What Is A Counter-Current Rotating Pan Mixer?

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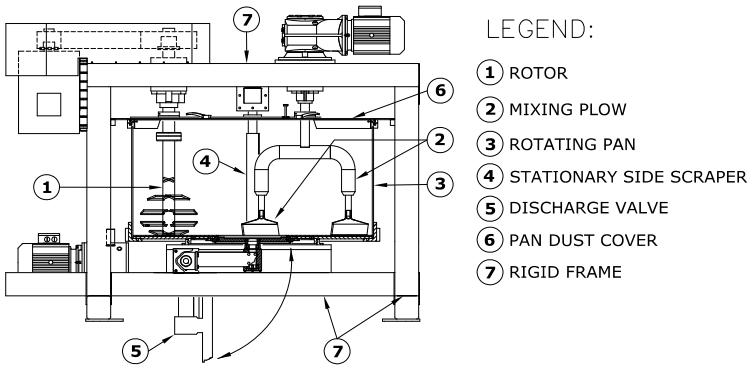

Figure 1

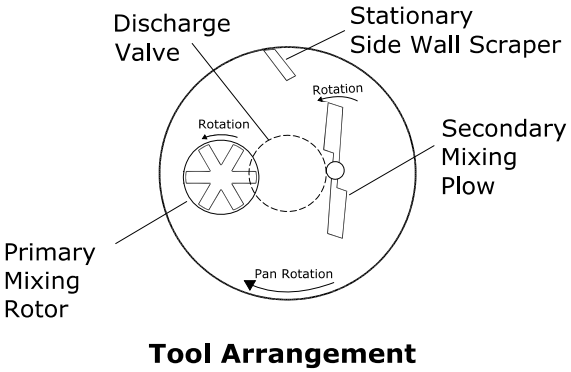

Figure 1A

Is this a new invention? Most technical books on mixing equipment rarely include this mixer design. Yet, counter-current rotating pan mixers have been serving industrial mixing needs for over half a century. So, how is this mixer different from, and perhaps superior to, other mixer designs?

Let's first review a home kitchen mixer. It has a top-mounted agitator and a vessel. The agitator is mounted through a stationary cover and the vessel removable. The rotational axis of the agitator may be fixed or move in an orbit.

We charge the mixer with say, a cake mix and water, lower the cover and turn on the agitator. Sometime after that, we stop the agitator, raise the cover and scrape the bowl to get the unmixed materials near or adhering to the wall or the bottom to where the agitator is for dispersion. We re-start the agitator to finish the mixing step before transferring the wet cake mix to a baking tray, again scraping with a spatula to make sure all the mix is transferred.

The above descriptions highlight some critical areas that beg improvement if we were to apply this general mixer design for industrial processes. Without improvements, unmixed or under-mixed materials will remain. And those manual-assist steps, which we don't think twice about when preparing a cake mix, become big issues when plant operation is mechanized and automated as they are today.

To improve mixing, designers increase the number of agitators or area of sweep. Hence we witnessed the progressive development through turbine mixers, planetary mixers etc. The common feature of these mixers is a stationary vessel and various measures to reduce dead zones either by increasing mixing tools and/or reducing the clearance between the tools and the vessel wall.

As the mixing tools and the vessel wall become closer and closer together in an attempt to engage the layer of unmixed materials, the risk of accidental collision from vibration forces the reduction in speed, hence offsetting the goal to both mix effectively and clean the wall of build up. Added tools also crowd out the mixer interior. The inevitable observation is: a stationary vessel cannot satisfactorily minimize wall build up and maximize mixing effect.

The recognition of the above problems led to the design of rotating pan mixer.

General design concept (Please refer to Figures 1 and 1A above.)

Consider the kitchen mixer again. What if we can mount a stationary spatula against the bowl and now make the bowl turn? Indeed, a rotating pan mixer does exactly that. The rotating pan (i.e. the *bowl*) runs at a certain rpm that is slow enough to be safe from vibrational collision but sufficient to accelerate the mix materials to the agitator by placing the spatula at a good location and deflection angle. The rotational speed of the bowl need not be high hence clearance between the spatula (= *Side Scraper*) and the bowl can be small. The *Side Scraper* + Rotating Bowl practically eliminate any dead zones in the mixer.

The rotating bowl (= *Pan*) provides macro material transport. Mixing is performed by the agitators(= *Rotor / Plow*) which are mounted in a fixed positions. The agitator can be relatively small, as the mix materials are channeled to it by the rotating *Pan* and the *Side Scraper*. This design has the added advantage of leaving ample space within the pan for maintenance purposes.

The “counter-current” reference of this type of mixer originally comes from the *Plow* which is a secondary agitator in the mixer. The *Plow* rotates at a moderate speed, allowing it to be set close to the *Pan* floor to prevent material buildup on the pan floor. For applications requiring low to moderate agitation, the *Plow* alone maybe adequate to provide the desired level of mix homogeneity. The *Plow* also rotates on a fixed vertical axis and counter-current to the rotating *Pan*. Its function is to create 3-dimensional mixing actions as well as to aid in material discharge when mixing is complete.

The *Plow* and the *Side Scraper* working in conjunction with the *Pan* can discharge a full batch in seconds. In most cases, 90% of the batch will have left the mixer within 5 seconds. It is typical to see no more than 10 pounds of materials left at the end of discharge. On a 3000-pound batch, this is equivalent to less than 0.3%. Other types of mixers can leave as much as 5% between batches.

Unique Design flexibilities

Since the *Rotor* (primary agitator) is not needed for global material transport, it can be custom-configured in shape and speed as well as rotational direction to suit a variety of applications. It can change speed and direction at will if so needed. It also allows for fast liquid distribution without the use of atomizing nozzles.

An interesting and often useful design option is creating preferential material flow directions using various Rotor shapes. A *Rotor* can induce preferred directional material flows, increasing or decreasing frictional interaction among mix particles. It can create vortex-like downdraft or updraft material motions. Or it can enhance spinning or shearing effects depending on design.

The capacity to custom-configure *Rotor* speed enables the processing of a wide variety of materials, from free flowing powders, through plastic to slurries and liquids. This flexibility allows the mixer to input mixing intensity over a wide range, hence the ability to homogenize a batch in fractions of the time required by other mixer types. A *Counter-current Rotating Pan Mixer* can be configured to input as little as 5 HP per 1000 pounds of mix at the low end, and as much as over 200 HP per 1000 pounds at the higher end depending on process requirements.

Counter-current Rotating Pan mixers are the equipment of choice for mixing, mix-pelletizing, reacting, de-dusting, slurrying, scrubbing, plasticizing and a long list of other applications.

Please refer to “Mixing Intensity vs. Mixing Time” for a discussion on the titled topic.