DW Product Development Used Moldflow Plastic Adviser to Create the Next Generation Black & Decker Workmate

DW Product Development, Inc. (formerly Design workshop) is an award-winning product development firm located in Ottawa, Ontario, Canada. The 21-year old company offers a variety of services - from design development and consulting services, to full blown art to part production ready geometry, as well as rapid prototyping and rapid tooling. The firm focuses on the consumer goods, telecommunications, medical, and appliance markets. Its 15-person staff is comprised of industrial designers, mechanical designers, and model makers. DW's roots are from broad and diverse industries, serving the needs of small, medium, and Fortune 500 companies. Prior to September 11, 2001, approximately 40 percent of DW's work came from the telecommunications industry. Since then, the firm has refocused its sights on other markets.

In addition, DW forms strategic alliances with outside partner companies when a project requires expertise beyond DW's multi-disciplined staff. According to Aldo Balatti, senior product designer/plastic applications specialist, DW will work with its outside finite element analysis (FEA) group when the need arises. "We trade our industrial design (ID) services for engineering or FEA services. If a client, for instance, needs a structural analysis, we will include a structural FEA analysis in the proposal that has been performed by a partnering firm that excels in FEA. And, vice versa, that firm may need our ID services for a project. This business strategy has worked very well for us."

DW designers use Moldflow Plastic Adviser (MPA) from Moldflow Corporation (Wayland, MA) for plastic injection molding analysis, and SolidWorks and Pro/ENGINEER for 3D CAD modeling. The firm has been performing mold-filling analysis since 1998. Prior to using Moldflow products, DW was a C-MOLD 3D QuickFill customer. MPA is a software that allows users to test every part and mold concept for manufacturing feasibility before the tool is cut, when the cost of change is minimal. Seamless integration with CAD solid models enables users to perform simulations and view results directly on the solid model.

Balatti adds, "We use MPA to reduce trial and error, improve part design, quality, and slash time-to-market. It's a powerful tool to optimize parts and improve plastic processing conditions. We have been able to save time and money by reducing/eliminating tool rework. We use MPA on the majority of parts that we are designing to obtain fast feedback on wall thicknesses, weld line placements, material selection, and gate locations. We want to make sure that the new part is designed right and ready for production prior to being sent to the mold maker, because there is typically no time to make changes with the mold. There's no margin for error because there are firms in Asia and other countries in Europe that are making molds considerably faster than their North American counterparts. Because of that, there is no time for tweaking or adjusting molds. Using MPA and our expertise, we have eliminated the mold trial and error phase from the molding process. The conventional trial and error method has to be eliminated from the equation. MPA allows us to have a virtual molding machine on our desktops."

Increasingly, more and more products are comprised of plastic materials to reduce weight and cost, as well as for miniaturization. It is a trend to make products lighter, less expensive, and more efficient in production. In addition, using molded-in color plastics there are fewer finishing operations. Balatti says, "We are seeing more metal replacement in traditional products. Using plastic materials, in a lot of applications, is more cost effective and they perform better in many cases in terms of insulation and impact resistance. The automotive industry is a good example of the increasing use of plastic parts in cars."

Seventy to 80 percent of the components that DW's designers create are injection-molded parts. Once the designs are developed in the 3D CAD systems, the parts can be optimized using FEA software. MPA is used to optimize parts, gate location and optimize mold fill. In doing so, DW can reduce the amount of material to decrease costs, speed up the cycle time, and assure that the parts will be injection moldable.

When replacing a metal material with a plastic material, the first thing that Balatti and his team do before designing the part is determine that the selected exotic plastic material, which typically has a low melt flow rate, will fill the mold. "We have to make sure that it can fill properly at the thinnest cross sections," says Balatti. "So, we create a shape that closely resembles what we want and then go ahead and simulate the part filling in MPA. If it short shots, then we know that the part walls maybe too thin, and we optimize the part. In addition, we can simulate different materials, different wall thicknesses, and we can use MPA with the FEA software."

Black & Decker Workmate 375 project

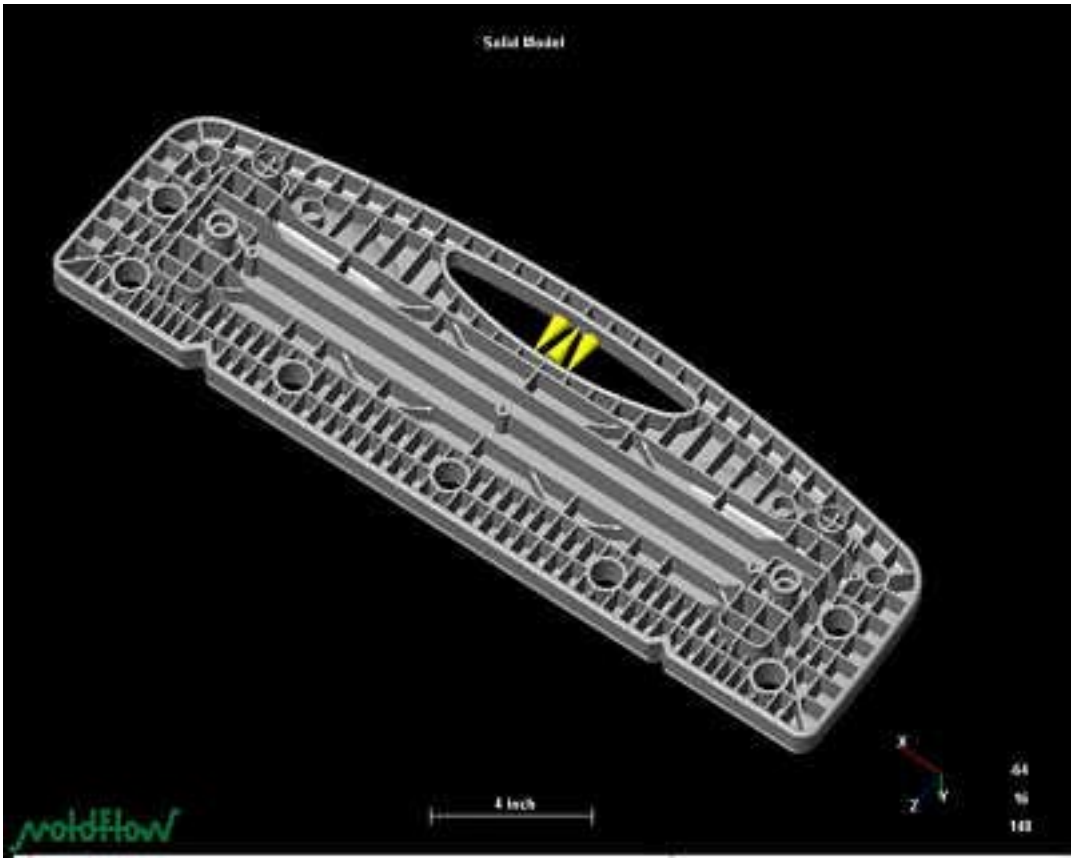
Black & Decker Workmate 375

The Black & Decker Workmate product has been on the market for about 30 years. It's traditionally known as a big, stationary piece of industrial equipment that typically is kept and used in a garage, basement, or other workspace. In November 2001, DW researched the Workmate marketshare and realized that the Asian competition was taking away profits with smaller, cheaper Workmate clones. DW created a redesigned Workmate - one that is portable, on wheels, rugged, yet handsome, and tailored for many types of users, not just a tool savvy workman. DW, along with Camalor Mfg. (Brockville, Ontario), the current Workmate manufacturer, approached Black & Decker with the next generation Workmate design in January 2002. The project for developing and manufacturing it was approved and funded by Black & Decker in March 2002, and the units began shipping in September 2002 - just in time for holiday sales.

"During the design of the new Workmate 375, we developed the possibility of manufacturing the jaws out of plastic instead of the traditional wood laminate. We used FEA to investigate loads on the front and rear jaw. Each molded jaw weighs approximately 1.9 pounds, 23-inches x 7-1/4-inches in size, with a nominal wall thickness of about 0.200 inch. We needed to optimize the ribbing inside for structural integrity mostly because Black & Decker requires that its products pass stringent safety, impact, and load testing. The company guarantees that the jaws can withstand a static load of 350 pounds. We tested the jaw parts we designed by quickly creating CNC machined polypropylene prototypes and tested them for strength and durability at DW and at Camalor," Balatti says.

"In the end, because of plastic creep, we felt it was necessary to put a small metal stiffener inside each jaw to resist creep that could occur, such as someone leaving a heavy object on the Workmate for a long period of time. The stiffener is a preventative feature.

"Camalor, which manufactures and assembles the new Workmate, is molding the jaws on a two-cavity family mold so that the front and rear jaws are in the same mold. That's a big shot of plastic in a 750-ton machine. We wanted to make sure that we would not short shot and that we could pack those parts which are thick with a lot of ribbing. The mold, built by Ottawa Mould Craft (Ottawa, Canada) was constructed of cores of Moldmax beryllium copper to extract the heat from the core. This was to make sure all the ribs cool very quickly so we would have limited warpage on the surface. That proved to be an excellent decision. For the gating solution, we came up with a very different approach. Our first solution was to gate at the end of the long part so the part would fill length-wise. However, that meant pushing a lot of plastic through a long flow length," Balatti adds.



Workmate jaw design in Moldflow

Using MPA, this seemed to be a good solution. But the molder would have to position the mold and the sprue offset in the mold - a tricky proposition. Then, Balatti and his team investigated the handle area as a better gate location. He says, "That was a beautiful place to drop a hot tip and cut the flow length in half. We devised a spider with one drop per part. The hot tip sits on a very small runner that has three spider sub-gates. There are two sub-gates facing the inside work area and another sub-gate facing the handle area toward the outside. This configuration eliminates any knit lines and cosmetic issues," he notes.

Then the DW design team, working closely with PolyOne, the polypropylene resin supplier of the new Workmate plastic parts, requested more advanced simulation performed by Moldflow Plastic Insight (MPI) software. MPI is used by companies that need detailed predictions about all phases of part and mold design, manufacturing, and resulting part quality. Integrated suites of software tools cover a wide range of thermoplastic and reactive molding processes. The software was used to perform mold filling and warpage analysis. Balatti and his colleagues wanted a second opinion on the gate locations and soon confirmed, after seeing MPI results, that the handle gating location was the best option. The MPI results were nearly identical to DW's MPA calculations.

In addition, Balatti sensed that the part would warp upwards because of the interior rib pattern being thinner. "Using MPI, we wanted to know the extent of the warpage. A warp analysis was performed and, based on the results, we advised Camalor that it needed to add a fixture to assure that the jaw parts, that act as a working surface, stay flat after molding," adds Balatti. Today, in production, after the one-minute molding cycle, the parts are then put into custom cooling jigs so they stay straight. After a few minutes in the jigs, the parts are moved to the assembly area.

Because DW designed the parts as injection molded parts, the team added other molded-in features into the design, such as color, measuring rulers, tool storage holes, pocket recesses for nails, screws, beads and other building or craft materials so they don't roll on the work surface. In addition, the next generation Workmate features handles for easy portability.

DW designers used Moldflow products to analyze all the new plastic parts, to assure accurate gate locations and to determine filling and cooling processes. Black & Decker is very serious about aesthetics. "The software was very helpful in terms of cosmetics, performance, and safety," Balatti explains.

In stores now, the new generation portable Workmate 375 can be used in living rooms, kitchens, dens, as well as workrooms and garages. From construction jobs to craftwork, the unit accommodates any task by any type user. The durable wheels make it easily mobile and it folds flat for quick and easy storage.