Understanding Sand Mixer Types For Cold Box Core Room Applications

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ARTICLE TAKEAWAYS:

- Advantages and disadvantages of common mixer types
- Using Single or dedicated mixers in core rooms

There are a number of considerations that should be addressed when installing a new multiple core machine project, or improving efficiencies in an existing core room.

In older plants many times the core machines are added in a somewhat sporadic manner as the company grows and production increases. Typically, this results in a core room with the core machines having no particular relationship to the others, the mixed sand supply, or the flow of the finished cores to the molding area.

It's very easy to look at a layout and realize it's obviously not the optimum design for current needs, but you need to realize that plants kind of grow up around themselves.

Many times, equipment is installed wherever there is room at that time, with the old adage that "we'll fix it later," and as we all know, later never comes. At best the core room is inefficient, at worst, it's dangerous.

For purposes of this discussion, we will assume a core room with 2 or more core machines using PUCB resins and a standard gas generating system and fume collection scrubber. And, while there are a number of different ways to mix sand, this is a general discussion of the most popular methods.

The most common process design is to have a mixed sand surge hopper above the core machine blow chamber valve, where the level indicator on the hopper tells the batch or continuous mixer when to cycle.

If a dedicated mixer is used for each core machine, a bulk transfer system (BTS) should be specified where the chemicals are in a location remote from the core room usually in a temperature controlled, fireproof room. A properly designed BTS will keep the day tanks at each mixer full with a small amount of resin. This day tank sizing is normally determined with the in-house safety and environmental personnel, insurance carrier, and plant engineers. A general rule of thumb is to have ½ a shift of

chemical close to the mixing system. In normal operation, the resin is heated in the temperature controlled fireproof room, and pumped to the day tanks. The day tanks will have a low watt density heat blanket wrapped around them to maintain room temperature.

MIXER SELECTION: BATCH OR CONTINUOUS

One of the primary drivers for core machine layout is the type and number of sand mixers selected. As in any manufacturing process, the introduction of raw materials

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and the movement of finished product after the process both require careful consideration.

Obviously, there are two main raw materials used in the core room, sand and binder – and additives such as oxide powders along with anti-veining products.

The first decision is the mixer type and the second decision is whether to have one mixer for multiple core machines or a dedicated mixer for each core machine.

In general, there are two types of batch mixers that are most commonly used; the S-blade vertical shaft batch mixer and the horizontal shaft batch mixer.

S-BLADE VERTICAL SHAFT MIXERS

The most popular is the S-blade, vertical shaft mixer. This tried-and-true foundry mixer is known for its durability and affordability. This design has been in service in the foundry for well over 50 years. S-blade mixers are comparatively inexpensive, require minimal maintenance, and are easily cleaned. Disadvantages include long mixing cycles (with the inherent potential to create fines), higher resin requirements for equal strengths compared to other mixer types, and, many times, inaccurate pumping systems given the era of technology when they were originally designed and built.

The chemicals are added after the sand is in the mixer and the mixer has started. There really isn't a better way to add the chemicals than a simple "overflow pipe" which is a short length of properly sized pipe mounted horizontally over the sand bed.

When the chemical is introduced to the chamber, the chemicals overflow and run into the active sand bed. This design lessens the potential for post flow of chemicals after the mix cycle has started and the desired amount of chemicals are added. A small amount of post flow is inevitable given the nature of the viscous liquids. This post flow is quite detrimental to the process since it is very common for this liquid to either fall on the S-blade or simply float across the top of the sand bed, building up on the side walls of the mixing chamber. This adds to the cleaning time required which is a waste of expensive chemicals and also adds variability to the final product

HORIZONTAL SHAFT BATCH MIXERS

This much more modern technology requires much less time to properly blend a batch of a given size as a result of the high intensity, very efficient mixing action. Most modern core machines are equipped from the manufacturer with some form of this mixer design.

Fines generation is reduced compared to S-blade mixers as a result of the greatly reduced cycle times, and hourly throughput is high since cycle times can be as much as 20% of the venerable S-blade mixers.

This type mixer forces the sand back and forth against itself from one side of the chamber to the other while the mixer shaft rotates

Modern horizontal shaft batch mixers are higher priced than S-blade mixers but have a much higher level of technology for all functions. However, the greatest advantage of this higher level of technology is the accuracy and repeatability of the batch, primarily from the accuracy and repeatability of the liquid addition.

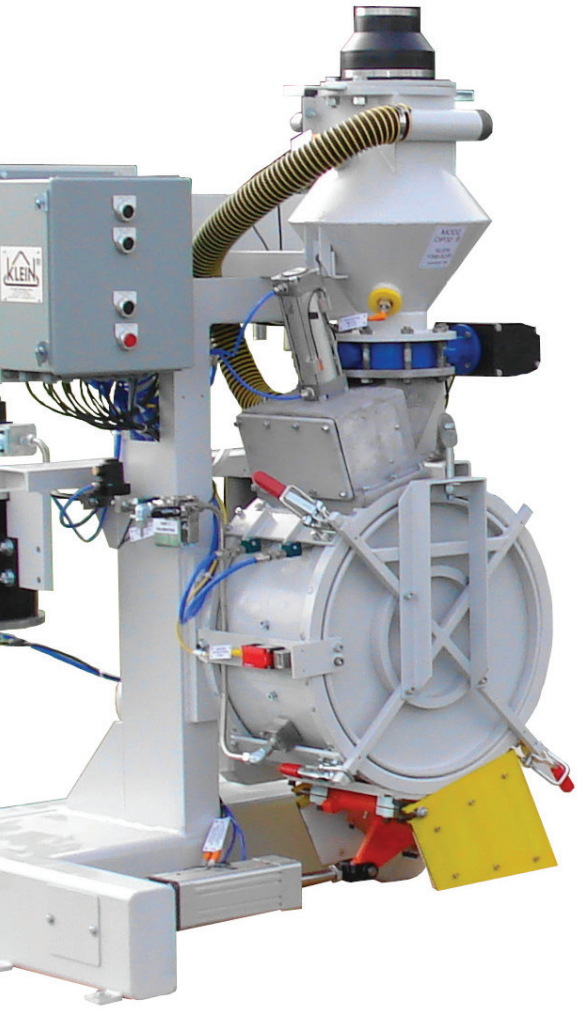
The sand batch amount is very accurately metered into a properly sized hopper above the mixer where the inlet valve is opened for a variable amount of time. This hopper is equipped with a discharge valve directly connected to the HSM main chamber – once the sand is delivered to the chamber, and the valve closes the discharge valve on the sand supply to the feed hopper for the programmed amount of time. Since this is accomplished while the previous batch is mixing, the next batch can be started immediately once the mix cycle is completed

We use the phrase "liquid addition" in place of the commonly accepted "pumping system "since the more accurate and higher technology batch mixers uses a bellows type mechanism to meter the liquid into the mixer at the correct time in the cycle at the most beneficial place in the mixer, and in a very accurate and repeatable manner.

Essentially the bellows type metering device is very similar to a medical syringe. When the

bellows is retracted to a physical stop with valve to the inlet to the resin storage open, it is filled completely. To meter the liquid into the mixer, the discharge valve is opened and the bellows is compressed at a controlled rate to a physical stop. This very simple and repeatable process results in extremely accurate liquid delivery to every batch time after time. The system can be configured to deliver the 2 resins at the same time, or one after the other. A controlled rate of addition is critical to eliminate the potential for resin saturation, resin balls, and streaking.

The liquid is introduced into the chamber by going through on the mixing blade components. This results in 100% of the expensive chemicals being used and practically eliminates post flow which helps lessen resin buildup on the chamber lining. As a result, the mix is consistent, batch times are reduced, maintenance time is reduced and the need to clean the chamber and mixing mechanism is also lessened.



VIBRATORY MIXERS

While not as well-known, vibratory mixers are the ultimate in simplicity. This design is very popular with high production automotive foundries where they have been tested extensively and proven to be exceptional in the areas of tensile strength, ease of calibration, cleaning, and resin efficiency.

While traditionally produced in smaller sizes, larger mixer designs are readily available.

The vibratory mixer is comprised of a cannister with internal flighting clamped to an isolated mechanical structure equipped with a high-speed vibrator opposite the cannister. The resin metering system is identical to the horizontal shaft mixer with the inherent durability, accuracy, and repeatability. The sand is metered into the cannister with the above-described timed hopper. When the vibrator starts, the sand flows around the carefully engineered and extremely durably flighting.

This process results in a very evenly coated sand with minimal resin additions. Once the mix cycle times out, the stopper in the bottom of the cannister opens while the vibrator is still running. The sand flows out of the cannister very quickly, closes, and is then immediately ready to be refilled.

CONTINUOUS MIXERS

While not as popular as batch mixers for modern no-bake core machines, continuous mixers are gaining in popularity for a variety of attractive reasons. The cost of a modern high speed continuous mixer is much less than others in a per lb produced / time ratio, and are more flexible. The amount of sand produced per minute is very repeatable as it is a simple matter to set the amount of time needed to produce the required amount of sand.

Mixing efficiency has been proven to be better than S-blade mixers, and are much faster assuming the mixer is correctly sized. The resin is metered into the mixing chamber with traditional close tolerance spur gear pumps and the pumps are magnetically coupled to eliminate resin leakage on the newer machines.

The level sensor in the hopper above the core machine blow chamber valve tells the mixer to run and for how long. There is an age-old controversy that states that the only way to get the exact same sand in a given amount is with a batch mixer. While this used to be true years ago, with today's accurate drive motors, valves and pumping systems, this is no longer a concern (much less a controversy).

A properly designed PLC, pumping system, diverter, valving, ensures that the resin can be delivered to meet the sand at the exact moment the sand is at the resin ports. It can also immediately cease delivery when the sand stops, resulting in the correct amount of resin being metered into the chamber, at the correct time.

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The sand from the continuous mixer normally discharges into a storage hopper above the core machine. If there happens to be a tiny amount of sand that isn't properly blended, it will blend into the existing sand.

SINGLE OR DEDICATED MIXER PER CORE MACHINE

In general, there are two ways to supply properly mixed sand to the core machines; a dedicated mixer for each core machine, or a system whereby the sand from a single mixer is delivered to multiple core machines. The dedicated mixer for each core machine is pretty straightforward. There is a mixer above the core machine surge hopper that discharges directly into the hopper. The advantages are that the sand can be custom mixed for the job that is running ensuring fresh sand.

The surge hopper above the blow chamber valve can be comparatively small which is important on hot humid days. In the event of a mixer breakdown, only one core machine is not producing (instead of the whole core room). This ensures that enough sand is made for each job, regardless of size or cycle time.

If a dedicated mixer is used for each core machine, a bulk transfer system (BTS) should be specified where the chemicals are in a location remote from the core room usually in a temperature controlled, fireproof room.

A dedicated mixer for each core machine will also require a sand transporting system, with a valve feeding each hopper above each mixer. Level controls for each hopper as well as level controls and dust collection fittings/ ducting are also required for each mixer.

There are a number of ways to deliver mixed sand to multiple core machines depending on the number of core machines, the distance they are from each other, and their respective layout. Three core machines can be fed with one mixer, either continuous or batch, where the mixer discharges either into the hopper above a core machine or onto a simple reversing belt.

The level controls will keep all three hoppers full as needed by either running directly into one core machine hopper, or onto the belt that can reverse to go to another core machine. A single belt can be used to feed multiple core machines by using plows to take the mixed sand off the belt. This process, however, exposes the mixed sand to more air which can result in crusty, or hardened sand on hot humid days. A single continuous mixer can discharge onto a belt that pivots to reach any number of core machines that are oriented in a semicircular or circular layout.

But the most popular single mixer, mixed sand delivery system is a shuttle car with all of the core machines in a straight line where the mixer discharges custom mixes for each core being produced. A shuttle car is a wheeled cart with a cone shaped polyethylene hopper on a track that is filled from either a batch or continuous mixer with each batch being custom designed for resin level, resin ration, powder additions, sand type, anti-veining product addition and release agents.

There are many advantages to this design:

- Only one raw sand hopper is needed with one discharge point for the transporter
- Only one dust collection connection is needed
- Only one set of resin supply tanks and level controls are needed

The disadvantages to this system, is that if the mixer, transporter, or shuttle car are down, all core machines will stop producing as soon as the hopper above the core machine is emptied. Careful consideration is needed to determine mixer size and mix cycle time to fill the shuttle car taking mix time and travel time into consideration.

If there are more than five or six core machines and they all are using a large amount of sand, multiple mixer and shuttle car systems may be needed. The mixer size, mix time, and travel time need to be carefully analyzed to determine the optimum system for your operation today and in the future. Sizing should always be determined by calculating the largest core possible on a given core machine at the highest production rate x the number of core machines.

Whether you are building a new core room, enhancing an existing core room, or completely over hauling your operation, today's technologies can ensure your core room is operating efficiently and economically.

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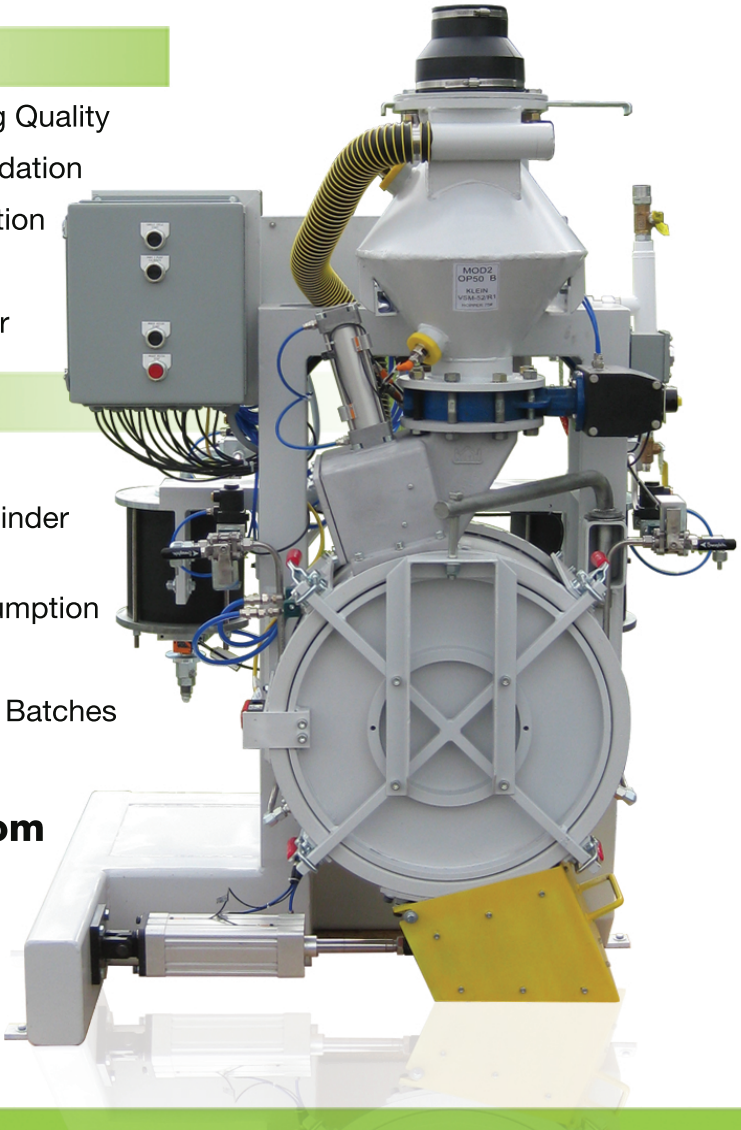

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