Mixing Technology

At Littleford, mixer design and application is based on a thorough knowledge and understanding of processing requirements within the food industry.

Littleford has designed and engineered an advanced line of mixers and mixing systems that combine degrees of speed, precision, efficiency and versatility not previously obtainable in a single mixing unit. Whether for batch or continuous material processing, Littleford equipment enables the user to have complete analytical control over the mixing operation, eliminating guesswork in preparing products and formulations.

The key to success in Littleford mixers is the unique action created by the movement of the plow-shaped mixing elements within the confines of a horizontal vessel that produce intense, but gentle intermingling of the materials of the mix in a mechanically fluidized bed. The mixing tools are arranged at intervals on the mixer shaft and their size, number, arrangement, geometric shape and peripheral speed are designed to force the product into appropriate components of axial and radial motion assuring absolute mixing.

Fluidized Bed Mixing Action

Excellent Heat Transfer—In applications where heat transfer is essential to the process, the Littleford mixer, fitted with a jacket, is one of the most efficient vessels available.

The unique mechanically fluidized bed mixing action of Littleford equipment exposes tremendous surface area of the mix, results in direct contact between particles, and provides associated momentum and heat transfer between particles, eliminating temperature gradients.

Split-Seal Feature—The Littleford Split Seal Assembly meets the needs of the food process industry for an easily cleaned and maintained mixer shaft seal. It is designed to conform to the rigid requirements of the USDA, BISSC and 3-A codes.

The seal can be disassembled, cleaned and reassembled in minutes without the need for special tools, and without disturbing bearings or drive components. This seal can be adapted for vacuum operation if needed.

This packing seal system, coupled with the outboard mounted bearings of the mixer, virtually eliminates any possibility of cross contamination between the bearings and the mix.

Air Seal Feature—Littleford mixers may easily be fitted with air purge shaft seals for applications, such as the blending of powders, that require keeping the product away from the seal area.

Bakery Mixes

The great variety of bakery mixes available today all have the same basic process requirements—precise mixing of the ingredients, incorporation of the shortening and finishing of the batch.

Littleford provides the most efficient method to meet these requirements ...all in a single processing unit.

Cake and Doughnut Mixes—Littleford mixers, equipped with high-speed (3600 RPM) blending choppers, can produce a completely uniform finished mix, free of agglomerates and ready for packaging in a total mix cycle of less than fifteen minutes.

The flour, sugar, baking powder, flavoring, coloring and salt are dry mixed for one to three minutes. Lumps that frequently form during storage of the raw materials are completely broken up by the choppers during the dry mix cycle.

When incorporating liquified solid shortening, the batch temperature is adjusted during the dry mix cycle to within 40°F of the shortening temperature by means of a heating jacket.

This prevents too rapid cooling of the shortening and resulting “prills”.

Following the dry mix, liquid shortening is introduced by lance type injectors mounted directly over the high-speed blending choppers or solid shortening, in cube form, can be added directly to the mixer through special addition ports. Shortening incorporation, up to 16%, requires two to five minutes depending on the type and quantity.

The high-speed blending choppers finish the mix in about five to seven minutes after the introduction of the shortening, depending on the product.

The finished mix is discharged directly into packaging equipment without further processing.

Frosting Mixes—Uniform, agglomerate free, finished frost-
FKM Series Batch Mixers

FKM Series batch mixers are widely used throughout the food process industry for solids to solids, liquid to solids, and paste or pseudo-plastic materials mixing applications.

Littleford offers these mixers in standard sizes from 11 cu. ft./300 liters to 283 cu. ft./8,000 liters and larger.

Construction—Littleford FKM Series mixers consist of a horizontal mixing cylinder, mixing elements mounted to the horizontal main shaft, sanitary construction, charging port located on top of the mixer, contour access doors at the front of the mixer with electrical limit switches, contour discharge opening at the bottom of the mixer, complete power and drive assembly, and electrical controls designed to meet the customer’s specific requirements. Various options are available such as vacuum construction, jacking for heating and cooling, and special discharge valving which expand the capabilities of the mixer beyond a mixing function. Pre-weigh hoppers and scale systems are also available for the processor to have a totally automated mixing station.

Operation—The unique fluidized bed mixing action of the Littleford FKM Series mixer is accomplished by a horizontal shaft which is rotated at an intermediate speed, rapidly projecting and hurling the mix materials away from the vessel wall into free space—filling the entire vessel. This mixing action causes the materials to crisscross in the direction of the vessel walls and inversely back again, providing a high volume rate of mass transfer throughout the entire length of the vessel. This blending action is the ing mixes are turned out with excellent reproducibility in mixing cycles of ten minutes or less, depending on ingredients.

The flavors and colors are first dispersed into very fine sugar during a one to two minute dry mix. Plastic shortening is then extruded into the high-speed blending choppers and incorporated into the sugar. Complete finishing of the mix requires several minutes of chopper action after the shortening has been incorporated. As in cake and doughnut mixes, post-milling is not required.

Dry Soups and Gravy Mixes

To process a dry soup mix compounded from dehydrated food stuffs usually requires special techniques and frequently multiple units of mixing equipment.

A Littleford mixer, equipped with choppers, can complete a dehydrated soup mix in a three step cycle.

An intimate mix of flour, precooled starch, herbs and spices, MSG and powdered meat is attained in a one to two minute mix cycle. Following the dry mix cycle, meat extract and animal fat or hydrogenated vegetable oil are added to the dry mix. The meat extract may be added in walnut size lumps and the vegetable shortening in tempered 50 pound blocks.

Following this addition, a three to five minute intensive mix utilizing the choppers is required. The choppers are then turned off while the plows rotate and gently mix the materials. During this gentle mix period, fragile dehydrated vegetables, such as whole mushrooms and carrot parts, are added and blended for approximately a minute. The total cycle time may vary depending on the product and number of ingredients for a specific application. The mixer is then discharged to the packaging equipment.

Dry gravy bases require intimate mixing followed by the incorporation and finishing of meat extract or fat. Littleford's unique mixing action of plows and choppers performs this two step application in less time than required by previous mixing practices.
result of the special mixing element shape and speed within the enclosed vessel which transmits energy to the mass of material in the form of particle speed with a minimum impact and subsequent degradation, even with fragile materials.

The FKM Series mixer can be supplied with a variety of port sizes and configurations to facilitate the charging of materials, liquids and other processing aids. Easy access doors are located on the side of the mixer to simplify cleanout and maintenance.

Littleford mixers and support accessories are engineered and constructed to meet the strict sanitary requirements of the food industry.

The FKM Series mixer is designed to allow for the incorporation of liquids with dry solids during the mix cycle. Since the basic incorporation of liquid ingredients is largely a function of the agitation rate of the mass, the mechanically fluidized bed action—particularly when combined with Littleford’s integral, high-speed blending choppers—changes problem applications into simple, normal daily production operations providing superior dispersion of liquids, and quality finished products with a minimum of equipment and handling.

Liquids may be introduced with or without spray or atomization attachments depending upon specific application, with the amount of liquid limited only by that quantity which the product will accept while remaining in a free-flowing physical state.

**FM Series Batch Mixers**

FM Series batch mixers, with charging/cleanout doors located on top of the unit, are produced especially for laboratory, pilot, and small scale production usage. The FM Series mixers are constructed and operate on the same principle as the larger FKM Series batch mixers.

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Total Capacity*</th>
</tr>
</thead>
<tbody>
<tr>
<td>FKM-300D</td>
<td>300 79 11</td>
</tr>
<tr>
<td>FKM-600D</td>
<td>600 159 22</td>
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<tr>
<td>FKM-1200D</td>
<td>1,200 317 42</td>
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<tr>
<td>FKM-1200E</td>
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<td>FKM-2000E</td>
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<td>FKM-3000D</td>
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<td>FKM-4200D</td>
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<tr>
<td>FKM-8000D</td>
<td>8,000 2,113 283</td>
</tr>
</tbody>
</table>

*Working capacity depends on the process and is normally between 50 and 70% of the total capacity.

**Spices and Flavorings**

**Natural Blends**—Uniform mixtures of aromatic vegetable parts such as ground bark, flower buds, or seeds with leaves are rather difficult to attain due to their dissimilar shapes and densities and the tendency to segregate on discharge. Littleford’s fluidized bed mixing action, which does not rely on gravity, produces a completely homogeneous mixture in a matter of seconds. Discharging the mixer with plows rotating prevents segregation of the product and rapid discharge of the materials. The thorough, but gentle and rapid discharge blending action does not reduce particle size of friable materials during normal blend cycles.

**Soluble Spices**—There is a growing use of spice extracts, or oleoresins, due in part to their advantage of showing no speckling in light colored foods. However, these oleoresins have the handicap of being very viscous and difficult to coat on suitable carriers.

The Littleford mixer, equipped with choppers, can uniformly coat the surface of sugar, salt, or dextrose with oleoresin in a short mixing cycle without requiring post-milling. Reduction in mix times as high as 90% have been reported for this application.

**Meat Cures and Preservatives**—Uniform, free flowing mixtures of salt, sodium nitrate, and sugar used to enhance the flavor, color, and yield of meats can be produced in minutes in a Littleford mixer. More important is the Littleford mixer’s ability to encapsulate certain additives to prevent contact with moisture. This coating action is attained by a combination of chopper action and the inherent high heat transfer required to melt and congeal the coating.

Other minor additives such as iodine and vitamin supplements can be applied with extreme accuracy. Vitamin-enriched salts are being produced in totally automated Littleford batch mixers with high precision at a low unit cost.

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**Packaging - Processing**

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KM Series continuous mixers are used primarily where high volume production is a prerequisite in the processing of dry products, and dry products with liquids in surface coating applications.

Standard sizes are 11 cu. ft./300 liters to 283 cu. ft./8,000 liters and larger.

Construction—In general, the construction of the KM Series continuous mixer is very similar to Littleford's FKM Series batch mixer. The horizontal cylinder and mixing element shaft move the product from the charging end to the discharge end of the mixer in a minimum of retention time and on a continuous basis.

Operation—Littleford’s KM Series continuous mixers are charged through a port mounted on the top side of the drive end of the mixer. Typical working level of the product is nominally 50% of total capacity. As in the case of the FKM Series batch mixers, Littleford’s plow-shaped mixing elements create a fluidized bed mixing environment, resulting in a superior mix achieved during a short retention period. Discharge of product is through an adjustable weir valve at the opposite end of the mixer from where the product was charged. Wide access doors in the front of the mixer make cleaning and maintenance fast and simple operations.

Throughput rates will vary depending on the size of the mixer, product being processed, fill level retention time required, as well as other variables that are essential to the process.

Standard Sizes of KM Series Mixers

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Total Capacity*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liters</td>
<td>Gallons</td>
</tr>
<tr>
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<tr>
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<tr>
<td>KM-1200D</td>
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<tr>
<td>KM-2000D</td>
<td>2,000</td>
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<tr>
<td>KM-3000D</td>
<td>3,000</td>
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<tr>
<td>KM-4200D</td>
<td>4,200</td>
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<tr>
<td>KM-8000D</td>
<td>8,000</td>
</tr>
</tbody>
</table>

*Working capacity depends on the process and is normally between 50 and 70% of the total capacity.

Food Specialties

Gelatin Desserts—Uniform appearance, good solubility and post-mill the material. The totally enclosed cylindrical design of the Littleford mixer reduces product loss during mixing and reduces plant clean up and maintenance expenses. A typical gelatin dessert can be processed in a Littleford mixer in five minutes or less depending on the ingredients of the mix.

Powdered Drinks

Instant Ice Tea—Extremely fine, light tea particles are difficult to mix with sugar and flavorings in many mixers. The Littleford mixer with high-speed blending choppers quickly homogenizes the mix and impinges the tea particles on other materials inhibiting segregation in later storage and transit. Littleford processed ice tea is readily soluble and produces sparkling clear tea.

Instant Breakfast Drinks—Vitamin and mineral-enriched powdered breakfast drinks demand high accuracy and reproducibility. Dry milk solids, flavors, colors, are quickly blended in a Littleford mixer and the vitamin supplement dispersed by the high-speed blending choppers in a few minutes. Tests have been confirmed that mix ratios as high as 1:20,000 can be processed in a Littleford mixer with a coefficient of variation of less than 1.0%.
Littleford Mixers and Mixing Systems

Littleford Polyphase® Systems

Littleford Polyphase Systems combine the fluidized bed mixing principle within a specialized pressure vessel. These functions accommodate processor objectives for the final product through chemical and/or physical reactions; to affect drying or solid phase concentration by solvent removal; and solvent recovery by reclamation of overhead vapors, with all the steps completed in one vessel. It is extensively applied to processes in the food industry requiring simultaneous functions of heat and mass transfer in pressurized (250 psi at 100°F) or vacuum (30" Hg) environments.

Polyphase vessels utilize the versatile fluidized bed mixing principle found in Littleford mixers for processing materials in the granular or powder state, the paste or pseudo plastic state, and the transition region between these states.

The objective when applying a Littleford Polyphase System to a specific application is to achieve mechanical fluidization of the product mass and affect the advantages associated with this type of agitation in a specialized mixing environment.

Littleford’s Polyphase Reactor achieves solids suspension in the gas phase by mechanically fluidizing the material within the horizontal, cylindrical processing vessel. An optimized axial to radial velocity ratio of the solid particles is achieved by the size, shape, peripheral speed and geometric arrangement of the mixing elements on the shaft. High-speed chopper assemblies are strategically located through the vessel.

Chocolate and Candy

Chocolate Paste Mixing—A critical operation in the manufacture of chocolate is the preparation of the paste prior to refining and final conching. The efficiency of the refining operation depends on the consistency and uniformity of the paste.

Leading chocolate manufacturers throughout the United States have installed Littleford mixers to improve this important process. Cocoa butter, dry milk solids, and fine sugar are rapidly blended into the chocolate liquor to form a uniform paste ideal for refining. Increases in refiner throughput as high as 30% have been reported.

High-speed blending choppers enhance this operation by reducing the mix cycles to approximately three minutes and completely eliminate agglomerates of dry milk solids.

Batch and continuous Littleford mixers have been supplied for chocolate paste mixing. Due to the short mix time required, the unit manufacturing costs have been reduced while attaining an improvement in product quality.

Cream Centers—With the introduction of dry, free flowing fondant, a major change in production techniques for butter cream centers has been developed. The utilization of a Littleford mixer to compound these dry fondants with other ingredients to form the cream center has resulted in drastic reductions in process time and operating costs, while improving the consistency of product.

A typical procedure would be to first add the fondant, either dry or cooked, to the mixer. The fondant would then be creamed by the addition of butter in approximately 30 seconds by the action of the mixing plows. Flavorings are then added and the mixing continued for another 30 seconds. At this point, fillers such as chopped walnuts are added and blended into the base in approximately 15 to 25 seconds. Some formulations require a consistency adjustment by the addition of dry
The Littleford Polyphase vessel is completely jacketed with flow channels to yield efficient heat transfer. Vessel connections are provided in accordance with the requirements of specific applications.

The finished compound is then pumped directly to storage or high-speed enrobing machines.

**Chocolate Cold Milk Additive**—Uniform dispersion of a viscous soya-lecithin liquid into cocoa powder has been found necessary to achieve the desired instant solubility of a powdered drink mix in cold milk. This incorporation may be accomplished in a Littleford mixer by using a special technique developed by Littleford for adding the soya-lecithin liquid and thoroughly dispersing it into the cocoa.

Sugar, flavoring, and other ingredients may then be added to complete the mix.

**NOTE:** All process and mixing cycle times may vary with individual material and product requirements as well as size of production unit.

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**Standard Sizes of Series DVT Polyphase Processing Vessel**

<table>
<thead>
<tr>
<th>Series DVT Venus Size</th>
<th>Liters</th>
<th>Total Capacity* Gallons</th>
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<tr>
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*Working capacity depends on the process and is normally between 50 and 70% of the total capacity.
Littleford Food/Candy Processing Equipment

Depicted on this page are just a few of the Littleford mixers/reactors which are providing cost-effective solutions to the food industry's most demanding application problems.

3,000 liter FKM Series Batch Mixer used in the production of bakery mixes. The unit is specially designed with load cell mounting to automate the processing system—thus ensuring product quality and increased production.

2,000 liter DVT Polyphase Processor used to blend, steam treat and cool coffee beans—all steps accomplished in one vessel.

2,000 liter FKM Series Batch Mixer, featuring sanitary design, enables the customer to maintain Good Manufacturing Practice (GMP) while meeting FDA and USDA equipment requirements. Photo below shows independently driven, shrouded chopper motors for enhanced dispersion and deagglomeration.

800 liter DVT Polyphase Processor specially designed for pressure and vacuum applications such as alkalization of cocoa, sterilization, instantization, protein modification, vacuum drying and solvent extraction. Photo, at right, shows high-speed chopper motors.

Dimensions, weights, production capacities and other specifics cited in this literature are illustrative only and may be subject to many variables. The only warranty applicable is our standard written warranty. We make no other warranty, expressed or implied.

Littleford Day, Inc., 7451 Empire Drive (41042-2985), P.O. Box 128, Flor

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