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ARM International Rotational Molding Design Class

I thought it would be interesting to write about article about ARM International's design workshop for this month's RotoWorld™ magazine since it will be published before this year's upcoming fall conference. The workshop is uniquely structured as a highly charged, fast paced, informative and interactive 8-hour design class. It begins with a 3-hour presentation of rotational molding design guidelines accompanied with a video of parts and the process. After design basics are thoroughly explained, attendees are encouraged to participate in applying their new knowledge to actual applications for the remainder of the day. It's during this session where the true benefits of rotational molding will be explored and the design principals creatively

"Explore the true benefits of design and rotational molding."

applied to actual products. This article will highlight some of the products and applications which have been "designed" in past workshops. It will hopefully encourage many of you to attend this year's design workshop and also demonstrate some of the numerous design possibilities afforded by rotational molding. It should be noted that these applications were identified and designed solely for the purpose of last year's workshop. New applications will be developed for this year's upcoming class.

The benefits of rotational molding are truly realized when products are designed with imagination and a solid understanding of the process. Good design will open new market opportunities for the industry, which will in turn encourage improved productivity, new resins and improved profits. Unfortunately, many rotationally molded products manufactured today undervalue good design, where the budgets are either non-existent or unrealistically low. Applications in this article were identified by the author to demonstrate how good design can literally transform conventional products into very novel products, only possible with rotational molding.

Our first example is an ice cream cart, which was brought to my attention by a friend, shown in FIG 001 A&B. The product was originally manufactured in South America in limited quantities and sold to local peddlers to sell ice cream. Apparently purchasing ice cream from local street vendors quickly became very popular, forcing demand for ice cream carts to increase as well. In response to this rapid increase in sales, the manufacturer sought more productive manufacturing methods. The original cart was constructed from a tubular painted steel frame for the cart, a plastic pail and an ice chest, which fit into the pail to store ice cream. One of the trademarks for this product and a contributor to its success was the easily recognized penguin, silk screened on the outside walls of the pail. The penguin became an important logo which consumers immediately associated with ice cream.

In his search for a more cost effective and productive manufacturing process, the manufacturer identified rotational molding. This process would permit him to consolidate parts and improve productivity. An obvious design solution would be consolidation of the outer pail and inner cooler as a single unit, which would be inserted into the tubular frame. Penguin graphics could be applied to the exterior as a molded in graphic logo and the lid could be hinged about the main container with a molded in feature. A foam filled double walled container body would provide thermal insulation.

Although this design concept is functional and somewhat obvious to those familiar with rotational molding, does it truly represent the best solution for this application? What about elimination of the frame by integration of a molded in handle and wheels? This concept would begin to take more advantage of the process by additional parts

FIG 005

FIG 006

FIG 007

FIG 008

FIG 009

consolidation and cost reduction, but does it adequately reinforce the company's trademark and brand identity? The container is still a conventional shape with a graphic penguin logo on the side. However, a little imagination and understanding of the rotational molding process makes it possible to mold the entire cart as a penguin!

The concept shown on page 44 represents a design that takes full advantage of rotational molding by playfully embodying a penguin figure as an integral part of the ice cream cart. Unlike the conventional designs previously discussed, this concept provides the manufacturer a truly unique point of purchase display, which invites customers with its boldly represented company trademark. This design solution is complete since it addresses technical, cost, manufacturing and merchandising requirements.

A double walled one-piece construction of the main cart provides an inherently structural geometry with functional internal features and whimsical external features. (FIG 002) Upon closer examination of the proposed, one can readily appreciate the numerous subtle details incorporated into this product. The orange colored wheels add a bright highlight to the product while also representing the penguin's feet. Molded in features on the bottom surface are created with an added removable mold shell. Holes for the axel are also included in these supports by a removable rod pulled from either side of the mold. (FIG 003) Molded in wheel wells protect the wheels and also visually integrate them into the main cart body. The opposite side of the bottom section is designed as the penguin's tail, which actually performs the function of serving as a foot to stabilize the cart when it is at rest.

A similar integrally molded in hinge feature is included at the opposite end of the cart to provide a pivot for the head top cover which was split from the main body along a contour defined by the penguin's head. (FIG 004) The inner chamber was designed with a stepped ledge all around to provide a support for an open grill, separating the ice cream from the ice in the lower section. A drain hole at the rear of the body, leading into the inner chamber provided a means of draining melted ice from the compartment. Provision of a molded in handle was designed as part of the beak which further integrated form and function within this playful product. (FIG 005)

In an effort to maximize product utility and ice cream sales, the inside surface of the lid has been designed to serve a dual purpose as a serving platform for customers when the lid is flipped open. (FIG 006) In addition, the penguin has been designed to carry a placard carrying types of ice cream, prices and flavors. This is an example of how good design can add market appeal and value to an otherwise mundane purely functional product. (FIG 007)

Another example of how good design can be applied to a potentially untapped rotational molding market is demonstrated in this next example, which was also reviewed in last year's ARM International Design Seminar. An upholstered couch frame can greatly benefit from the

advantages of rotational molding. (FIG 008) Rotational molding provides furniture manufacturers with an ideal manufacturing process to replace the labor intensive wooden inner structures with a one-piece or modular multi-piece rotationally molded frame. Almost all inner structures of upholstered couches are constructed in a similar manner, using an assembled fabricated interior wooden frame. The frame must be milled, assembled and finally upholstered. Extensive labor is required in all phases of production, especially if complex curves and shapes are included in the frame geometry.

The frame could be molded as a one-piece structure using recycled polyethylene as shown in FIG 009. This concept demonstrates how structural rigidity and complex shapes can be incorporated into a one-piece couch frame. In our example, all features were molded in line of draw. A double walled construction with numerous openings imparts tremendous rigidity and structural integrity to the design. (FIG 010) Features in ribs could be included to attach springs for added comfort. Grooves along edges and critical upholstered joints would provide a means of reducing labor when applying fabric. Molded in feet would also eliminate parts and labor. The example shown in this picture has an estimated weight of 40 lbs. based on a .07" nominal wall. (FIG 011)

The reason triangular openings have been included around the sides of the couch is because they provide added structural integrity and rigidity to the frame. They are also in line of draw and can be molded with a simple two-piece mold. Similarly, holes through the surrounding arm rest tie the top and bottom surfaces together, forming a superior structure with minimal weight. (FIG 012) Examination of the under side of the frame reveals cored sections, which add rigidity and flatness to the bottom surfaces. Generous draft on all shut offs and molded surfaces improves tool life and part removal from the mold.

"With Imagination and understanding of the rotational molding process - the Ice Cream Cart can be molded as one-piece."

One should be reminded that this concept represents only one example of a rotationally molded inner upholstered couch frame to demonstrate the feasibility of such an application. There are infinite design possibilities based on different shapes

as well as design approaches. For example, the frame could be designed as a modular system with interchangeable parts, allowing a manufacturer to configure various sizes and styles depending upon what building blocks were used. Systems could be designed with a combination of wood and rotationally molded parts. The possibilities are endless, being determined by cost, product line and manufacturing requirements.

Rotational molding could also be considered for game room products such as foosball tables. Most foosball tables are constructed from particle board and are manufactured in China because of their high labor content. They are typically shipped disassembled and compactly arranged in a corrugated box for easy distribution and customer self-assembly. Therefore, the product must be designed for compact storage in a corrugated shipping container and easy customer assembly.

"A combined synergy of images yields a contemporary product reminiscent of traditional pool tables."

The existing table is shown in FIG 013. One can readily appreciate the overall construction to consist of four support legs, which are assembled to the main table deck with four bolts per leg. A plastic funnel and corrugated tube have been included under the deck to provide a pathway between the goal slot and ball collection opening located at either end of the table. Furthermore, the player handles located on either side of the table are supported by self lubricating plastic inserts. (FIG 014) These bearing inserts must be accurately aligned such that they are coaxial at opposite sides and parallel to each other. Proper alignment will provide a low friction sliding and rotary motion of each player controlled rod. The top surface must be flat, smooth and slippery. It should be printed with graphics representing goals and player zones.

The current product has a style and appearance limited by the cost, materials and manufacturing process used to product the item. Although the design is clean and straightforward, it lacks character. There are no design details or features which would impart a specific style to the product. Rotational molding could provide the solution because of its cost effectiveness and design flexibility. When considering rotational molding one can either develop a design which is a direct replacement of the existing product or explore more interesting interpretations. Again, investment in good design is no different than investing in a good mold or molding machine.

The results are always dictated by the quality of the initial investment.

Designs for a rotationally molded foosball table can be developed in an infinite variety of styles and levels of detail. The concept provided in this article, which was shared with last year's ARM International design workshop, represents one of these possibilities. An attempt was made to capture some of the characteristics of a classic pool table and combine them with contemporary design elements in the concept shown in FIG 015. Instead of designing a boxy table mounted on four legs with a cross brace, the rotationally molded foosball table was designed with many more three dimensional features and decorative details, taking advantage of the molding process. Traditional features such as grooved bands around legs and the table surface conveyed a nostalgic style for the table. Design of the legs as heavy round pillars located at each corner also helped reinforce a nostalgic style for the product. These traditional features were intentionally opposed by introducing a simpler more contemporary table body to avoid designing a cheap imitation of a pool table. The combined synergy of images yielded a contemporary product with reminiscent overtones of traditional pool tables.

Additional design features such as the curved underside of the table, slotted openings through the sides and arced cuts on opposite ends, resulted in a table which was visually and functionally balanced. The slotted side openings on either side provided structural integrity, straighter walls and visual interest. Applying a curved surface to the underside of the table also contributed to rigidity as well as aesthetics. It should be pointed out that inclusion of open "honeycomb" features within rotationally molded parts adds considerable rigidity and dimensional control to the overall structure. This is particularly evident in the table design, where the inner playing surface has been created as a web of open crisscrossed hollow ribs. (FIG 016) It should be further pointed out that circular pads have been placed on the ribs at various locations. These pads have been added to provide dimensionally controlled surfaces to which a flat panel can be bonded or fastened. (FIG 017)

Those familiar with rotational molding are aware of the difficulty molding flat surfaces. A low cost, smooth, slippery, flat, glossy panel should be applied as a separate part since none of these features can be achieved with a rotationally molded part. Designing discrete mounting pads, strategically placed on the ribbed surface will provide areas that can be either post machined or molded to a specific flatness specification for mounting the panel.

Adequate draft must be applied to the inner side walls so the part can be removed from the mold. Circular holes located on either side of the table have been molded in as an integral part of the assembly to permit self lubricating nylon bearings to be inserted for each player's rod.

FIG 015

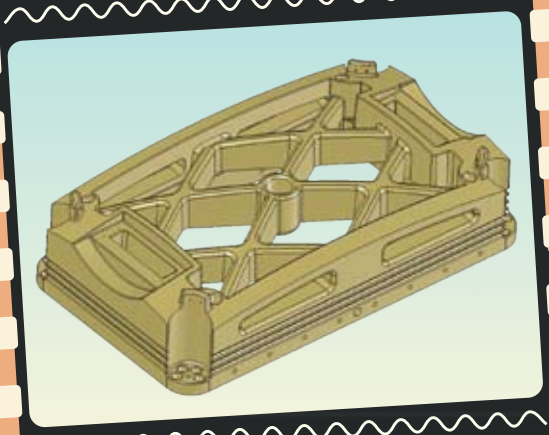

FIG 016

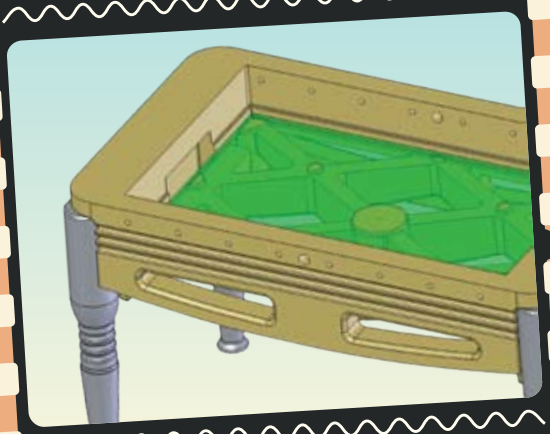

FIG 017

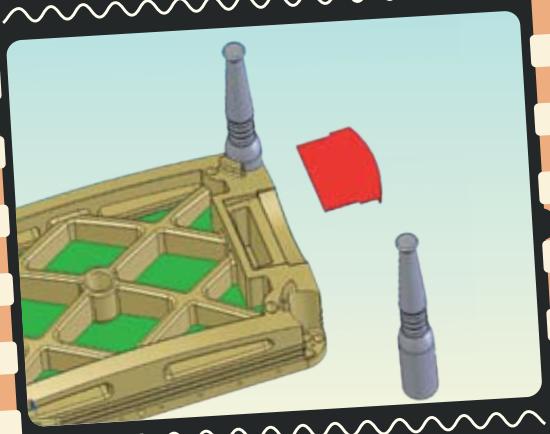

FIG 018

FIG 019

The proposed design was based on a knockdown assembly, similar to the original particleboard product. Detachable rotationally molded legs have been designed for easy assembly and stability. A locating hole in the main table locates and secures the leg into position, while two screw holes molded into a standing boss provide a means of locking the leg to the main table. Tolerances between the leg and table surfaces must be controlled to assure perpendicularity between the leg and the table. The separate plastic tray has been designed to be easily mounted to the underside of the table with four screws. (FIG 018) This surface creates a compartment to retain balls which have passed through the goal and also provide a convenient opening for player access.

Foosball tables require significant weight for maintaining stability during the sometimes aggressive activity that can take place in a game. Since particleboard is inherently dense, mass is a function of material used and is not an issue. However, added weight increases shipping and handling costs as well as complicates assembly. The rotationally molded table will be much lighter than the particle board table, therefore making it easier to store, ship and install. However, the hollow product will not be as stable as the particleboard table unless it is filled with a denser material. Mass can be added to the product by filling the legs and even the table with sand or water. This practice is commonly done with rotationally molded kickboxing posts used in karate gyms throughout the world. Filling the hollow walls of the product on site will save the manufacturer money and improve assembly.

Use of color, texture and graphics provides an additional dimension to this design without significantly increasing cost. The appearance of the product can be drastically changed by simply mixing colors, materials and graphics as demonstrated in FIG 019.

These three examples represent an arbitrary sampling of markets and applications that could be dramatically transformed with well designed rotationally molded replacements. The success of products such as these requires a visionary manufacturer, molder and designer to work together with common objectives. It requires a familiarity with the product, market and manufacturing process which must be combined with imaginative design skills. An understanding of materials, environmental factors, assembly, shipping and product function are added levels of perception provided by a good design team. This investment in a product at the beginning will improve overall value, increase market size and improve profits.

If you have any product ideas or markets that can benefit from similar explorations, I encourage you to submit them to me by emailing to paloian@idsys.com. I also look forward to seeing some of you at this year's upcoming fall ARM International conference in Washington DC. If you attend my design workshop we can creatively interact and explore new ideas for rotational molding. Hopefully, some of them will be your's.