

### Reactor Obsoletes Cellulosic Reaction Vessels

The chemical, pharmaceutical, and food industries rely heavily on multi-step processes to transform raw materials into finished products through chemical and/or physical reactions between solid-liquid, liquid-liquid, solid-gas, or liquid-gas. Most conventional processing vessels are process specific, i.e. they are only designed to accomplish one process step. A typical process installation might require a vessel for reaction, a different apparatus for drying and deaeration, and still more equipment for milling and screening. Thus, not only are several pieces of process equipment needed, but material handling facilities are also needed between steps.

Littleford has taken a major step forward in advancing the "state of the art" in multi-step processing involving reactions. Littleford has introduced to the U.S. market the DVT Polyphase® System which renders conventional processing equipment obsolete by:

1. improving reaction rates while increasing reaction efficiencies within a vessel which exhibits outstanding heat transfer characteristics,
2. providing multi-step processing in a single piece of equipment,
3. eliminating between-step material handling, and even post-milling or grinding in some cases.

Typically, reaction vessels, such as kettle reactors, autoclaves, and even ribbon-agitated devices, create contact between the reagent and product more by diffusion than by complete and homogeneous mixing. The reaction therefore is slow, uncontrolled, and takes place at different times and different rates throughout the vessel. The result — low product yield, lengthy cycle times and higher process costs. Moreover, conventional methods often leave the product in an undesirable state, as in lumps or in cake form, often requiring post-reaction grinding and screening.

A single apparatus, the Littleford DVT Polyphase Reactor, is designed to handle materials of varying composition — those which may pass through liquid — dough — granule — powder — without creating zones of unmixed product.

The characteristics of product agitation and particle individualization combine to make the Littleford DVT a unique piece of processing equipment. The size, number, arrangement, geometrical shape, and peripheral speed of plow-shaped elements rotating within a horizontal cylinder force the product into three dimensional motion. This is unique — every particle of product is exposed for reaction or heat transfer. Particles constantly collide with the heated or cooled interior walls of the jacketed vessel, and also with one another, resulting in excellent heat transfer capabilities.

High shear choppers further complement the action of the plows. Located in the lower half of the drums between the travel paths of neighboring plows, the choppers disperse trace liquid or powder additives, size particles, and speed reactions by reducing reactants to their primary grain size.

The dual action of the plows and choppers, in conjunction with operational features such as pressure capability (250 PSIG @ 100°F), vacuum capability (30" Hg), and effective heat transfer (heating or cooling), enable the DVT to accomplish many processes:

- a.) heating, with steam, hot water, or oil
- b.) cooling, with tap water or chilled water
- c.) reaction, either under pressure or vacuum
- d.) mixing & dispersion
- e.) deagglomeration and particle sizing
- f.) wetting
- g.) densification
- h.) granulation
- i.) drying (the recovery of expensive solvents)
- j.) sterilization
- k.) chopping
- l.) coating, etc.

These processes can be carried out simultaneously or successively in a single vessel thus resulting in increased processing efficiency and reduction of costly material handling as follows:

Application	Reactions: Type	Timing		Reaction Parameters	Phase
		Successive	Simultaneous		
CMC and cellulose derivatives	chemical (alkalization)	X		100 °F oxygen free	Solid — Diced, wet fibers
	chemical (Chloroacetic acid)	X		122-158 °F 20 PSIG oxygen free	Solid — Diced, wet fibers
	physical (drying)	X		70 °F 30" Vac.	Solid — Dry fiber
Cocoa	chemical (alkalization)		X	212 °F Saturated steam 3.5 Bar absol.	Solid — Wet press cake
	physical (sterilization)		X	250 °F Saturated steam	Solid — Wet press cake
	physical (drying)	X		80-100 °F 30" Vac.	Solid — Dry press cake
Dyestuffs	physical (drying)	X		220 °F	Solid — Slurry, paste, wet powder, dry powder

Figure 1 shows reaction parameters for preparation of a typical cellulose derivative.

Figure 2 shows a typical purification process for such a derivative.

The Littleford DVT Polyphase Reactor is not only versatile in its application, but rugged in its construction. It is available in a wide range of capacities, with extremely large units built to the customer's requirements. Electrical controls are available which can provide truly automated batching. Let us put our engineering and design experience to work for you.

Figure 1

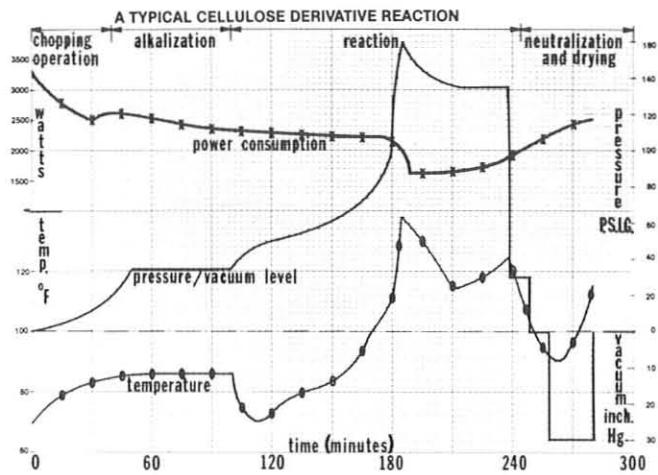


Figure 2

