

## SCRAMBLING TO ENHANCE EGG HANDLING SYSTEM PERFORMANCE

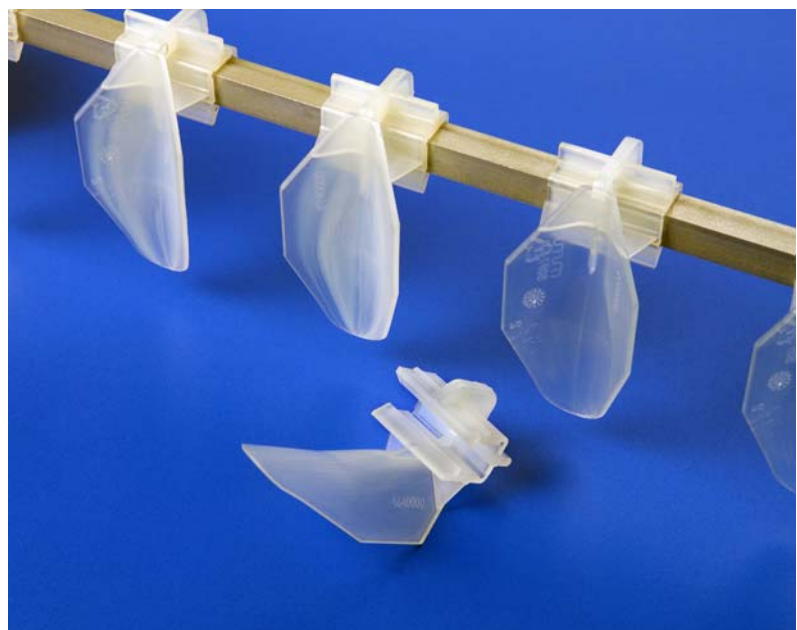
*Re-engineering and replacing primarily metal assemblies with innovative molded plastic parts and assemblies helps reduce product loss, reduce wear, and reduce costs*

The centuries old question of which came first, the chicken or the egg, in part has been answered—the egg! At least, that is, when it comes to careful handling. That’s the conclusion reached by the staff of engineers from one of the world’s premier manufacturers of egg packing equipment, paired with a like group from Molded Materials, Inc. (MMI) of Plymouth, MI. The cooperative effort was formed to study the overall operation of an existing egg-handling system, and determine if the incorporation of redesigned components, new materials or technologies would result in cost savings, reduced egg breakage, and lower system maintenance cost.

The system of interest consists of a central unit and a stainless steel packer, capable of handling up to 80 cases per hour...that’s gently packing 30,000 eggs per hour. Optional modules include egg grading, printing and separating machines, de-nester devices (used to separate the empty egg cartons) as well as a unit that packs the egg cartons into corrugated containers. The packer systems feature electronic controls that easily adjust the machine to accommodate various carton sizes and automatically monitor incoming egg volumes and control the speed of the system.

The equipment manufacturer’s team reviewed the operations and identified three areas in particular they thought could be

improved upon. These included the upper ‘clamshell’ units which are small, opposing pieces with a spoon-like appearance that catch, close on, transfer, then open and place the eggs in the lower clamshell units which place the eggs in the cartons; and the pivot block assemblies which are the mechanical drive linkage for the lower clamshell assemblies. Both of these component groups are used with the central



These are the lower clamshell units for the clamshell assembly which achieved reductions of 80% in weight and 108 piece part reduction per machine.

packing machine. The third component reviewed is called the flap holder; a part of the shipping container machine that indexes into position, holds the flaps of the box open and out of the way while the container is filled, then retracts.

For all three projects, the manufacturer's team asked their MMI counterparts, to assist in the transformation. MMI employs specialists in the design, engineering and manufacture of custom solutions for protective dunnage, trays, totes, and various proprietary products. MMI then began the process of analysis, design, reengineering and fabrication of the parts they were to improve by switching to plastic materials, or by using compounds different from previous designs.

According to Tom Elkington, Vice President-Operations for MMI and coordinator for the egg system project, these types of jobs entail more than one might expect. "When your substituting one material for another," says Elkington, "each part requires more than just transferring dimensions of a steel part to a plastic one. Because the materials are so different, tensile strength, hardness, rigidity, impact, chemical resistance, and wear characteristics all have to be taken into account. There are questions such as how will the parts fit into the overall design? What is the manufacturability of each component? What are the cost considerations that have to be addressed? With respect to these egg handling projects, the results were pretty remarkable."

Results that include retrofitting the packers with snap-on clamshells that replaced a series of complex assemblies. The savings in parts was 108 pieces per machine including screws, spacers and washers, bearings, and roll pins, and a 36-minute reduction in assembly labor time...all leading to an estimated 50% part to part cost savings. At the same time, a thermoplastic urethane (TPU) material was used for the upper clamshell, replacing the previously used Acetal material. The TPU had the strength needed to catch the egg, yet with a more pliant surface to cushion the egg. The TPU also demonstrated a higher wear resistance, a critical factor as the eggshells, Elkington points out, "are abrasive". Additionally, the TPU clamshells allowed the machine to be adjusted to handle smaller eggs.

"Besides the obvious savings indicated by the numbers," Elkington remarks, "other improvements resulting from the design change include less wear experienced with fewer parts and reduced weight, and simpler repair and maintenance. Also, users have reported that egg breakage, though at acceptable levels before the change, has dropped to virtually nothing."

The second component of the egg packer, the pivot blocks, showed significant numbers improvement and required a high degree of engineering analysis to accomplish. First, the numbers as reported by Elkington are comprised of an 80% reduction in weight as compared to the previous metal

assembly, a part reduction of 120 pieces per packing machine, and the time for machining, welding and assembly all eliminated. The pivot block now consists of five distinct molded parts that include two Delrin connecting rods, two nylon bearing blocks, a GFN3 pivot block, a Delrin slide assembly, and two UHMW rollers.

“Because the pivot blocks are part of the drive system,” Elkington notes, “the engineering analysis was complicated taking into account the motions, linkages, and frictional forces. Each part had to be individually modeled and put under anticipated loads via computer animation to determine deflections and stresses that would be encountered before materials could be selected and designs established. We were working under the constrictions of chemical resistance for cleaning the machines, size constraints, strengths versus flexibility and durability to stand up to packing 60 to 80 egg cartons per minute. The tight tolerance requirements and dimensional stability of the new assembly was critical for it to work.”



The pivot block (lower left) consists of five distinct molded parts with a part reduction of 120 pieces per packing machine and time for machining, welding and assembly all eliminated.

“We were also able to satisfy the client’s request to isolate the ‘weak point’ in the drive design, then incorporate an easy to repair or replace linkage component that would help protect higher cost parts that were more complicated and time consuming to replace.”

The third segment of the project turned out to be relatively straightforward. The flap holders previously consisted of an expensive stainless steel weldment, with four holders (one for each box flap) per machine. The earlier version of the holder was constructed from a stainless gusset, a stainless

steel machined detail, and the stainless steel sheet metal holder fabrication that was laser cut and formed to shape. Significant assembly time for the welding was also required.

By contrast, the MMI molded flap holder is made of single piece construction and from High Impact Nylon. The new unit has cut the weight of the holder by 90% over the metal fabrication, and slashed costs through material and labor savings by 90% too.

“The weight reduction aids in eliminating considerable wear and tear on the machine,” comments Mr. Elkington. “The manufacturer has also found that the high-impact nylon holders, in cases of occasional misfeeds, are flexible enough to bend out of the way without causing damage to the themselves or other components. In the past, the stainless steel units would typically have to be repaired or replaced.”

Considering the entire project, the numbers add up to savings all across the board. In weight savings; 90% for the flap holder, and more than 80% for the clamshell assemblies. In part count reductions; 108 for the clamshells, and 120 pieces for the pivot blocks plus all the labor time for assembly of those parts. Additionally, when the savings in downtime, maintenance and product losses are factored in, the conclusions are even more noteworthy.

“Though the egg packing system project is somewhat unique, the results achieved are not uncommon and can be applied to many applications where today’s high technology polymers and state of the art engineering are applied. The true path to cost reduction and higher quality is not merely the substitution of one material for another, it is the culmination of a comprehensive and accurate design and engineering analysis that verifies performance”, concludes Elkington.

Complementing its experienced and knowledgeable staff, Molded Materials’ resources offer complete in-house design and engineering services, including finite element and mold flow analysis, in-house machining for mold and tool making, and in-house injection molding.

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