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Streamlining Dry Bean Continuous Blanching to Achieve Full-Bean Hydration

New technical applications in continuous bean hydration and blanching are providing significantly improved efficiencies over traditional continuous blanching systems and dry bean soak tanks, such as a 60%-plus full-bean hydration capability that supports flexible pouch applications, and a reduction in dry bean processing damage to less than 1%.

by Jim McMahon

On any given day, almost 14% of the United States population, 42 million Americans, eat dry edible beans. The U.S. per capita consumption of dry beans rose 19.2% from 2004 to 2007, reaching 6.56 pounds last year according to the U. S. Department of Agriculture, and consumption is expected to increase again in 2008. 42.7% of dry beans consumed in the U.S. last year were Pinto beans, followed by Navy beans at 14.8%, Black beans at 9.8%, Garbanzo beans at 6.7%, Red Kidney beans at 6.4% and Great Northern beans at 3.8%. 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 featuring 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 Indian food supply. As a group they are one of the most nutritionally-complete foods, 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, and 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. And one of the newest of these is 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 common historical batch soak tank process to a fully-automated continuous hydration/blanching method.

Dry Bean Continuous Blanching, a Technology in Evolution

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 followed with a short five- to ten-

minute blanch. The beans were hydrated from 12 - 15% moisture content up to 55 - 58%, at which point they were considered to be fully hydrated. With this mostly manual-controlled process, the quality of the finished product often suffered if the measurements of water, dry beans and soak time were not held within narrow parameters. The beans were then sent off to be canned or otherwise packaged. The soak tank process is functionally the same today.

By the early 1970's, only about 10% of dry bean processors had eliminated their tank farms, opting instead for processing continuously through multiple blanchers in series. This method 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 feet, which were supported on center shafts. 48" diameter cylinders were a source of product damage and inconsistent process results. These factors were a major reason for poor quality. Shafts in dry bean blanchers also routinely failed from being overloaded.

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

Throughout the 1990's 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 degree F water at the start, with staged temperature changes to 170, 180, and finally 195 to 205 degrees F. The gradual increases in temperature dramatically decreased 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 reached the point of being overloaded when the beans were being run frequently 18" in depth. Deeper loads take longer to reach the center of mass in the machine, which necessitated longer blanch times, and in turn overcooked the beans on the outside of the mass. Deeper loads can also cause the top of the relatively static load to ride out of the water, causing those beans to be under-cooked.

Two subsequent major developments ensured more uniform processes and allowed blanchers to handle even higher throughput. One was a gentle mechanical stirring action that was imparted to the beans as they progressed through the machine. The other was a system called Hydro-Flow™ which was perfected in the early 2000's. This system applied a combination of air and water injection which physically and

buoyantly supported the heavier loads, and more evenly distributed the bean loading across the width of the machine. 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%.

Effectively, improvements designed into dry bean continuous blanchers, including the Hydro-Flow system, over the past 30 years have proven successful in limiting bean damage to under 5%. There are different designs of continuous bean blanchers, 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.

Process Automation and Consistent Bean Quality

It has only taken 30 years for continuous blanching technology to catch up with the soak tanks, as far as bean quality is concerned. But during that time the technology was also able to reduce processing times to a fraction of what the soak tanks can deliver, and along the way pick up a hefty 50% of the dry bean processing market to try out and adapt to its automated systems. This, of course, has been aided by the integration of pre-programmed PLC control systems which provide precise automated control of the process functions, including recipe management. The PLCs provide uniform heating and cooling achieving a totally consistent end process.

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. Human intervention is always capable of introducing arbitraries of process time fluctuations, temperature changes, bean-to-water ratio differences, inconsistent stirring and deviations in recipe applications. Not all dry beans take the same amount of time to hydrate. Recipe differences can vary from 30 to 60 minutes depending on the type of bean.

Lines that have changed over from batch to the most technologically-modern continuous systems have seen a large improvement in quality. The beans are typically uniformly blanched, and properly hydrated, not under- or over- hydrated. The product looks the same, has the same color and it is the same size after blanching.

60%-Plus Full Hydration Supports Ready-to-Eat Flexible Pouches

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% hydration, which in essence hydrated the beans within 90% of their desired saturation, they were then put into a can with brine, sealed up and cooked. In the can the beans picked up the remaining 10% hydration to reach full intended saturation for the consumable product.

In the desire 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%-plus saturation level where the bean would be considered fully hydrated and cooked. In the latest upgrade to continuous dry bean processing, a new development called Pressure-

Flow™ has emerged which for the first time makes possible the hydrating of dry beans to a 60%-plus saturation level through a continuous blanching process. The bean is then 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 an exceptionally low product damage rate of less than 1%.

"Today we are seeing more customers coming to us wanting their beans fully hydrated and fully cooked in a continuous method," says Steve Hughes, CEO of Lyco Manufacturing, the food equipment manufacturing company that developed Pressure-Flow. "They want the process done up front so if it goes into a pouch for soup, or going into some other application, the bean is then already hydrated and cooked, fully cooked in most cases."

"The two factors of bean hydration are time and temperature," Hughes explains. "When we began researching on a continuous dry bean blanching system that could bring beans to a fully-cooked 60%-plus hydration, increased process time was not an option for us, so we began testing different variations with increased temperature over 212 degrees F in a pressure vessel instead of the normal atmospheric vessel used in continuous blanching. We built a Pressure-Flow 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 with Pressure-Flow."

Continuous Hydration, a Better Option?

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 pulse 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, and Pressure-Flow in particular, has positioned itself in a new role as the dry bean hydrating and blanching process of choice. And maybe, for the first time in more then half a century, it has usurped soak tanks as the dominant dry bean processing technology.

About Lyco *- Lyco Manufacturing, a world-leading manufacturer of commercial cooking and cooling equipment for food processors, is focused on improving its customer's return on investment through innovative designs. The company's personnel have extensive experience and knowledge in the food processing industry.*

Lyco's passion is developing the best customer-aligned, innovative food processing machinery in the world. World-class metal manufacturing lasers, precision press brakes, and robot welders enhance the quality and reduce the cost of products made in the food and fabrication divisions of the company. Founded in 1980 by the owner and Chairman of the Board, David R. Zittel, Lyco Manufacturing is housed in a state of the art 80,000 square-foot facility located in Columbus, WI, 30 miles northeast of Madison, WI, USA.

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Jim McMahon writes on emerging technologies in food processing.