

**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

*LCI is a world leading global provider of thin film evaporation, drying, and modular systems.*

### 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 to assist with process and mechanical troubleshooting and design
- Rapid aftermarket response including a 24-hour helpline and stocked warehouse located in Charlotte, NC USA



### 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 continuous operation.*

### 1. PRELIMINARY EVALUATION

Fully identifying your processing needs is the first step toward providing you with a comprehensive solution. LCI's Preliminary Evaluation Service (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. DELIVERY & SUPPORT

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.



## 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.*

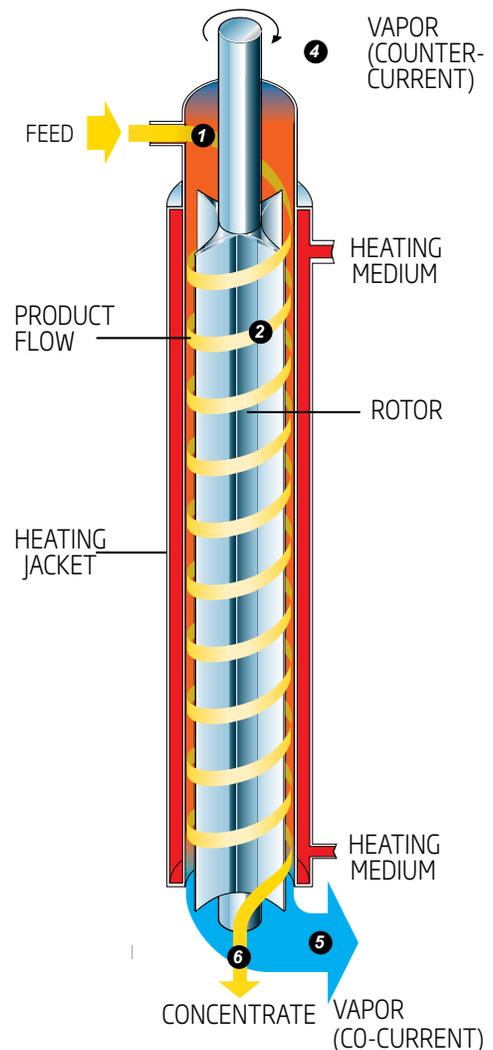
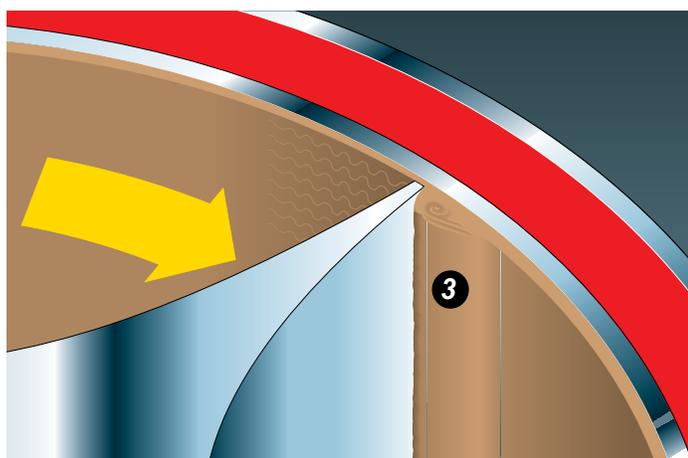
*Short residence time and open, low pressure drop configuration allow continuous, reliable processing of many heat sensitive or viscous materials without product degradation.*

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



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## 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 Provide:

- 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



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## 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
- Minimal thermal surface fouling due to pendulum blade action
- Fully enclosed design to process reactive, toxic, and hazardous substances
- Reduced energy use (1.15 lb steam/lb water boiled)
- Well suited for solution and suspension feeds



## 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

0.25ft <sup>2</sup> Heated Surface Area	0.5ft <sup>2</sup> Heated Surface Area
<ul style="list-style-type: none"> <li>■ <b>Feed Rate:</b> 2-20 lb/hr</li> <li>■ <b>Viscosity:</b> 4,000 cP Max</li> </ul>	<ul style="list-style-type: none"> <li>■ <b>Feed Rate:</b> 2-40 lb/hr</li> <li>■ <b>Viscosity:</b> 8,000 cP Max</li> </ul>

### 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.



#### D-Velpac© Fast Facts

1.4ft <sup>2</sup> Heated Surface Area
<ul style="list-style-type: none"> <li>■ <b>Feed Rate:</b> 25-250 lb/hr</li> <li>■ <b>Viscosity:</b> 50,000 cP Max</li> </ul>

## 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



## 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/carmelization 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 and dewatering 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

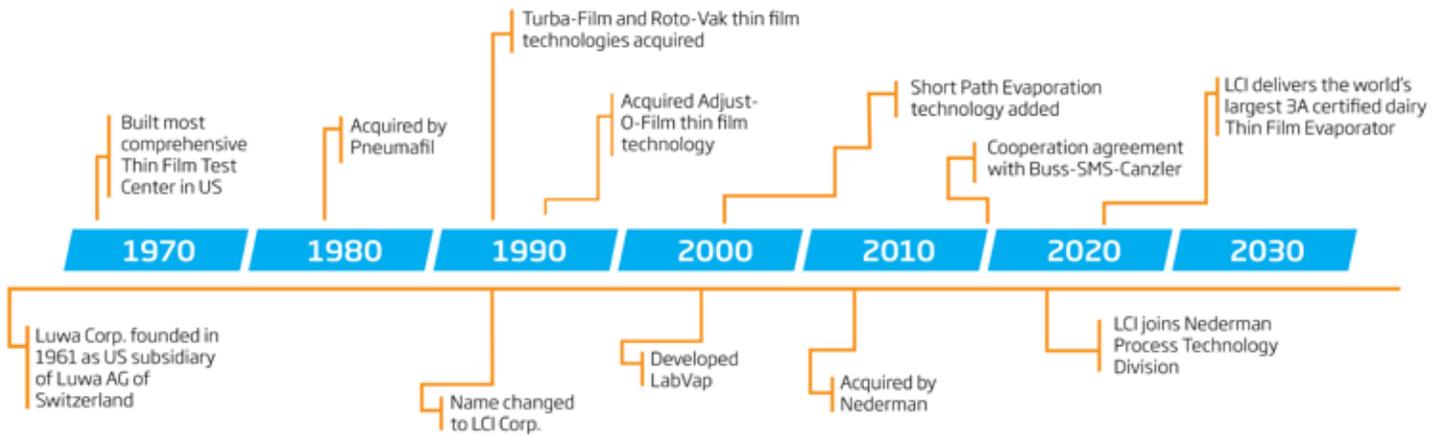
### Green Technologies

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



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# Our History



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## Representative Client List

Abbott Laboratories  
ADM  
BASF Corporation  
BP  
Bristol-Myers-Squibb  
Bunge  
Cargill  
Chevron  
International Flavors & Fra-  
grances  
Dow Chemical Company  
DuPont  
Eli Lilly  
ExxonMobil Chemical Company  
Georgia Pacific Corporation  
Henkel  
IBM Corporation  
Infineum  
Kraft Heinz  
Merck & Co. Inc.  
Procter & Gamble  
Sabic  
Solvay  
Pfizer Incorporated  
Rohm & Haas (Dow)  
Safety-Kleen Corporation  
Shell Chemical Corporation  
The J.M. Smucker Company  
Sony  
Tate & Lyle

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