



LCI

Part of the Nederman Group

Evaporation Technologies

Thin Film, Wiped Film, High Viscosity, Short Path & Thin Film Drying

LCI Corporation

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Leading through Commitment and Innovation

The LCI Advantage:

- Diverse equipment lineup encompassing thin film evaporation technologies.
- Superior equipment quality enabling long equipment lifetimes.
- Extensive knowledge depth including hundreds of years in accumulated evaporator experience.
- Comprehensive engineering support assisting process troubleshooting and design.
- Rapid aftermarket response including a 24-hour helpline and selective local stock.



Superior Technology and Expertise

Since our beginning as LUWA in 1961, LCI has provided thousands of systems into a wide variety of applications: chemical manufacturing, specialty polymers, food products, and pharmaceuticals. Our ability to provide tailored engineered solutions has made us widely recognized as the leader in agitated thin film evaporation technology.

LCI Development & Support

LCI provides the support you need from preliminary evaluation through delivery and continuing operation.

1. Preliminary Evaluation

Fully identifying your processing needs is the first step toward providing you with a comprehensive solution. LCI's Preliminary Evaluation Services (PES) will quickly and inexpensively determine if one of our technologies could meet the requirements of your application.

2. Testing Services

If samples and data on particular feed materials are crucial to developing the right solution, LCI pilot testing services allow you to generate those samples and observe the process in operation. Our test center is the most comprehensive in the industry and is fully staffed and equipped for your most demanding developmental work. Alternatively, test at your own facility using one of our lease units with guidance from our trained process engineers.

3. Final Design & Proposal

Drawing on data gathered in your earlier design stages, our technology specialists and engineering staff create fixed price proposals and established lead times.

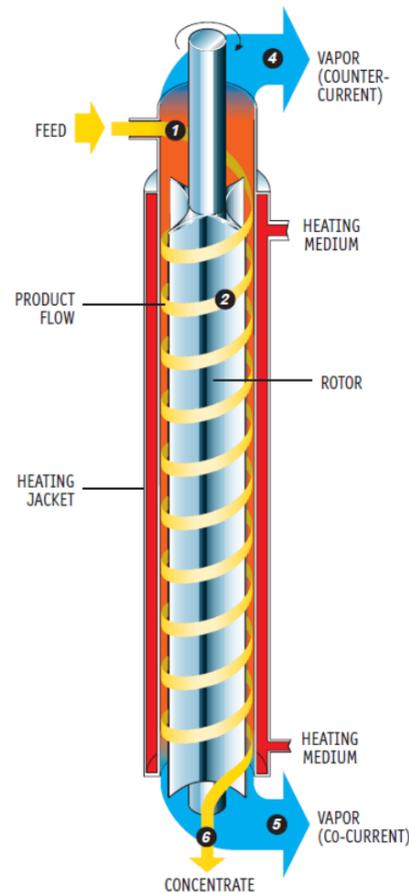


4. Final Design & Proposal

Our steadfast commitment to customer satisfaction means your project will be completed on time, within budget, and at the highest quality possible. That commitment doesn't end with startup; it continues through the long life of your LCI system. We're always on call and eager to help – with technical advice, troubleshooting in the field or promptly supplied replacement parts.

A permanent record of your system is maintained in our Charlotte, NC headquarters. Should you need a major overhaul or component repair, LCI shops are equipped to act quickly.

Agitated Thin Film Evaporation



LCI thin film evaporation technology quickly separates volatile from less volatile components using indirect heat transfer and mechanical agitation of a flowing product film under controlled conditions.

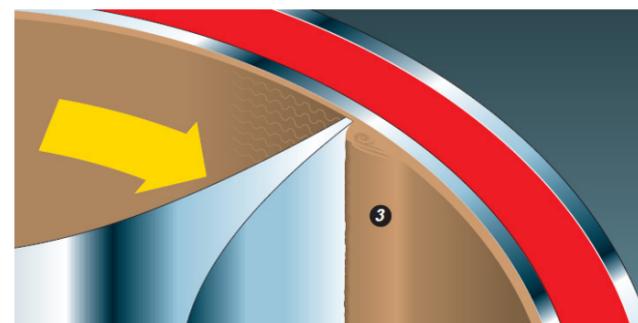
Short residence time and open, low pressure drop configuration allow continuous, reliable processing of many heat sensitive or viscous materials without product degradation.

An inherently simple device, the LCI agitated thin-film evaporator consists of two major assemblies: 1) a heated body and 2) a rotor.

Products enter ① above the heated zone and is evenly distributed over the unit's inner surface by the rotor. As the product spirals ② down the wall, bow waves ③ developed by the rotor blades generate highly turbulent flow, resulting in optimum heat flux and mass transfer.

Volatile components are rapidly evaporated. Vapors flow either counter-currently ④ or co-currently ⑤ through the unit, depending on the application. In both cases, vapors are ready for condensing or subsequent processing.

Non-volatile components are discharged at the outlet ⑥. Continuous agitation by the bow waves minimizes fouling of the thermal wall where product or residue is concentrated most.



The combination of:

- Short residence time
- High film turbulence
- Narrow residence time distribution
- Rapid surface renewal
- Minimal hydraulic head
- Small material hold up

permits the LCI thin film evaporator to successfully handle heat-sensitive, viscous, and fouling-type fluids.

High Viscosity Processors

LCI High Viscosity Processors are specially designed thin film evaporators capable of handling extremely viscous liquids. LCI High Viscosity Processors provide concentration, devolatilization, reactions, and processing for various other viscous separations.

High heat and mass transfer rates, combined with continuous, reliable operation make LCI High Viscosity Processors the perfect evaporation solution for viscous products such as polymers, plastics, resins, and food products.

LCI High Viscosity Processors Provides:

- High maximum viscosity capabilities (10,000,000 cP)
- High volatile splits (up to 90%)
- High product surface-to-volume ratios
- Small material hold up
- Lower total energy costs
- Less and highly localized shear
- Moderate residence time control
- Minimal quality defects ("black spec", "fish eyes", etc.)



Short Path Evaporation



Short-path evaporation (also called molecular distillation, sometimes SPE) is a thermal separation technique that provides minimum pressure drop, permitting high vacuum operation down to 0.001 mbar. Short-path evaporation is excellent for gently processing heat sensitive, high boiling products.

LCI Short Path Evaporators Provide:

- Smallest pressure drop for deep vacuum service
- Low residence time of a few seconds
- Moderate maximum viscosity
- Excellent turn down capability
- Low product holdup
- Small system footprint due to internal condenser

Thin Film Drying

LCI thin film dryers convert slurries to powder in one system. LCI thin film dryers are used in a wide variety of process duties including drying, stripping, cooling, reacting, devolatilizing, de-monomerizing, and melting.

LCI's Vertical and Horizontal thin film dryers are being used in a multitude of installations worldwide. They can be heated by steam or hot oil, and can be operated semi-batch-wise or continuously from vacuum to pressure. The Vertical and Horizontal designs can also be combined via Combi-Dryer for multi-stage drying processes.

Horizontal Dryer

- Able to produce "bone dry" solids in a single pass
- Moderate residence time control
- Small product hold-up
- Superior mixing efficiency
- Self-cleaning heated surface
- Process flexibility with configurable rotor elements
- Reduced energy use (1.15 lb steam/lb water boiled)
- Well suited to slurry and cake feeds



Vertical Dryer

- Able to produce free-flowing solids in a single pass
- Little to no thermal degradation of products
- Low residence time
- Reduced energy use (1.15 lb steam/lb water boiled)
- Well suited for solution and suspension feed Minimal thermal surface fouling due to pendulum blade action
- Fully enclosed design to process reactive, toxic, and hazardous substances



Lab and Pilot System Solutions

LCI's Lab and Pilot scale systems are ideal for product development and production on our scalable technology.

LabVap® System

The LabVap System brings the benefits of Thin Film Evaporation technology and couples it with small product holdup, making it ideal for initial research and development 3-A designs are available to suit the most stringent sanitary processing requirements.



LabVap Fast Facts	
0.25 ft ² Heated Surface Area	0.50 ft ² Heated Surface Area
■ Feed Rate: 2-20 lb/hr	■ Feed Rate: 2-40 lb/hr
■ Viscosity: 4,000 cP Max	■ Viscosity: 8,000 cP Max

D-Velpac® System

The D-Velpac is ideal for greater product generation and offers a wider range of solutions, making it ideal for customers needing pilot scale production or commercial unit sizing data.



LabVap Fast Facts	
0.25 ft ² Heated Surface Area	0.50 ft ² Heated Surface Area
■ Feed Rate: 2-20 lb/hr	■ Feed Rate: 2-40 lb/hr
■ Viscosity: 4,000 cP Max	■ Viscosity: 8,000 cP Max

Features and Benefits

- Test or Lease to quickly and efficiently determine feasibility of product development
- Minimal product required for operation
- Quick disassembly/assembly for ease in cleaning and inspection
- Available in different sizes and sanitary designs
- Customizable for your individual product's needs

Thin Film Drying Testing at the LCI Test Center

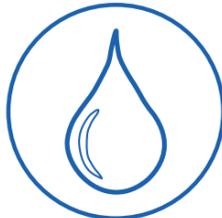
The LCI Test Center is your customized resource for Thin Film Drying product development and scale-up, and is the most comprehensive thin film development facility in the industry.

It is expertly staffed and equipped for process development work using LCI agitated thin film drying technology (evaporation, reaction, devolatilization, etc.).

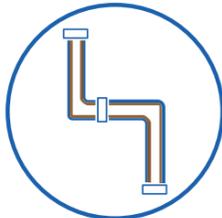
Our team of evaporation experts provide testing, design, and feasibility samples for your challenging thermal separation process according to your stringent process requirements.

Find confidence in your processing solution at the LCI Test Center.

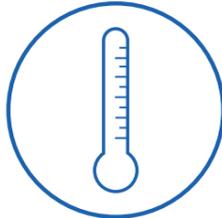
Thin Film Drying Solutions For Your Most Challenging Applications:



Viscous Products



Fouling Tendencies



Heat Sensitivity



Foaming



Our LCI Test Center is located in Charlotte, NC



LCI Thin Film Technology for:



Evaporation



Purification



Reaction



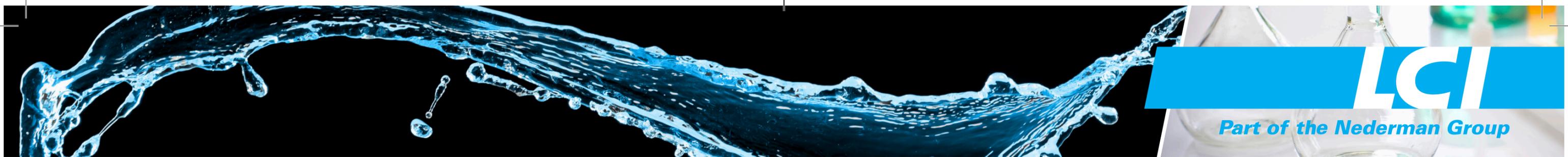
Devolatilization



The LCI Test Center has a wide variety of Thin Film Technology to test your challenging applications.

LCI Development Center Capabilities

- Thin film evaporators ranging in size from 0.25 - 5.4 ft² of surface area
- Various rotor designs that allow for processing materials from **1 - 15,000,000 cp**
- In-depth experience with flammable and other hazardous materials
- Hot oil systems provide heating temperature up to 750°F
- Vacuum systems provide operating pressures down to **<1 mm Hg absolute**
- Reactor vessels / tanks from 60 - 250 gallons
- Lab space for setting up special analytical procedures
- Flexibility for setting up special equipment and set up tailored systems
- Flexibility to process market development quantities of product
- **Explosion-proof** electricals (Class 1, Group C, Division 1)
- Steam heating system providing 200 psig steam



LCI Evaporation Solutions: Example Applications

Chemical

- Recycling solvents from paints, inks, oils, and resins
- Recovery of organic products from tars and residues
- Recovery of acetic acid from process streams
- Volume reduction of inorganic salt streams in the nuclear industry
- Recovery of polymer in plastic-coated paper recycling
- Recovery of catalysts from reaction residues
- Recovery of ethylene glycol from polyester condensate
- Purification and separation of components in petrochemicals and natural oils
- Purification of chlorinated hydrocarbons

Food

- Drying of lecithin to 99.5%
- Concentration of enzymes
- Purification of vitamins
- Concentration of cheese-related products to 65% TS
- Concentration of proteins
- Concentration of fruit and vegetables purees
- Concentration of egg products
- Cooking / caramelization of candies
- Stripping of glycerins from mono and diglycerides
- Concentrations of various sugar solutions to 99.9%
- Concentration of gelatin to 35%
- Concentration of omega-3 fatty acids

Pharmaceutical

- Concentration of penicillin and related products
- Desolventizing of delicate botanical and fermentation extracts/broths

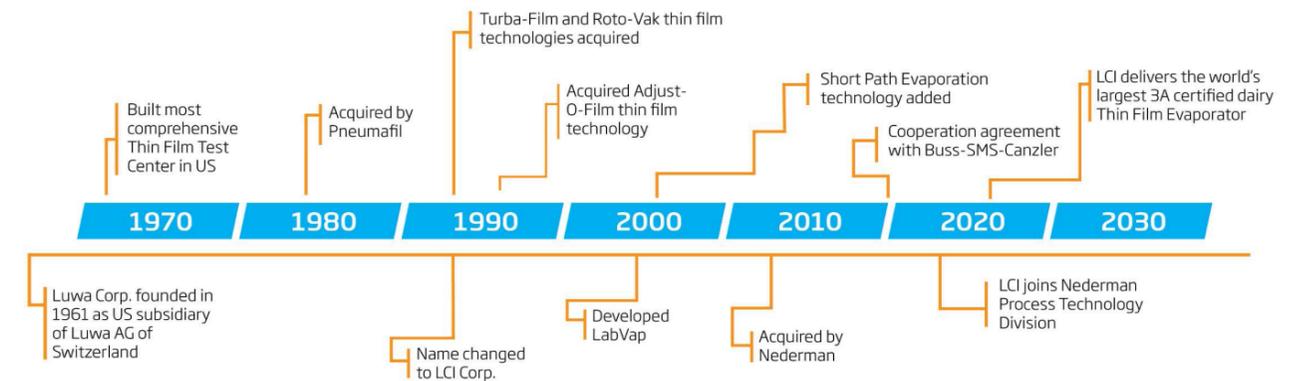
Specialty

- Purification, color improvement, and depitching of rosin acids
- Purification and deodorization of antioxidants, oil additives, and plasticizers
- Purification of isocyanates
- Purification and separation of fatty acids
- Removal of monomers and volatile solvents from acrylic resins
- Removal of reactants, solvents, and monomers to ppm levels from engineered thermoplastics
- Removal of free phenol and water from phenolic resins
- Reaction and removal of caprolactam from Nylon 6
- Concentration of surfactants
- Improved shelf life and reactivity for herbicides, insecticides, and fungicides
- Purification of silicone oil and gums

Green Technologies

- Purification of methyl ester biodiesel
- Purification of glycerin
- Distillers grains drying
- Concentration of fermentation broths
- Concentration of biorationals

Our History



Representative Client List

Abbott Laboratories

ADM

BASF Corporation

BP

Bristol-Myers-Squibb

Bunge

Cargill

Chevron

International Flavors & Fragrances

Dow Chemical Company

DuPont

Eli Lilly

ExxonMobil Chemical Company

Georgia Pacific Corporation

Henkel

IBM Corporation

Infineum

Kraft Heinz

Merck & Co. Inc.

Procter & Gamble

Sabir

Solvay

Pfizer Incorporated

Rohm & Haas (Dow)

Safety-Kleen Corporation

Shell Chemical Corporation

The J.M. Smucker Company

Sony

Tate & Lyle

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