary auxiliary equipment for dryers and coolers to provide a completely integrated system.

FILTERS

Swenson makes rotary drum filters for separating and dewatering slurries. They come in two basic configurations; vacuum and top-feed.



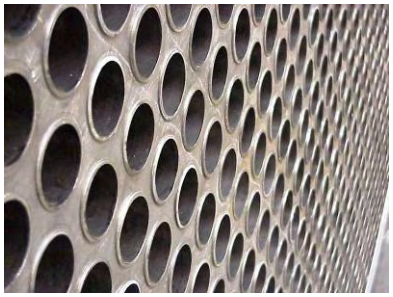
These units operate as a combination filter and dryer. They can dry salts which normally form hydrated crystals to the anhydrous phase without special methods of operation.

These rotary filters are easy to maintain and keep clean. Because they operate at low speed they have a long service life.

HEAT EXCHANGERS

Shell and tube heat exchangers are used for the majority of Swenson evaporator installations. The heating medium is almost always steam which is normally condensed on the outside of the tubes to heat the liquor or slurry which flows inside the tubes.

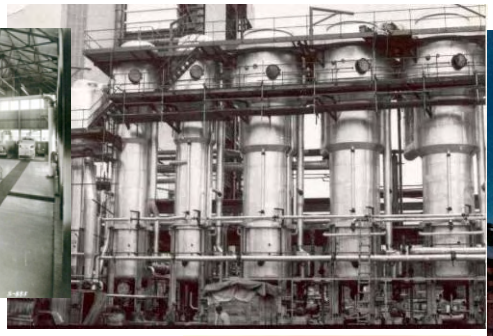
Both vertical and horizontal tube heat exchangers are utilized. The majority of Swenson installations use vertical-tube heat exchangers. The horizontal exchanger is used for installations with limited headroom or where maximum liquor submergence is needed to prevent surface boiling and subsequent salt precipitation on the tubes.

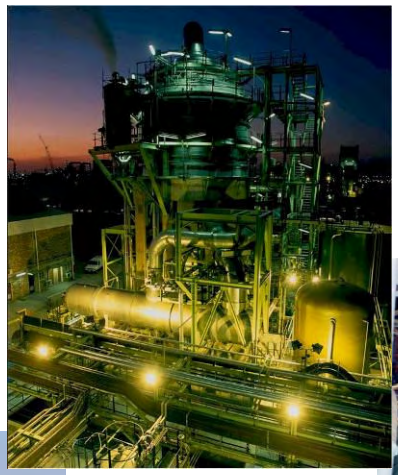


Heat exchangers are typically one or two passes and are designed for relatively low temperature rises in the solution. This limits the supersaturation of scaling components when heating materials of inverted solubility. In most applications, the steam-to-liquid delta T is also limited to prevent mass boiling within the tubes or vaporization at the tube wall.

PROVIDING SOLID SOLUTIONS TO LIQUID PROBLEMS














SWENSON®

EQUIPMENT FOR THE PROCESS INDUSTRIES

CONDENSERS
- Direct Contact
- Digester Blow
- Surface

COOLERS
- Flash
- Fluidized Bed
- Rotary
- Spray

CRYSTALLIZERS
- Batch
- Draft Tube
- Draft Tube Baffle
- Forced-Circulation
- Surface Cooled
- Reaction
- Decomposition
- Recompression (MVR/TC)
- Thermocompression
- Spray Evaporators

DRYERS:
- Fluidized bed, Direct Fired / Indirect
- Rotary, Direct Fired / indirect / Steam Tube
- Spray, Mixed / Parallel / Reverse Flow
- Flash, Direct Fired / Indirect

EVAPORATORS
- Calandria
- Forced-Circulation
- Falling-Film LTV
- Rising-Film LTV
- Multi-Stage Flash
- Natural Circulation
- Recompression (MVR/TC)

FILTERS
- Top Feed
- Rotary Drum Vacuum

HEAT EXCHANGERS
- Direct Contact
- Shell and Tube

TESTING FACILITIES
- Laboratory
- Bench Scale Tests
- Pilot scale equipment
- Evaporation
- Crystallization
- Drying
- Cooling
- Filtration

From solution to slurry to crystals to dry product SWENSON handles every step

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