PICTURED: The High Capacity HDX Continuous Mixer is capable of producing dough at up to 7,000 kg/hr.

WHITE PAPER

Higher Dough Capacities Multiply the Advantages of Continuous Mixing

By Jim Warren, Vice President, Exact Mixing

For nearly thirty years, bakers have been making the choice between batch and continuous mixing for their bakeries. The advantages of continuous mixing, including quality, consistency, just in time dough, labor reduction and energy efficiency, were enough to convince bakers to make the switch. However, two factors influenced why bakers continue to select batch mixing. Those were 1) the higher initial cost of continuous mixing and 2) risk aversion; the tendency to repeat past processes to avoid any perceived risk.

As continuous mixing became more common in the baking industry, and the technology evolved, most bakers no longer saw continuous mixing as a risk; however, the initial cost of continuous mixing continued to be the primary reason bakers selected batch mixing for new projects. This thought process remains true today even though the continuous mixing cost of ownership is less than batch mixing, especially for large capacity production systems.

Continuous Mixing technology has greatly advanced over the last thirty years. These advances include improved ingredient metering, metering of solid fats and particulates, enhanced controls, specialized mixer designs, larger capacity mixers, improved temperature control and more. While all of these advances in technology have made continuous mixing attractive to more bakers, it is the high capacity continuous mixers that offer the most benefit.

The purpose of this paper is to highlight the benefits of high-capacity continuous mixers compared to batch mixers and the reasons high-capacity continuous mixers have been widely accepted by today's bakery industry.

In 2000, the highest throughput continuous mixers operated in the range of 5,000 kilograms per hour (kg/hr) of dough produced. By 2020, continuous mixers were being manufactured in the 15,000 to 20,000 kilograms per hour range. Even higher rates were accomplished by linking continuous mixers together. With the increased throughput of the largest continuous mixers, one would expect the additional cost of a larger mixer to magnify any resistance due to initial investment requirements. However, higher throughput mixers quickly became best sellers. Why would high throughput continuous mixers become so attractive? The answer is that while the larger mixers were somewhat higher in initial acquisition cost, the same advantages seen with the smaller continuous mixers became much more important at higher rates. Also, as production rates increase, the cost of a batch system tends to increase linearly – double the capacity and double the cost. On the other hand, if you double the capacity when using a continuous mixing system, the cost would only increase about 25%.

EXACT MIXING
BY READING BAKERY SYSTEMS

FIVE PRIMARY REASONS THAT THE ADVANTAGES OF CONTINUOUS MIXING INCREASE AS THROUGHPUT INCREASES

REASON 1:

CONTINUOUS MIXING IS MORE COST EFFECTIVE TO OPERATE THAN BATCH MIXERS FOR LARGER CAPACITY LINES

In both the continuous mixing and batch mixing process, four factors contribute to the required initial investment. Those are mixer cost, bulk materials delivery, ingredient metering, and post-mixing dough handling. As bulk material delivery costs are very similar for batch mixing and continuous mixing, this cost will not be considered for comparison purposes.

In the case of continuous mixing, three cost factors comprise a system. Those are metering, mixing, and post-mixing dough handling. Since the post-mixing cost is very small (less than 2%), it will also be ignored in this discussion.

In the case of batch mixing, three costs also comprise a system. Those are metering, mixing and dough handling. The batch mixing metering cost is less than 2% and will also be ignored in this discussion.

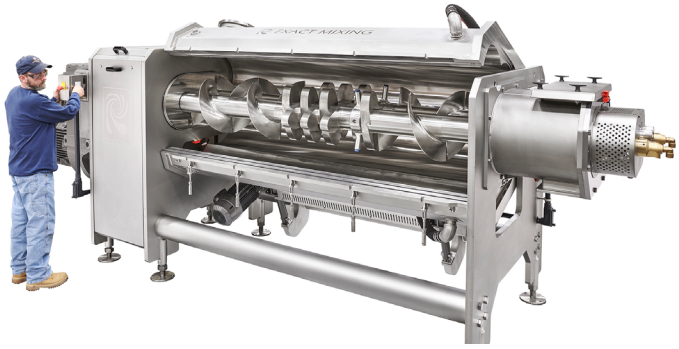
Typical Cost of a Continuous Mixing System at Various Capacities

Continuous Mixing System Capacity	Cost of Continuous Mixing System	Cost Per Kilogram of Dough Per Hour
500 kilograms per hour	$500,000	$1,000
2,000 kilograms per hour	$750,000	$375
15,000 kilograms per hour	$1,500,000	$100

First, consider the affect throughput increases have on a continuous mixing system cost. The key concept to understand is that when the throughput of a continuous mixing system increases, the cost of the system changes at a much lower ratio. This is because the ingredient metering portion of the cost is nearly constant no matter what the new throughput is. The chart above clearly shows this relationship. At four times the throughput (500 kg/hr to 2,000 kg/hr), the continuous mixing system cost has only increased by 50%. At 7.5 times the throughput (2,000 kg/hr to 15,000 kg/hr) the system cost only doubles.

When considering batch mixing, the cost of the model is quite different. Basically, doubling the throughput of a batch mixing system increases the cost by 80% to 100%. Both the mixer and the downstream metering system must double in capacity. In short, compare cost per pound of dough produced.

While the above information alone might explain why continuous mixing becomes more attractive at higher throughputs, we have only discussed the initial investment. We will now consider other factors that make continuous mixing even more attractive for higher capacity production needs.



PICTURED: The versatile MX Continuous Mixer is capable of producing dough at up to 6,500 kg/hr.

REASON 2:

CONTINUOUS MIXING IS FULLY AUTOMATED, REQUIRING LESS LABOR THAN BATCH MIXERS

Does higher dough output require more personnel in the mixing area? The intuitive answer is yes. Mixers are larger. More mixers are required. Ingredients are added in larger quantities. Larger dough quantities are discharged and must be delivered to the downstream equipment. Failing to deliver dough on time results in a larger reduction in production. With a batch mixing system, all these factors require more employees.

This is not the case with continuous mixing, as the system is fully automated. First, the ingredient addition and mixing are controlled by the recipe control system. Second, the dough is automatically cut into smaller chunks by the mixer or allowed to flow as a rope. This means no additional dough sizing and handling is required. As a result, no more employees are required at higher capacities.

With any size continuous mixer, the operator has two primary responsibilities. The first is to occasionally inspect the dough quality as a final verification of the quality prior to forming (although many customers see this as an unnecessary task). The second responsibility is to address any system alarms. With larger systems, alarms tend to be even less frequent than smaller systems. The system automatically attempts to correct any alarms and is often successful. An operator would not be expected to address alarms more than a few minutes a shift and often not at all. It is common for the operator to have responsibilities other than just "operating" the mixer. This is true at all dough throughput capacities.

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As batch sizes increase, there are also other concerns that arise. Most crucial among those concerns is training. The batch processes tend to be manual in nature requiring operator intervention. This is even more so as the dough volume increases. This intervention requires a great deal of training to ensure the mixing steps are completed correctly. With batch mixing at least one person per shift must be trained because the quality of the finished products depends on their decisions and actions.

Anytime training becomes critical, retention is also critical. As the dough requirement increases with a batch system, the demands on the staff are multiplied. In the case of continuous mixing, no matter what the rate, only one operator is required and for only a small portion of the day.

REASON 3:

CONTINUOUS MIXING REQUIRES LESS DOUGH HANDLING EQUIPMENT THAN BATCH MIXING

The method of handling dough after mixing is completely different with batch vs. continuous mixing systems. In the case of continuous mixing, the dough generally comes out of the mixer in a rope or log. A cutter at the end of the mixer allows the baker to make any size dough chunks desired, with 25-kilogram to 50-kilogram chunks being the most common. The chunks fall onto a conveyor belt or directly into a hopper. The smaller chunks are ideal for feeding multiple lines from one mixer.

In the case of batch mixing, the dough discharges from the mixer in a large mass that must be resized for downstream equipment, resulting in additional cost for this handling equipment.

As the requirement for dough increases, the dough handling becomes a greater challenge with a batch mixing system. Larger chunks of dough mean more equipment, and more people. However, in the case of continuous mixing, dough handling is the same regardless of throughput.

REASON 4:

MORE EFFICIENT THROUGHPUT - LESS DOUGH IS AT RISK WITH CONTINUOUS MIXING COMPARED TO BATCH MIXING DURING SHUTDOWNS

When a baking line is running, dough exists between the mixer and the proofing or forming equipment. This is referred to as dough-on-hand. This dough-on-hand includes dough in the forming hoppers, dough waiting to be placed in the hopper, dough being discharged from the mixer or the dough currently in the mixer. In the case of a batch mixer, this amount is typically around 2.5 to 3 mixer volumes. The issue for batch mixing, is that all dough-on-hand is at risk should downstream equipment require an extended shutdown.

In the case of continuous mixing, the hopper levels can be kept as low as possible to improve piece weight control, so only a few chunks are in transit. In effect, the dough at risk for continuous mixing is basically the volume of the mixer at any capacity.

At lower rates, this may not be a significant factor, but at a rate of 10,000 kilograms per hour there could be 5,000 to 6,000 kilograms of dough on hand with a batch system. With a continuous mixing system, dough on hand would be closer to 1,000 kilograms for a similar throughput production rate.

PICTURED: RBSConnect controls allow you to monitor real-time and preventative maintenance information, key performance indicators, alarm history and trending.

REASON 5:

AUTOMATED CONTINUOUS MIXING SYSTEMS ELIMINATE VARIABLES THAT EXIST IN THE BATCH MIXING PROCESS

Mixing systems inherently have variables which must be carefully controlled. Some of these include recipe, temperature, energy input, humidity, flour quality, and batch spacing. There are two steps required to control such variables: measurement and reaction to inconsistencies. It is how variables are measured and how the system reacts, that determines the success of the mixing operation and ultimately the consistency of the dough.

Accurate measurement:

In the case of batch mixing, the recipe is often based on hand-measured minor ingredients. Typically, these batches are not double checked. The operation is totally dependent on a person and a scale.

In the case of continuous mixing, minors are blended with the use of loss-in-weight technology and a blender on load cells. All measurements are weighed automatically, and the data is saved in the system. Dry and liquid ingredients are carefully metered into the mixer, and automatically weighed and recorded. Metering rates are graphed in real time and saved for future reference.

FIVE PRIMARY REASONS THAT THE ADVANTAGES OF CONTINUOUS MIXING INCREASE AS THROUGHPUT INCREASES

As the mixer throughput increases, hand measuring creates greater opportunity for errors, more employees are required to batch ingredients and the pressure to create blends quickly increases. Continuous mixing guarantees accurate measurement all day, every day.

Reaction to inconsistencies:

Variables are a part of any process. As was stated above, the first step to controlling the process is to measure the variations. Ideally, measurements are made in real time and the most important variables are being measured. If process success is only measured in the QC lab, or by the number of customer of complaints, improvement will be difficult. Measurements should be early, often, and with a plan for correction.

Often in a batch system, the plan for correction is at the operator's discretion. Forget to add something? Dough is too warm or too stiff? Not enough development? Wrong consistency? Downstream shutdown? When presented with these problems, if there is not a plan to act quickly, product will often be inconsistent and out of spec, creating waste. With continuous mixing, the system anticipates potential concerns, determines proper corrective steps in advance and is programmed to take those steps automatically.

CONCLUSION

While continuous mixers have been available for more than thirty years, only in the last ten years have we seen the development of mixers capable of producing dough at more than 8,000 kilograms per hour. These high capacity mixing systems function exactly as the lower throughput systems; however, unlike batch mixers that increase in workload with capacity, continuous mixers require no additional workload or resources with increasing capacity. Most importantly, the potential problems associated with batch mixing of dough at higher rates do not exist with continuous mixing at higher rates.

Even though continuous mixers have a higher initial cost than batch mixers, the operational efficiency benefits of continuous mixing will quickly repay the additional expense and then multiply a financial advantage for large capacity manufacturers. Continuous mixers will cost less to operate over time than comparable batch mixing systems.

To calculate how much you can save when using continuous mixing compared to batch mixing, try our Continuous Mixing Calculator at https://www.exactmixing.com/calculator.

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