

Dry And Wet Mixing Of Short Kevlar® Fiber

Short "Kevlar" aramid fiber material is now being used as a reinforcing fiber in friction material, plastics, gasketing, rubber products and other industrial goods. Littleford has developed a totally new mixing process technology involving special mixing elements and procedural techniques for formulations which utilize short "Kevlar" fiber.

Research and development work at Littleford, coupled with valuable input from the manufacturer of "Kevlar" fibers, has enabled Littleford to modify components of the basic FM/FKM Series horizontal batch mixer to effectively process this material with its unique characteristics.

The equipment and techniques developed by Littleford have made it possible to take full advantage of the reinforcing strength of the short "Kevlar" fiber by achieving the maximum opening and separation of the individual fibers. It has been demonstrated that short "Kevlar" fibers could be opened (density decreased) to the highest degree known in the industry. This high degree of fiber opening makes the "Kevlar" more economical since the strength modulus in the finished product is directly proportional to the degree of fiber opening or separation.

The primary mix action of a Littleford FM/FKM Series mixer is developed by the rotation of sweep action mixing elements at a speed sufficient to place the materials of the mix into a "pulsating" mechanically fluidized bed. This basic mix action is supplemented by high-speed, fiber opening and dispersing blades which are exclusive to the Littleford mixer. The combined action of the mixing elements with the high speed fiber opening blades act to fully open the fiber and uniformly mix and disperse all components of the mix.

A suggested procedure for mixing a typical dry mix using short "Kevlar" aramid fiber is as follows:

- 1.) The Littleford FM/FKM Series mixer must be equipped with the sweep action plows and a full complement of high-speed fiber opening dispersing blades. The number of fiber opening dispersing blades is dependent on the size of the unit. All plow clearance (plow to drum wall) should be set at 3/8" - 1/2" to prevent the fibers from wedging between the plow and drum. Fiber opening disperser blades must be the special multi-tier type. Mixing should be

done with the main shaft and fiber opening blades operating at designed speeds.

- 2.) For batch sizing purposes, keep in mind that the final mixed volume of batch **must not** exceed 80% of the total mixer volume. Add all ingredients of mix (short "Kevlar" fibers, dry powdered resins, fillers and additives) to the mixer and mix with the sweep action plows and special fiber opening and dispersing blades for approximately 5-10 minutes or until the desired degree of homogeneity is achieved. The mixture should be highly fibrous with the individual fibers well coated with the dry resins and fillers. Overmixing should be avoided since clumps or balls could be formed and possibly render the batch useless.

The procedures used for mixing short "Kevlar" aramid fibers into a wet mix have been found to vary with the wetness of the final mix.

If the mix is relatively "dry" and uses viscous resins then the following guidelines can be used:

- 1.) Equip the FM/FKM Series mixer in the same manner as for a dry mix.
- 2.) Charge an appropriately sized batch of short "Kevlar" fiber to the mixer. Use the same guidelines used with the dry mix.
- 3.) Fluff for 3-6 minutes with plows and fiber opening blades operating or until the desired degree of openness is achieved. Discharge all fibers.
- 4.) Charge mixer with all remaining components (powders and resins) and mix with plows and blades until fully mixed and dispersed (wet out).
- 5.) Reintroduce the fluffed fibers and mix with the plows and fiber opening blades until the fibers are uniformly mixed and dispersed (coated) with the resin/powder mix. Required time for mixing is normally 5-10 minutes, however, longer times may be necessary to achieve the desired coating of the fibers.

If the mix is relatively wet (dough or slurry) then the following guidelines can be used:

- 1.) Equip the FM/FKM mixer in the same manner as for a dry mix with short "Kevlar" fiber.
- 2.) Charge an appropriately sized batch of "Kevlar" fiber, fillers, dry resins and additives

to the mixer. Mix with the sweep action plows and high speed fiber opening disperser blades to fluff the fibers and mix all ingredients.

- 3.) Continue to mix and inject the liquid resins and solvents via lance injector pipes located above each chopper. The normal required time for

the wet mixing is approximately 5-10 minutes, however, longer mixing times may be necessary. The mix should be free of dry, uncoated fibers. Yellow clumps or balls of fiber should not be noticeable.