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HIGH VACUUM FILLING AND STUFFING: IMPLICATIONS OF INSUFFICENT AIR REMOVAL IN MEAT AND POULTRY PRODUCTS

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Careful thought and research is required to make sound purchasing decisions for capital equipment expenditures. This is especially true when considering vacuum stuffing equipment as it will become an integral part of the operation for an extended period of time and plays a vital role in the finished product quality of the meat and poultry products being produced. Before a well-educated purchasing decision can be made, it is important to understand the implications that insufficient air removal (or improper vacuum) can have on various meat and poultry products and production processes.

First, we must look at the functionality and performance characteristics of the high vacuum stuffing equipment that is available for selection by meat and poultry processors. In general, there are three main types of fillers/stuffers including vane cell, twin-screw (screw feed) and twin-piston technologies. All can be useful depending on the desired finished product characteristics. Vane cell and twin-screw vacuum technologies work efficiently for comminuted products as well as portioning of exact weights. Even so, vane cell and twin-screw stuffers impart more product damage to raw materials, especially whole muscle meat and poultry products when compared to twin-piston vacuum filling equipment. In addition to the gentle handling of whole muscle, ground and comminuted products, the twin-piston design offers the strongest vacuum capabilities to provide maximum air evacuation as a result of a single stage vacuum system.

In vane cell or screw feed high vacuum filling systems, there is a dual stage vacuum system present where two controlled vacuum systems function independently to remove entrained air in the meat system. This means that when the product enters the hopper via vacuum through the intake or hopper feed (where 98% of the deaeration occurs), the vacuum level present in the hopper must be lower than that of the feed system (screw or vane) to prevent poor loads, inconsistent flow and inaccurate portioning capabilities. Thus, the level of vacuum that can be pulled on the product during the most critical stage of the air removal process is decreased to account for proper filling capabilities and the total evacuation capacity is lowered to prevent competition amongst the vacuum systems. In Marlen's twin-piston design, the sleeves and pistons create a strong suction action (similar to a syringe) to pull the product into the pumping chamber overcoming the high vacuum environment of the hopper. This allows for the maximum air evacuation to take place during the sheeting process when product is pulled into the hopper and the surface area of the blend is increased while being exposed to high vacuum, resulting in a denser, higher quality meat product free of air voids.

Product density is typically 3-5% greater in a twin-piston high vacuum stuffing system. This improved density can provide cost savings in meat and poultry products that are stuffed into logs or chubs by reducing fibrous and plastic casing usage. Maximum air removal has allowed processors to see a 16% increase in weight for the same size casing. This allows for less meters of casing used per pound of product produced or gives processors the ability to reduce casing calibers and in turn reduce casing input costs.

A denser product plays an important role in food safety when feeding meat and poultry products to a pipeline x-ray process as the system relies on differences in density to determine physical contaminates in the raw material. In general, the transparency of a raw material to x-rays is related to its density; the denser the material, the fewer x-rays that pass through undetected. Hidden contaminants, like glass and metal, show up under x-ray inspection because they absorb more x-rays than the surrounding product. The improved product density through the Opti twin-piston pump provides the in-line x-ray system with a greater contrast and clarity of the meat product as it makes its way through the pipeline. This eliminates false rejects by the system as the variation in product density is no longer present and the x-ray system can more accurately detect contaminates instead of density differences due to the presence of air.

The ability to effectively eliminate pin holes and air voids from the meat matrix provides not only improved drying capabilities for dry and semi-dry meat products, but increased shelf life due to elimination of residual air. The oxidation of fat (lipid) is a chemical reaction that results in the degradation of the fatty acids producing chemical compounds that give meat an off odor and taste. This reaction is also known as oxidative rancidity. Oxygen is necessary for the oxidation reactions to occur. If oxygen is eliminated from the meat matrix through vacuum filling, the oxidation reaction cannot take place. The ability of a twin-piston vacuum filling system to deaerate the product at maximum levels will prevent the oxidation reactions and in turn, results in longer shelf-life of the product.

Eradication of residual air also becomes critical when producing co-extruded, cook-in pack comminuted sausage products. If air is not eliminated from the sausage blend prior to being extruded in the collagen casing, the casings can rupture during the pre-cook and cook-in pack process. During the pre-cook process, links containing entrapped air will expand causing the sausage to swell more than the stretch capacity that the collagen casing can withstand. This can cause not only cracks on the surface of the casing, but also extrusion of meat out of the linked ends. This same cracking phenomenon can occur when the pre-cooked link is placed in the vacuum package prior to cooking and entrapped air causes the link to expand during the packaging process as the sealing machine evacuates the air from the package. If the air is not thoroughly removed, the packed links will float throughout the final cook and will have a wrinkled surface following chilling. With proper deaeration, meat batter expansion during subsequent heating and vacuum packaging stages is significantly reduced in cook-in-package comminuted products.

This expansion of entrapped air can also be detrimental to vertical filling applications producing deli style products as the high levels of entrapped air will create “flashing” and expansion in the vacuum sealing process, contaminating the seal and preventing proper sealing. The high levels of entrapped air can also cause bubbles to migrate to the product surface creating undesirable product from a visual perspective following thermal processing and finished packaging. Evacuation of air between whole muscle pieces in deli style products greatly improves the intermuscular binding in the finished product and eliminates the spherical cavities that are often entrained within large muscle pieces. This enhanced binding between muscles via high vacuum twin-piston fillers allows the processor to greatly reduce losses on the slicing lines due to poor binding between muscles and internal cavities.

Insufficient air removal during filling/stuffing can have detrimental impacts on various meat and poultry products and production processes. Regardless of the types of products one is producing, it is important to

understand that the Marlen twin-piston design allows processors to optimize air removal during stuffing and can ultimately decrease production costs and increase the quality of meat and poultry products being produced.

About Marlen

Recognized as a global manufacturer of highly engineered food processing equipment and systems, Marlen designs and builds innovative solutions for the food processing industry. Our premium products have long set the standard for quality and performance in vacuum stuffing and pumping, portioning, size reduction, thermal processing, and food handling. Marlen is a Duravant Company.

About Duravant

Headquartered in Downers Grove, IL, Duravant is a global engineered equipment company with an over 100-year operating history. Through their portfolio of operating companies, Duravant delivers trusted end-to-end process solutions for customers and partners through engineering and integration expertise, project management and operational excellence. With worldwide sales distribution and service networks they provide immediate and lifetime aftermarket support to all the markets they serve in the food processing, packaging and material handling sectors. Duravant's market-leading brands are synonymous with innovation, durability and reliability. Visit www.duravant.com.