Reading Bakery Systems Continuous Mixer Plant Run
Observation Report- Northeast Foods Baltimore, MD
April 29, 2016
Written by: Kirk O'Donnell

Scope of work

1. Observe 8-hour production run of Hamburger rolls on April 28, 2016. Half the time, the production was done using a conventional batch mixer (2,200 lb. of dough per batch), while the other half of the time was done using the Reading Bakery Systems continuous mixer (rate of about 7,800 lb. per hour)
2. Observe the entire process again on the second day (April 29, 2016).
3. Develop a report based upon the observations over the two days.

Summary of the process

The plant was running Big Mac buns for McDonald's on the batch mixer when I arrived at the plant both days. The process began with a large Shaffer batch mixer, at which were combined all raw ingredients in addition to a mature liquid sponge according to the formula standards. After a total mixing time of about 10 minutes, the dough was pumped and belted to an AMF Do-Flow machine and then fed to an AMF extruder bun divider/rounder/intermediate proofer/automatic panner. After passing over an automatic pan shaker, the pans filled with dough were sent to a Stewart conveyor-style proofer. The proof time was about an hour with a temperature around 99 F and relative humidity between 82 and 84%. After proofing, the dough pieces were topped with sesame seeds (Burford machine), and then loaded into a Stewart conveyor-style oven. The baking time was just over 9 minutes. After baking, the buns were depanned and conveyed to a continuous conveyor cooler. The empty pans were passed through a Henry group pan cleaner before being cycled back to the AMF machine for new dough pieces. After the cooling time, the buns were sliced and bulk-packed. One the run of Big Macs was finished, the empty pans were sent to the pan stacker.

For the continuous mix, we switched over to regular 4" buns, and this was done on both days of my observation. The staff at Northeast Foods wanted to produce regulars to evaluate the quality of the continuous mixer, because this product has less room for error than the other products that they manufacture. In other words, we could more readily see all defects.

The differences in the bun production process for the test were as follows:

1. The batch mixer was shut off, and the pneumatic flour system was not used.
2. The continuous mixer and feed system were prepped. The preparation included turning on the glycol system (in order to control dough temperature), bleeding the lines that would later convey the ingredients to the continuous mixer, re-installing the ingredient feed lines, disconnecting the liquid sponge discharge pipe and connecting the tank to the Reading Bakery Systems feed system, and setting up the manual flour feed. A great

amount of this preparatory work will be eliminated once the continuous mixer is completely installed.

3. The ingredients were fed to the continuous mixer in seven (7) streams: Flour, water, syrup, vegetable oil, yeast slurry, liquid ferment, and minor ingredient slurry. Flour was dropped first, then the liquids shortly after along the length of the mixer.
4. The continuous mixer discharged the dough onto a belt, and the dough was conveyed about 50 feet to the Do-Flow machine atop the AMF divider. Northeast Foods turned down the RPM of the Do-Flow during the test and they told me that this machine would not be necessary in the future with the use of the continuous mixer.
5. Besides using different pans, the line speed was higher- 132 cuts per minute or 924 buns per minute.
6. Proof time and temperature were not changed, and the seeder was not used for the test on the continuous mixer.
7. Baking time was reduced from just over 9 minutes to just under 8 minutes. This was due to the smaller unit size, not to the test.

<u>Quality of the dough and the product</u>

Before the test began, it was clear to me that the staff at Northeast Foods had the knowledge and skill to make high-quality hamburger rolls. Therefore, my concern was to see how the continuous mixing process product measured up to their normal product.

On day 1 at the start-up of the continuous mixer, our biggest problem was that the dough was too cold (low 60s). We were able to get the dough temperature in the desired range after about 5 minutes. On the second day, we started the glycol system later; and we also turned the glycol value to give half the flow as the first day. This solved the problem, because we achieved desired temperature on day 2 within a minute or two.

On day 1 we had some inconsistency in the stickiness of the dough, but it was not due to changes in dough temperature. I noticed that the delivery of liquid sponge had too much variation from the set point, which was slightly over 2500 pounds per hour. The Reading technicians made adjustments in the control systems, but the biggest breakthrough was the elimination of the strainer at the bottom of the liquid sponge feed tank, which was part of the Reading system. Once the variation of liquid sponge was under control, the dough rounded and sheeted better on the production line. The dough was very consistent for most of day 1 and all of day 2.

Interestingly enough, on day two, the discharge conveyor for the continuous mixer was bumped, causing the micro-switch to stop the system. We were down for just over 30 seconds, and the dough before and after the stoppage was consistent in terms of both gluten development and dough temperature. I was very impressed!

For almost all of the 6 hours that I observed the continuous mixer, an operator was not required. Once everything was set up and running, it ran by itself, and I was only observing.

The ingredients came in at their programmed rate, and the dough loaded onto the conveyor at the programmed rate. The amount of dough in the divider hopper was very consistent. Another interesting fact is that the 30 second stoppage for the bumped conveyor on day 2 was the ONLY time the machine stopped in the entire two days of observation.

The staff at Northeast Foods made some minor formulation adjustments during the two days of observations. They simply made some minor changes on the feed rate of the yeast slurry and the feed rate of water. With a batch system, any formulation adjustments are made with baker's percentage. However, the continuous mixer system allows very small changes in pounds per hour. For example, the yeast slurry rate on day one was 266 pounds per hour. On day two, this was adjusted down to 261 pounds per hour

Northeast Foods has a Dipix product inspection system installed shortly after the buns are de-panned, and the total defects that could be associated with the dough were about 0.25 to 0.50%, which is very low. The specific defects were doubles (due to problems in the makeup area), some blistering, and some mis-shapen. Most of the defects as recorded by the Dipix unit were light heel color, which the staff attributed to newly-glazed bun pans. What was most interesting to me in viewing the freshly-baked product passing by as well as the Dipix data is that the graphs of attributes (such as color and height) were much more consistent with the continuous mixer. On the other hand, the batch-mixed product had cycles of about 16 to 18 minutes, especially in the measurement of color. This is most likely due to the effect of floor time. The batch process requires about 18 minutes to run the dough before the start of the next batch. In theory, the beginning of the batch will have a darker color, and the end of the batch will have a lighter color, due to the effect of fermentation. This effect was readily displayed in the data, and even to the naked eye, the continuous mix product had a more uniform color.

<u>Efficiency of the process</u>

The continuous mix process was extremely efficient during my time of observation. On the first day, our efficiency was 100%, because the mixer never stopped from the time we began until the time we finished. In fact, no part of the production process stopped on day 1. On the second day, our efficiency was 99.6% with the line losing only 30 seconds of time. We operated at the full speed of 924 buns per minute on both days.

Another part of efficiency is the changeover time. Because we had to do most of the preparatory work outlined in the process description by hand, our changeover time was 11 minutes. With the continuous mixing system properly installed, I estimate that this changeover time can be cut in half (from 11 minutes to 5.5 minutes). We did NOT have any changeover time from one variety to another on the continuous mixer during my observation. In other words, each day we ran regular 4" buns, and when we finished, we shut down the mixer. On the other hand, a non-allergen cleanup is estimated at 5 minutes, because it takes slightly less than 5 minutes for the ingredients (which become dough) to pass through both parts of the continuous mixer. An allergen clean-up would require more time, but we did not test this.

I also observed the time to clean-up the area once the continuous mixer was shut down. After the ingredient feed system is stopped and the dough is emptied, the two parts of the mixer are opened. I did not weigh the dough adhering inside, but I am guessing that it was between 50 and 100 pounds. The persons doing the cleaning were spraying the insides of the mixer with high pressure water, so there was no scrubbing involved. Once the mixer rinsed clean, the inside of the mixer was dried by hand and then closed. The mess was confined to the floor and the drains, and the total cleanup took 30 minutes.

Adjustments and results

We ran their standard 4" bun formula for the most part. The only adjustments made in the formulation were water and yeast. In my judgment, the dough was mixed beautifully. For example, the dough pieces at the end of the makeup process (as the dough was falling into the pans) could be stretched into a transparent film very easily with no stickiness.

Recommendations for improvement

The continuous mixer has a port (which we did not use) for the introduction of re-work dough. This needs further study for other applications. In the case of our test with Northeast Foods, they had a long run of one product (4" hamburger buns) and had no need to recycle dough. However, other applications may require moving from one variety to another

Summary of experience with continuous mixing technology

As an independent observer, I would recommend continuous mixing technology to companies with the following production concerns:

1. High volume of production
2. Desire to improve consistency of product quality
3. Desire to reduce operating costs (not only due to more efficiency and less manpower, but also through energy savings, which were not yet documented).
4. A minimum of product changeovers

Respectfully submitted,

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Notes about the Author. Kirk O'Donnell server as Vice President of operations for AIB for 16 years prior to retiring. He now is the owner of Bakers Growth LLC, a consulting firm for bakers producing buns and other baked goods.