BEAN CUISINE MACHINE

New technical applications in continuous bean hydration and blanching are providing improved efficiencies over traditional continuous blanching systems and dry bean soak tanks while reducing damage and accommodating flexible pouch packaging.

By Jim McMahon

On any given day, almost 14 percent of the United States population — 42 million Americans — eat dry edible beans. The U.S. per capita consumption of dry beans rose 19.2 percent from 2004 to 2007, reaching 6.56 lb in 2007, according to the U.S. Department of Agriculture, and consumption is expected continue to increase. Among the types of dry beans consumed in the U.S. in 2007, 42.7 percent were pinto beans, followed by navy beans at 14.8 percent, black beans at 9.8 percent, garbanzo beans at 6.7 percent, red kidney beans at 6.4 percent, and great northern beans at 3.8 percent. Clearly, dry beans are a popular and growing choice in the U.S. diet. Factors driving the growth in dry bean consumption include widespread interest in ethnic foods that use cooked dry beans, rising immigration (particularly among the Hispanic population), and changes in America's dietary awareness.

Dry beans can be traced back 7,000 years to both North and South America, where they were an important staple in the Native Americans' food supply. As a group, they are one of the most nutritionally complete foods yet inexpensive and widely available. Dry beans contain bits of trace minerals and lots of fiber, protein and carbohydrates. They are also low in sugars and fats. Americans use dry edible beans in many ways, and all varieties are available dry in consumer or foodservice packages as well as canned products such as refried beans, soups, chilis and baked beans.

Unmistakably, dry beans have a great reputation with Americans that shows no signs of waning. It is no wonder why dry bean processors continually look for new ways to bring their bean products to market. One of these methods is packaging fully cooked and ready-to-eat dry bean products and meal combinations in flexible pouches. But before dry-bean production could be brought to fruition on any broad scale, processors had to bridge the gap between the batch soak tank process historically used and a fully automated continuous hydration/blanching method.

Blanching Systems

Continuous processing using multiple blanchers in series reduces the hydration process from many hours to somewhere between 30 and 60 minutes, depending upon the bean variety.

The Evolution of Blanching Technology

Fifty to 75 years ago, almost all dry bean processors used a batch process employing soak tank farms. A precise measure of dry beans and water were introduced into each tank, left to soak for 8 to 24 hours, then blanched for a short 5 to 10 minute period. The beans were hydrated from 12 to 15 percent moisture content up to 55 to 58 percent, at which point they were considered to be fully hydrated. Following blanching, the beans were sent off to be canned or otherwise packaged. Functionally, the soak tank process is the same today.

With this mostly manually controlled process, the quality of the finished product often suffered if the measurements of water, dry beans and soak time were not held within fairly narrow parameters.

By the early 1970s, about 10 percent of dry bean processors had eliminated tank farms in favor of continuous processing using multiple blanchers in series. This method

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reduced the hydration process from many hours to somewhere between 30 and 60 minutes, depending upon the bean variety.

Prior to 1985, blanchers were typically 48" in diameter with cylinders no longer than 16', which were supported on center shafts. The cylinders were a source of product damage and inconsistent process results, and these factors were a major reason for poor quality. Shafts in dry bean blanchers also routinely failed due to the equipment being overloaded.

In the mid-1980s, 60" and 72" diameter machines were introduced, and machine lengths were increased to 20' and 24'. These larger machines had higher water-to-product ratios, which had a direct impact upon improving product quality. They are the most common size machines used in modern dry bean processing lines today.

Throughout the 1990s, additional enhancements were made to the continuous blanching process, such as step blanching, where incremental temperature increases were made throughout the process. Beans would be introduced into 145 to 165°F (63 to 74°F) water at the start, with staged temperature changes to 170°F (77°C), 180 (82°C), and finally 195 to 205°F (91 to 96°C). The gradual increases in temperature dramatically reduced the incidence of bean splitting. Those processors that made the switch from batch to the continuous blanching method during this time quickly realized the benefits of improved product quality — specifically, consistently cooked beans which were hydrated to the same degree throughout the day.

With improved dry bean quality, continuous blanching systems handled increasingly higher volumes of throughput. Machines that were designed to handle 12" of product in 23" of water were soon being overloaded to keep up with demand, with the beans being run at levels up to 18" in depth. Of course, deeper loads require more time to bring the entire load, including the center of mass in the machine, to processing temperature, which necessitated longer blanch times; consequently, the beans on the outside of the mass were overcooked. Deeper loads also can cause the top portion of the relatively static load to ride out of the water, causing those beans to be undercooked.

Two equipment developments help ensured more uniform processes and allowed blanchers to handle even higher throughput. The first was a gentle mechanical stirring action that was imparted to the beans as they progressed through the machine. The second was a system that applied a combination of air and water injection. This air/water injection system physically and buoyantly supported the heavier loads and more evenly distributed the bean loading across the machine width. The system also minimized bean contact with the auger's perforated skin sheets, which further reduced damage. In handling one particular red kidney bean variety, for example, damage to the fragile skin was diminished by more than 30 percent.

Effectively, improvements designed into dry bean continuous blanchers over the past 30 years have proven successful in limiting bean damage to less than 5 percent. Many different designs of continuous bean blanchers exist, and not all incorporate these technologies for maintaining bean integrity, but those that do are able to provide dry bean blanch quality equal to or surpassing that of soak tanks.

It only took 30 years for continuous blanching technology to "catch up" with soak tanks as far as bean quality is concerned. But during that time, continuous systems also were able to reduce processing times to a fraction of what the soak tanks can provide. Because of the reduced processing times, continuous, automated systems have captured approximately 50 percent of the dry bean processing market. This market share gain has been aided by the integration of preprogrammed PLC control systems that provide precise, automated control of the process functions, including recipe management. The PLCs provide uniform heating and cooling, achieving a totally consistent end process.

Ready for Ready-to-Eat

As the flexible packaging trend continues to spread throughout the food processing industry, so has the demand for a fully hydrated and cooked bean obtained through continuous blanching. Up till now, both batch and continuous hydration methods have been focused on bringing dry beans to 55 to 58 percent hydration, which in essence hydrated the beans within 90 percent of their desired saturation. Then, they were put into a can with brine, sealed up and cooked. In the can, the beans picked up the remaining 10 percent hydration to reach the full intended saturation for the consumable product.

To provide consumers with a fully cooked product using flexible pouches (in the form of soups and entrees, for example), processors have been limited to using batch tanks to hydrate beans to the needed 60+ percent saturation level where the bean would be considered fully hydrated and cooked.

WEB EXCLUSIVE

Process Automation and Consistent Bean Quality

In comparison to batch (tank) processing, the PLCs used in conjunction with the continuous blanchers deliver a level of consistency in processing that cannot be obtained with manual-operated batch systems.

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Now, processing systems have been developed that can hydrate dry beans to a 60+ percent saturation level through a continuous blanching process. The bean then is full hydrated and cooked, ready to be consumed — and ready to be put directly into flexible pouches without the need for further hydration or cooking. Processing times for the beans are comparable to previous continuous blanching methods. The system has the added benefit, however, of providing a low product damage rate of less than 1 percent.

"The two factors of bean hydration are time and temperature," says Steve Hughes, CEO of Lyco Manufacturing Inc., a food equipment manufacturing company that developed a continuous blanching system that can fully hydrate dry beans for flexible pouch packaging. "When we began researching a continuous dry bean blanching system that could bring beans to a fully cooked 60+ percent hydration, increased process time was not an option for us, so we began testing different variations with increased temperature over 212°F in a pressure vessel instead of the normal atmospheric vessel used in continuous blanching. We built a continuous simulator so that we could work directly with our client companies to test increases in temperature while maintaining process times and footprint."

"Bean bursting or splitting normally occurs by hydrating a bean too fast or at too high a temperature," continues Hughes. "This is usually not a problem with soak tanks, but requires precision processing in continuous systems, and even more so when processing with pressurized vessels, as we are doing here."

In conclusion, if a company is processing 6,000 to 10,000 pounds of dry beans per hour, or more, then it would well justify a continuous-method system. The processor that is only handling say 1,000 pounds of beans an hour may, however, be better suited for batch processes. But given the trending increases in the varieties of bean popularity and consumption, coupled with the newly emerging desires by food processors to put fully cooked beans into flexible pouches, it just may be that continuous hydration blanching has positioned itself in a new role as the dry bean hydrating and blanching process of choice. **PH**

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