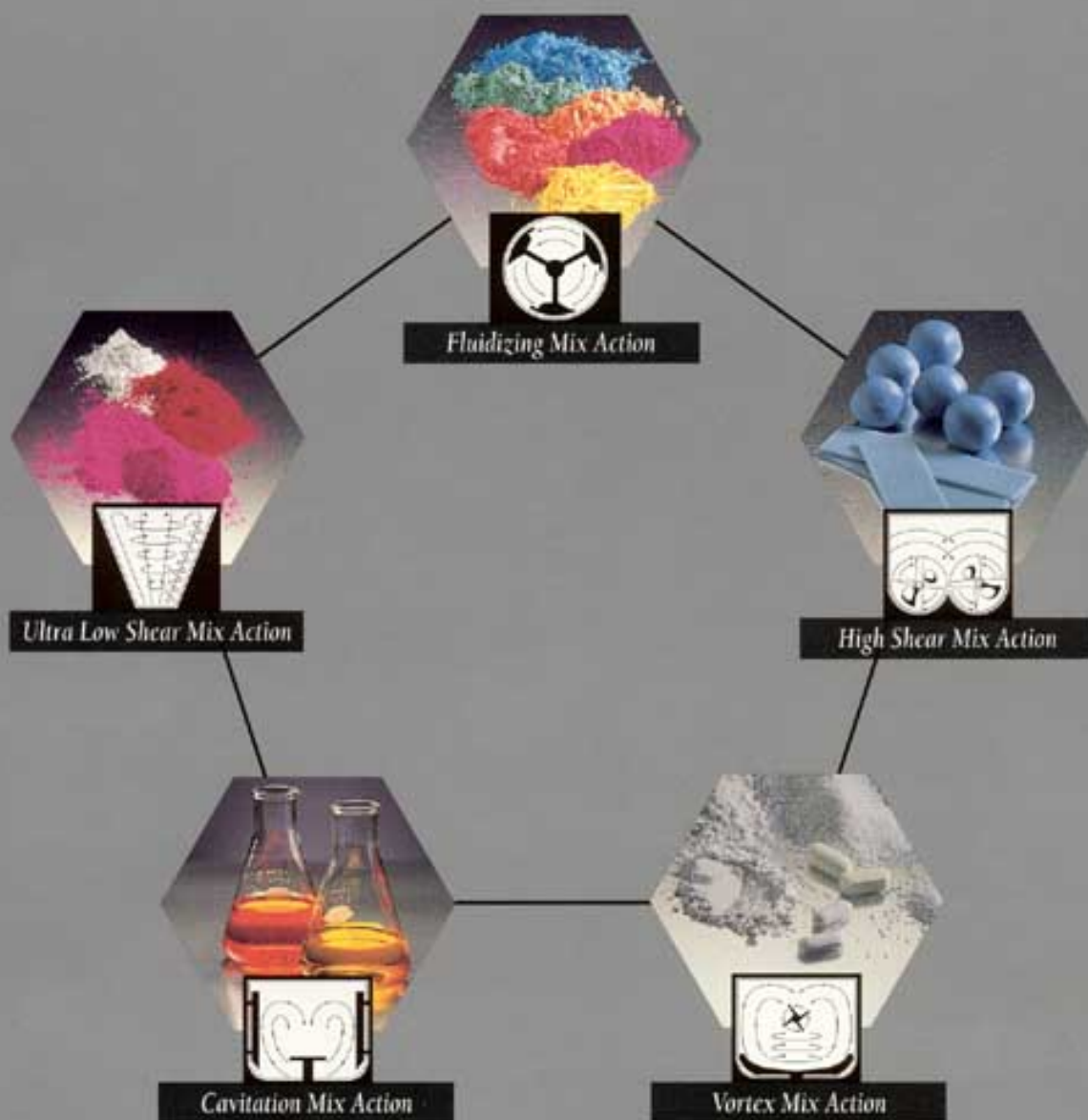


Optimize Your Pharmaceutical Processes

With The Right Technology From Littleford Day



Littleford Day
Where Processing Ideas Become Reality

Optimize Your Pharmaceutical and Biotech Processes

With The Right Technology From Littleford Day

Littleford Day understands the demands of today's Pharmaceutical Processing Industry...your company needs to continually reduce production costs while maintaining optimum product quality. Littleford Day equipment incorporates state-of-the art engineering and design based on our detailed understanding of pharmaceutical processes and applications.

Our advanced pharmaceutical technologies have positively impacted the manufacturing processes of some of the world's leading pharmaceutical and biotechnology companies, helping deliver the newest and highest quality products to the marketplace more quickly than ever before. For Mixing or Drying, for testing or a full-scale installation, you can count on Littleford Day for the right equipment to meet your unique pharmaceutical processing requirements.

FOR MIXING...

A complete line of Littleford Day advanced mixing technologies offers unsurpassed speed, precision, efficiency and versatility. For any type of mixing, granulating or liquid dispersing, there is a Littleford Day Mixing Technology engineered to achieve the results your processes require.

FOR DRYING...

Littleford Day thermal processing technologies efficiently transform products from liquids to dry powders. For unparalleled results, choose from three uniquely-designed Littleford Day pharmaceutical vacuum dryers, or a dryer equipped for both vacuum and hot-air drying.

FOR REACTING...

Advanced reacting technologies from Littleford Day offer distinct advantages over autoclave systems or slow moving ribbon or agitated vessels. If your process requires highly controlled reactions and more effective heat transfer, choose a Littleford Polyphase[®] Reactor for efficient, single-unit processing of your multi-phase pharmaceutical materials.

Match your specific pharmaceutical processing needs with technological solutions from Littleford Day:

Precise Dry Mixing and Dispersing

Wet Granulation and Agglomeration

Liquid – Solid/Dry Dispersion

Liquid – Solid/Slurries and Pastes

Blending Accuracy to <1% Coefficient of Variation

Vacuum/Atmospheric Drying

Reactions Through Effective Heat Transfer

Sterilization of Solids

Clean-in-Place (CIP) Capabilities

Designed for Sanitary Applications

Continuous Mixing Capabilities

Mixing/Vacuum Deaeration

Process Validation System

Filtration/Extraction Capabilities

High Binding Accuracy

Pressure Reacting

Where Pharmaceutical Processing Ideas Become Reality



The Littleford Day Process Development and Testing Program

For pharmaceutical new product development, formula changes, processing challenges, efficiency requirements or regulatory compliance, the Littleford Day Process Development and Testing Program will help you find the best processing solutions. A visit to our Process Development and Testing Center allows your company to quantitatively test and analyze program results before making a large investment in capital equipment.

- The expertly trained engineers, chemists and technologists who facilitate your tests understand the specific processing requirements of the Pharmaceutical Industry.
- Our full line of processing equipment is available for your testing needs:
 - Mixers, Dryers, Reactors, Granulators, Intensive Mixer/Coolers
 - Filtering and Vacuum Drying Systems
- We draw on extensive pharmaceutical process testing experience, including:
 - Testing feasibility of distributive and dispersive mixing of heat sensitive products.
 - Determining process cycle times and process steps.
 - Assisting the customer in formula and process enhancements.
 - Testing feasibility of consecutive dry blending, granulation and vacuum drying in a single Littleford Day processing unit.
- Pre/Post mixing and engineering reviews will define objectives and benchmark the results of testing.
- A detailed, confidential report will provide a comprehensive analysis of test results.
- Testing can typically be completed in one day.



Faster Cycle Times and More Capabilities – The Secret is Our Amazing™ Ploughshare® Technology

Littleford Batch and Continuous Ploughshare® Mixers/Granulators

Littleford Ploughshare® Mixers/Granulators provide versatile mixing capabilities and extremely fast cycle times in a single unit of processing equipment. Our FKM Batch Pharmaceutical Mixers/Granulators are ideal for uniform batch mixing of trace amounts of active ingredients. For high volume production of dry products, liquid addition, and/or granulation, Littleford KM Continuous Pharmaceutical Mixers/Granulators provide fast, accurate mixing in a continuous flow. Our unique Ploughshare® Mixing action, integral on both the batch and continuous Pharmaceutical units, provides gentle yet thorough mixing, covering the full range of powders to pastes to dough viscosities.



Littleford Ploughshare® Vacuum and Atmospheric Dryers

Littleford Ploughshare® Technology brings unparalleled efficiency and economy to the drying function. For temperature sensitive materials, Littleford FKM Series Ploughshare® Atmospheric/Vacuum Dryers employ excellent heat transfer and vacuum capabilities to allow products to be dried at lower temperatures. Littleford VT Series Ploughshare® Vacuum Dryers operate on similar principles as our FKM Dryers, but are specifically designed for efficient and thorough drying at increased levels of vacuum, pressure, or temperature. Our DVT Series Dryers are effective for applications which require internal pressure ratings greater than 50 p.s.i.g. The mechanically fluidized Ploughshare® action yields heat transfer coefficients as much as ten times other dryers.



The key to Littleford state-of-the-art Ploughshare® pharmaceutical processing technology is our unique, mechanically fluidized Ploughshare® action which agitates and individualizes particles for efficient mixing or drying in just one process step.





Fluidizing Mix Action

BATCH, CONTINUOUS, VACUUM AND INTERNAL PRESSURE PLOUGHSHARE® BENEFITS:

- Custom designed to the exacting specifications of your pharmaceutical application
- Optional high speed chopper system quickly disperses liquid or minor powder ingredients for even faster mixing times
- ASME code stamped heating and cooling jackets allow precise temperature control
- Stainless steel and all welded construction in accordance with your sanitary requirements
- Large doors allow easy access to internal components (non-pressure units only)
- Liquid injection lances for quick and easy dispersing of liquids or gases
- Vent filters for dust control and solvent recovery
- Superior seal integrity that meets sanitary requirements

Littleford Polyphase® Reactors

For processing materials of varying composition which pass through liquid, doughy, powder and granular phases, the Littleford Polyphase® Reactor can complete the entire drying process in a single unit. Because the materials being reacted are maintained in a mechanically fluidized state, the Reactor provides increased reaction rates and greater overall efficiency. Littleford Polyphase® Reactors are ideal for pharmaceutical applications that require mixing, reacting, drying and solvent recovery.



The Polyphase® Reactor is routinely manufactured in accordance with "GMP" and can be specified to meet or exceed all of the different sanitary regulations as detailed by the FDA, 3A, USDA and the Pharmaceutical Industry.

Small Batch Mixing in Optimum Sanitary Conditions – Ideal for High Value Pharmaceutical Products

Littleford Day MGT Series Vertical Pharmaceutical Mixers/Granulators

The Littleford Day MGT Series Vertical Mixers/Granulators are designed for applications that require precise dry powder mixing or liquids/solids dispersions. Its medium intensity vortex mixing action delivers rapid, consistent distribution of ingredients of varying size and density. For processes requiring reliable dosage of carrier and high-potency drugs and tablet granulation, the MGT provides thorough, uniform dispersion – batch after batch. The MGT's precise mixing action is ideally suited for wet granulations including the use of solvents as a binder. The MGT will yield a very narrow particle size distribution which is reproducible batch to batch. The MGT allows thorough clean-out between batches for maximum assurance of closely controlled, high quality mixing results.

MGT BENEFITS:

- A unique, vortex mixing impeller design enables high degree of batch-to-batch consistency
- High speed chopper system quickly disperses liquid or minor powder ingredients for even faster mixing times
- 100% Stainless steel and all welded construction is easily sanitized after every batch
- Swing-away discharge assembly allows complete, tool-free cleaning
- Counter-balanced lid for easy opening and loading
- Superior seal integrity that meets sanitary requirements



Vortex Mix Action



The MGT Pharmaceutical Mixers/Granulators can deliver blending accuracy to <math><1\%</math> coefficient of variation in very fast cycle times, making it ideal for small-batch mixing of high-value products.

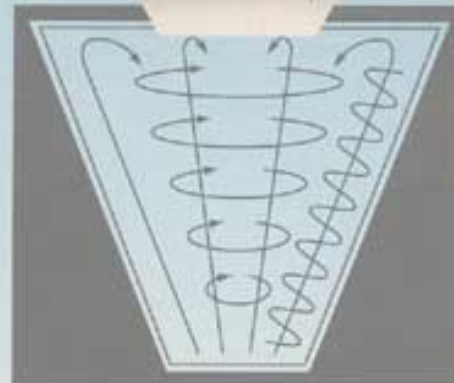
Achieve Highly Accurate Results – Even When Your Process Requires Low Temperature, Low Intensity Mixing

Littleford Day Nauta Pharmaceutical Mixers/Granulators

The Littleford Day Nauta Vertical Pharmaceutical Mixers/Granulators deliver gentle yet highly accurate mixing with minimal heat buildup for your most fragile pharmaceutical applications. Capable of mixing items of varying density and size, the Vertical Cone Pharmaceutical Mixers/Granulators allow you to achieve precise, intimate blending of both dry and liquid pharmaceutical materials. The Vertical Cone Pharmaceutical Mixers/Granulators can mix down to 20% of full batch size without loss of accuracy... at this high level of accuracy, batch repeatability is assured for processing pharmaceutical powders, pastes, creams or lotions.

LITTLEFORD DAY NAUTA PHARMACEUTICAL MIXERS/GRANULATORS BENEFITS:

- 100% Stainless steel and all welded construction is easily sanitized after every batch
- ASME certified heat and cooling jackets allow precise temperature control
- Full vacuum and/or internal pressure capability as required by the process
- Hinged half, flanged, vacuum and domed cover options
- Sliding gate, rotating plug, sliding plug and rotary slide discharge valve options
- Free hanging screw design
- Tapered and standard screw design options
- Multiple dispersion blade options
- Liquid injection system
- Upper cone scrapers available
- Pintle bearings, sealed bottom support and captive ball support options
- Available air drying capability



Ultra Low Shear Mix Action



Three distinct screw mixing actions in the Littleford Day Vertical Cone Pharmaceutical Mixers/Granulators gently shift ingredients from the bottom, top and sides of the conical mixing unit and into the mixing zone.

Heavy-Duty Processing of High Viscosity Pastes

Littleford Day Sanitary Double Arm Pharmaceutical Mixers

Littleford Day Sanitary Double Arm Pharmaceutical Mixers are the mixing, drying and granulation solutions for dense high binder ratio granulates and high viscosity pastes. Our heavy-duty Double Arm agitator designs, custom-matched to your pharmaceutical applications, can effectively process product viscosities from 250,000 to 5,000,000 cps. Specialized engineering and durable construction give Littleford Day Sanitary Double Arm Mixers the capability to reliably distribute minor ingredients in high viscosity pastes and granulations. Plus, excellent heat transfer capabilities allow our versatile Double Arm Sanitary Mixers to perform as both a mixer and a dryer. Littleford Day Sanitary Double Arm Mixers are designed for very low maintenance costs and low instances of replacement amounting to a minimal investment in labor and capital equipment for your pharmaceutical process.

SANITARY DOUBLE ARM BENEFITS:

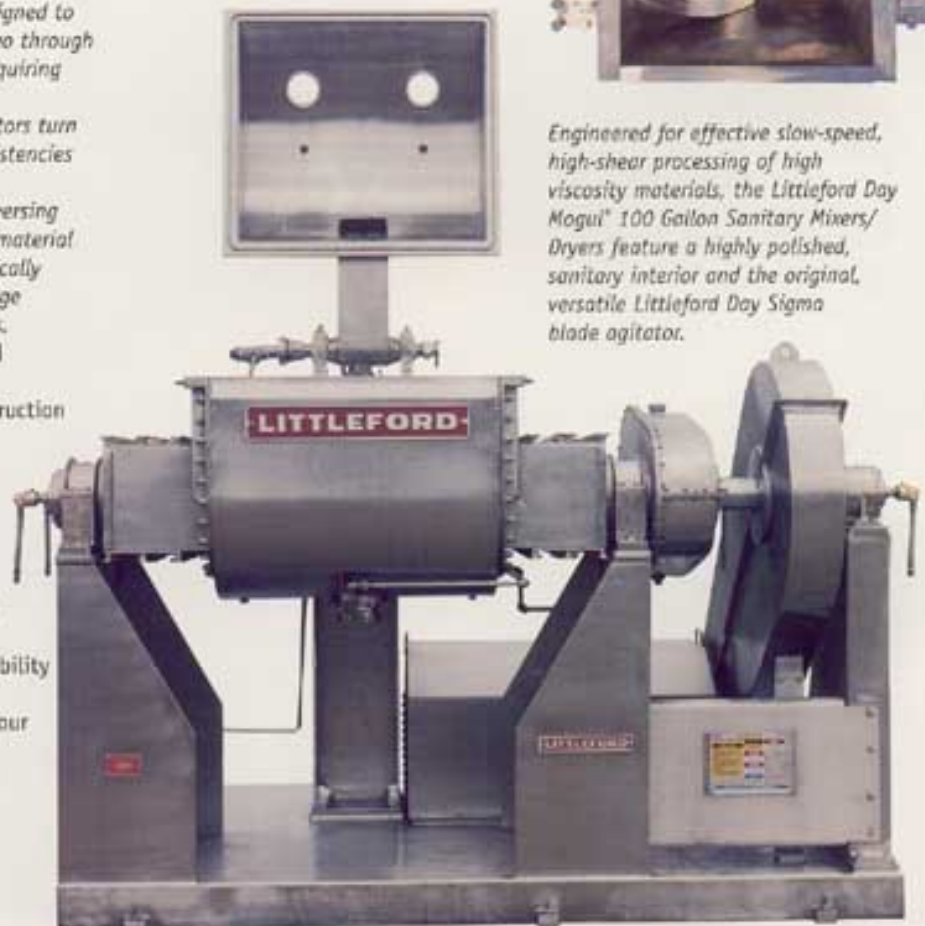
- A comprehensive range of mixing actions are available to meet specific pharmaceutical processing requirements:
 - **Tangential action** in which the front agitator rotates faster than the rear agitator, designed to process heavy pastes and products that go through a solids/liquid phase of high viscosity requiring extremely high shear.
 - **Overlapping action** in which both agitators turn at the same speed, ideal for dough consistencies and pharmaceutical granulations.
 - **Mixtruder action** with a forward and reversing discharge screw that continually pushes material into the mix zone of the agitator, specifically engineered to process difficult to discharge pharmaceutical pastes, doughs and gums.
- Heavy-duty construction for durability and long machine life
- 100% Stainless steel and all welded construction is easily sanitized after every batch
- E-Z Clean "encapsulated" stuffing boxes and shaft seals for hassle-free cleaning after every batch
- Modular construction for mobility and ease of installation
- ASME certified heat transfer jackets allow precise temperature control
- Full vacuum and/or internal pressure capability as required by the process
- Tilt or valve discharge options to match your downstream process configuration
- Variable speed drives for meeting varying process requirements



High Shear Mix Action



Engineered for effective slow-speed, high-shear processing of high viscosity materials, the Littleford Day Mogul® 100 Gallon Sanitary Mixers/ Dryers feature a highly polished, sanitary interior and the original, versatile Littleford Day Sigma blade agitator.



For the Fastest Liquid Processing Cycle Times, Choose the Ultimate Liquid Phase Dispersers

Littleford Day Daymax[®] Liquid Phase Dispersers

With tip speeds of nearly 10,000 feet per minute, Littleford Day Daymax[®] Liquid Phase Dispersers are the ideal solution for liquid mixing applications requiring extremely fast cycle times. The state-of-the-art cavitation style Daymax[®] Dispersers are nearly three times as fast as standard "sawtooth" dispersers. A unique yet simple design provides easy batch repeatability with minimal maintenance requirements. Simplicity of design also facilitates easy cleaning, sampling and quality control – all essential to meeting pharmaceutical "GMP" standards. Daymax[®] Dispersers deliver quick, complete dispersion for a range of pharmaceutical liquids and slurries with viscosities up to 40,000 cps.

DAYMAX[®] BENEFITS:

- 100% Stainless steel and all welded construction is easily sanitized after every batch
- Heating and cooling jacket ASME coded stamped for precise temperature control
- Full vacuum and/or internal pressure capability for deaeration and product blanketing



Cavitation Mix Action



The unique cavitation flow of Daymax[®] Dispersers allow for complete dispersion of all particles in the liquid-phase pharmaceutical process.

Experience the Accuracy and Quality of the Littleford Day Technology Through Lab and Pilot Size Equipment

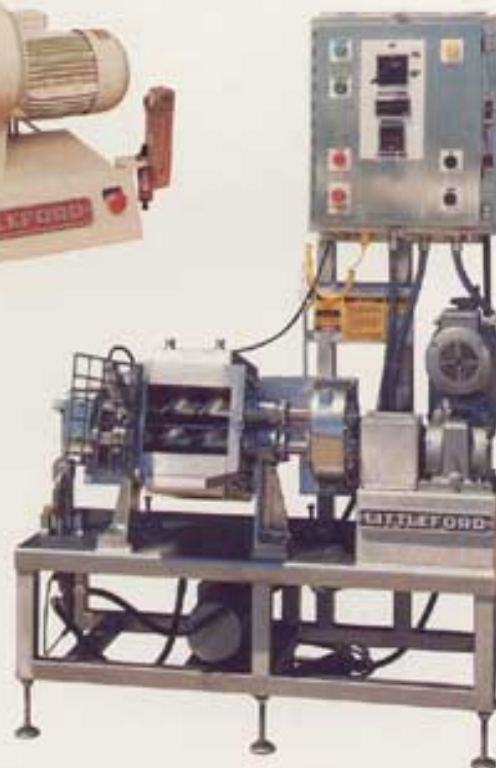


Littleford Day Pharmaceutical Laboratory and Pilot Plant Equipment

For research and development, product formulation, quality control, or direct production scale-up needs, your company can purchase Littleford Day pharmaceutical processing equipment in a laboratory or pilot plant size. Built to the same design and manufacturing standards as our full-size processing equipment, our laboratory-size equipment will meet the most stringent of pharmaceutical process requirements while yielding the highest degrees of accuracy and quality. All Littleford Day lab units are free-standing in design, and can be equipped with any features available on larger pharmaceutical processing units.

LITTLEFORD DAY TRIAL DEMONSTRATION AND RENTAL PROGRAM

For testing pharmaceutical processes in your own manufacturing environment, rent a Littleford Day trial demonstration Mixer or Dryer. Our Trial Demonstration Program allows your company to determine and witness in-house the advantages of the Littleford Day technology.



State-of-the-Art Controls Help Ensure Product Quality

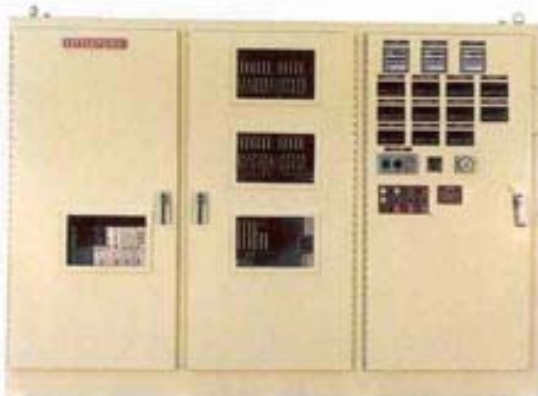
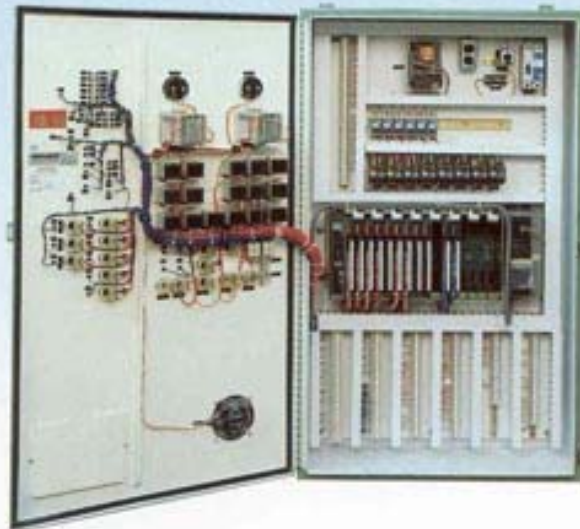
Where
Processing
Ideas Become
Reality

Littleford Day Statistical Process Control Technologies

The most effective way to ensure reproducible product quality from batch to batch is with advanced state-of-the-art instrumentation. Littleford Day process control technologies allow you to monitor and analyze data throughout the entire pharmaceutical process. The Littleford Day control technologies manage cycle times, temperatures and other process criteria critical to effective product quality control and end point determination.

INSTRUMENTATION OPTIONS INCLUDE:

- A reliable process validation system, including Watt Totalizer and Statistical Process Controls, to help meet FDA, 3A, USDA and other Pharmaceutical Industry standards
- Programmable Logic Controllers (PLC's) to help regulate:
 - Vacuum levels
 - Jacket heating and cooling
 - Chopper timing and duration
 - Control and documentation of process steps
- Recording Watt (power) Meters to accurately measure:
 - Total energy usage in KWh
 - Granulation end point
 - Drying stages, from paste to granule to powder
- Power source electrical controls to meet NEMA certified standards for your process
- Chart Recorder to document temperature profiles
- Load cell mounting to detect volatile loss by monitoring change in the mass weight of your unit and its contents



Processing Technology for the Pharmaceutical Industry



Littleford Day Assures Quality, Performance and Reliability With Every Order

The production of all Littleford Day processing equipment for the Pharmaceutical Industry begins with the engineering of quality, performance, and reliability into every order specifically for each customer. This is accomplished utilizing the advanced engineering sciences of today including Finite Element Modeling and Analysis (FEMA) and state-of-the-art three dimensional Computer Automated Design (CAD), integrated with Computer Aided Manufacturing (CAM) and Computer Aided Engineering (CAE).

Littleford Day Clean-in-Place (CIP) and Sanitize-in-Place (SIP) have been developed for sanitary pharmaceutical operations. Littleford Day engineers will work closely with your process team to determine the proper CIP or SIP system for your process.

Littleford Day offers a variety of highly polished interior finishes, from 120 grit to mirror finishes. The inherent design of all Littleford Day pharmaceutical processing equipment allows for easy batch-to-batch cleanout and sanitation.

As part of the Pharmaceutical Industry, all Littleford Day processing equipment for the Pharmaceutical Industry is efficiently manufactured under our control by Littleford Day, Inc. at our Florence, KY Manufacturing Facility utilizing state-of-the-art manufacturing including CNC cutting, machining, and milling equipment under the care and diligence of skilled craftsmen and technicians to assure quality of manufacturing. All Pharmaceutical equipment is routinely manufactured in accordance with "GMP" and can be specified to meet or exceed all of the different sanitary regulations as detailed by the FDA, 3A, USDA and the Pharmaceutical Industry, making Littleford Day equipment the best Pharmaceutical equipment in the market today.



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Littleford Day, Inc.

7451 Empire Drive (41042-2985), P.O. Box 128, Florence, KY 41022-0128
606-525-7600 • Fax: 606-525-1446 • 1-800-365-8555
Internet: www.littleford.com • E-mail: sales@littleford.com