

Equipment such as batch mixing pugmills can make recycling clay a much easier process for many classrooms and pottery production studios.



Efficient Clay Recycling

by Randy Wood

For centuries, many pottery producers and schools have recycled clay by hand. Manual recycling can, of course, produce a high-quality plastic body when done correctly. However, the process is very labor intensive and time consuming. In general, school ceramic classes create large quantities of overly wet clay as students experiment with throwing, while production potteries, art potters and sculptors usually end up with quantities of overly dry and bone dry material.

Since a big part of the recycling process is adjusting the moisture content of clay, using a machine that can handle clay of varied consistencies, from totally dry to very wet, can be a significant time saver. Three basic types of machines used for recycling are clay mixers, standard pugmills and batch mixing pugmills.

Clay Mixers

Clay mixers are excellent for mixing dry powder and adding recycled material back into a body to achieve the desired moisture content. They are simple, effective, reasonably priced and relatively easy to clean, and they also do most of their work

without operator assistance. The downside of clay mixers is that unloading, transferring and storing the produced body is usually cumbersome. The clay is in irregular, difficult-to-manage “chunks” and is often entrained with air. For most applications, the product must be run through a pugmill and/or aged for a prolonged period to be conveniently used.

Standard Pugmills

Standard pugmills can be effective for homogenizing (blending) a body and deairing clay, if the systems are designed correctly. The biggest problem with standard pugmills is their inability to deal effectively with adjusting moisture. Pugmills cannot handle clay that is dry or overly wet, and bone dry is completely out of the ques-

tion. Dry clay must be slaked and then dried to some extent on plaster before running it through the pugmill, and this slaking/drying process is time consuming.

Another drawback with standard pugmills is they require constant hand feeding, which can be both time consuming and laborious. Wads of clay must be divided into small pieces and forced through a small shoot using a long lever handle. The necessity of grates and safety shutoffs exacerbates this force-feeding process. Standard pugmills are also prone to drying between uses. If clay is left in a standard pugmill for, say, two weeks and dries out, the pugmill will be damaged if it is not cleaned of dried chunks before being used again. Most users find this very inconvenient.

Standard Pugmill Considerations

- A standard pugmill that puts out 500 lbs of clay per hour will require at least one hour of constant operator feeding to pass the 500 lbs through once.
- A standard pugmill without vacuum capabilities will produce clay that is compacted but not deaired. If the pugmill is designed correctly, the clay body will probably be compacted enough so that it doesn't contain bubbles or pockets, but it might still be somewhat short because of air entrainment.
- A standard pugmill without vacuum capabilities should homogenize (blend) just as well as the same pugmill with a vacuum.

Efficient Clay Recycling

Typical uses of standard pugmills include compacting and deairing clay after mixing; running bagged “factory” clay through to pre-wedge, measure and cut pug lengths; or combining clay that is too dry with clay that is too wet by placing a ball of each in the shoot together. Often the latter process can require running the clay through two or more times to get an even consistency.

Batch Mixing Pugmills

Batch mixing pugmills (BMPs) combine the advantages of clay mixers and pugmills and eliminate many of the disadvantages. As mixers BMPs unload themselves, and as pugmills they feed themselves. They make usable product from any consistency (moisture content) of clay—even totally dry or powder.

BMPs use augers or paddles that are rotated in a forward direction to pug and a reverse direction to mix. They are easy to load, as the hopper openings are usually relatively large, and constant force-feeding is not necessary since the whole batch is loaded before mixing—most of which is merely dropped into the expanded hopper. Best of all, they do most of the work without operator assistance. The laborious task of transferring clay from mixer to pugmill is completely eliminated. No slaking is required, and the whole batch, when extruded, will be of even consistency and will not need to be run through the machine a second time.

What to Look for in a Batch Mixing Pugmill

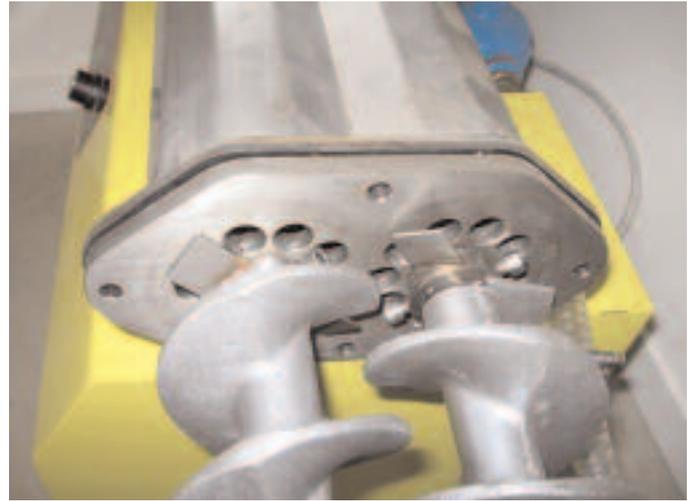
Simplicity

A BMP might sound like a complicated machine—after all, it does the work of both a mixer and a pugmill. However, correctly designed systems are actually quite simple to use. Some machines have fewer parts than conventional mixers or pugmills, and therefore require less work to clean and maintain.

Single-auger BMPs can thoroughly mix the clay and have the simplest design. They have been around for a quarter of a century and are well proven in the field. Because BMPs do all the mixing/blending in the mixing chamber, a very short pugging chamber is all that is required to provide the pressure necessary to effectively compact the clay through the nozzle.

BMPs with double augers provide the same results as those with one auger but can require much more horsepower. Double-auger systems designed with one of the augers considerably longer can also require additional horsepower when pugging to drive the long auger while the mixing chamber still contains a full batch. The long auger must turn numerous additional auger blades through the resistance of all the clay being pushed through the tube and out of the reduction in the nozzle. Forcing the clay through vacuum screens also increases the horsepower draw.

Why worry about horsepower? With today’s escalating electricity costs, every bit of energy consumption counts. For example, when running a 3-hp instead of a 2-hp machine, two hours per day can cost an extra \$100 per year, depending on electricity rates. The 3-hp machine running eight hours per day at business rates could cost an additional \$374 per year—or \$3740 over a 10-year period.



An example of a twin-auger screen-type standard pugmill.

Screen Requirements

Some BMPs use screens and long auger tubes, which are typical of standard vacuum pugmills. Others use a patented system that deairs in the mixing chamber during the mixing cycle.

Screen-type systems require long augers with blades on both sides of the screen. This requires increased drive horsepower and a high-horsepower vacuum pump. In fact, these vacuum systems can require three to five times as much horsepower as a non-screen deairing system.

Screen-type vacuum systems run the pump continuously during the pug cycle. However, when the vacuum pump is off between batches and the rotation is reversed, all the clay left in the long tube and nozzle is exposed to air. Reintroducing a vacuum during the next pug cycle might not catch this trapped air. This situation can also occur if the mix section slows down or stops feeding for a moment—the vacuum section clears and opens to allow air into the entire pugging barrel.

Non-screen deairing systems are simpler, with no screens to plug, clean or maintain. Screens are not required with systems that deair in the sealed mixing chamber; complete deairing occurs while the clay is being mixed in a vacuum.

Non-screen vacuum systems also use much smaller vacuum pumps. The pump removes the air from the sealed mixing chamber as part of the mix cycle (this takes about a minute, even with a small pump) and is then turned off. With this method, the whole batch of clay is stirred in a vacuum, which provides complete contact to thoroughly deair the whole body. Small vacuum pumps are considerably quieter, require less horsepower than the screen system pumps, and only run for about one minute at a time.

Cleaning and Maintenance

It is important to understand the requirements for disassembly and reassembly—i.e., how many bolts are in the system? Which components can be removed, and how much do they weigh? Are there any “nooks and crannies” that will need to be scraped clean? Do you have complete access to all components, and are they easily transported to your sink or cleaning area? Non-screen, single-auger systems have no screens to clean and fewer auger blades to deal with. Additionally, their pug barrels tend to be shorter and easier to clean and handle.

Vacuum Sealing

Most vacuum BMPs are equipped with seals between mating surfaces to maintain vacuum in the deairing chamber, and a simple vacuum sealing design is mandatory. O-rings used for seals are very effective, durable, easy to handle, readily available since they are standard worldwide, and cheap to replace. Flat gaskets are often custom made and are only available through the original equipment manufacturer.

Storage

BMPs that are designed to completely seal can also serve as a storage container in which a batch of clay can be stored indefinitely. BMPs that deair in the mixing chamber are best for storage because their hopper doors and nozzles are completely sealed.

Separating Clay from Drive Components

An inherent problem with all clay processing machines is keeping the clay out of the works. This is a minor issue with standard pugmills, since they only run in one direction and always move the clay away from the gears and bearings. However, with BMPs that rotate in both directions, clay moves toward the rear wall and can cause contamination in systems where the bearings and gears are located at the rear wall. A design with an integrated chamber between the mixing chamber and the gear drive virtually eliminates this problem. Any clay working its way along the shaft will drop into the chamber and can be easily removed, thereby avoiding damage to the drive components.

New Technology

Variable speed is a new option available on some BMPs. This option allows control of the rotational speed of the auger and is especially useful when extruding (particularly smaller shapes). Control over the speed of an extrusion can aid in handling and quality. Some studio potters also find it helpful to slow the pugmill output to allow time to cut and package reclaimed clay.



A BMP with an integrated chamber between the mixing chamber and the gear drive. Any clay working its way along the shaft will drop into the chamber and can be removed before it can damage the drive components.

Quality Counts

When researching any new piece of pottery production equipment, be sure to look for quality. Clay offers significant resistance and can easily tax processing machinery. Any machine you purchase should be able to work hard for a long time. Buying your equipment from a manufacturer with a good repu-

tation and a long track record of performance and excellent customer service can help ensure a solid return on your investment. 🌐

About the Author

Randy Wood is president of Peter Pugger Mfg Inc. and has been designing and manufacturing batch mixing pugmills since 1978. For more information about mixing and pugging equipment, contact Peter Pugger at 3661 Christy Lane, Ukiah, CA 95482; (707) 463-1333; fax (707) 462-5578; e-mail info@peterpugger.com; or online at www.peterpugger.com.

Editor's note: The comparisons and opinions presented in this article are those of the author and do not imply endorsement by *Ceramic Industry/Pottery Production Practices* of a specific equipment brand or type. Pottery producers should carefully evaluate all products and related claims before making a purchase.