Green robots

Robot-based automation is enabling energy efficiency in the plastics industry

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Green thinking is smart thinking. At least that's what governments, businesses and consumers all seem to agree on. Concern for the environment is no longer a fringe issue that interests only a small segment of the population, and industries – including plastics – have taken heed. Lessening the impact on the environment often results in cost savings, in particular when it comes to saving energy, a key element in the environmental improvement equation. The fact is, increasing energy efficiency is currently one of the biggest trends in the business. In the plastics industry, robots are helping increase energy efficiency by making processes more precise and efficient, and by becoming more precise and efficient themselves.

Energy efficiency is an important element in increasing overall factory efficiency. Effectively managing energy requires involvement and accountability of all people and departments. It also means that goals and targets must be set and that energy consumption must be measured for continuous improvements. To improve energy efficiency, factories must focus on life-cycle costs, rather than front-end costs.

Cantex Inc. increased production by 30 percent by retrofitting 75 kW, 90 kW and 110 kW ABB drives for the motors powering the mixing screws of three extrusions.

"Most plastics processing plants can reduce their energy costs by 10 to 30 percent through a combination of no-cost, low-cost and investment actions," said Santiago Archila, manager of the factory planning group at Husky Injection Molding Systems in Canada. The group specializes in factory efficiency, and is also looking into how machines can be used more efficiently, an area with great potential for savings. With smart planning, the number of machines can be reduced, and more energy can be saved.

Builders of injection molding machines are also looking at the whole molding process to improve energy efficiency. The choice of machine, mold and peripherals all work together, and the right choice and installation process will reduce energy consumption as well as material, eg, the number of rejected parts. By optimizing the processes and reducing downtime, as well as reducing setup, heating and start-up phases, unproductive high-energy phases will be shortened. Here, not only do mold and machine maintenance play an important role, but well-functioning automation solutions also have a striking impact.

Less energy per produced part

One important trend within the plastics industry is the progressive shift from hydraulic-powered injection molding machines to electric machines. A study performed by Materialdepån, a Swedish supplier of plastics material and equipment, compared 160 metric ton hydraulic- and electric-powered injection molding machines running at the same number of hours per year. Savings of about $7,000 in running costs were achieved with an electricity-powered machine. With the same total hours of operation, the hydraulic machine used 16 kWh of electricity compared with only 7 kWh for the electric machine.

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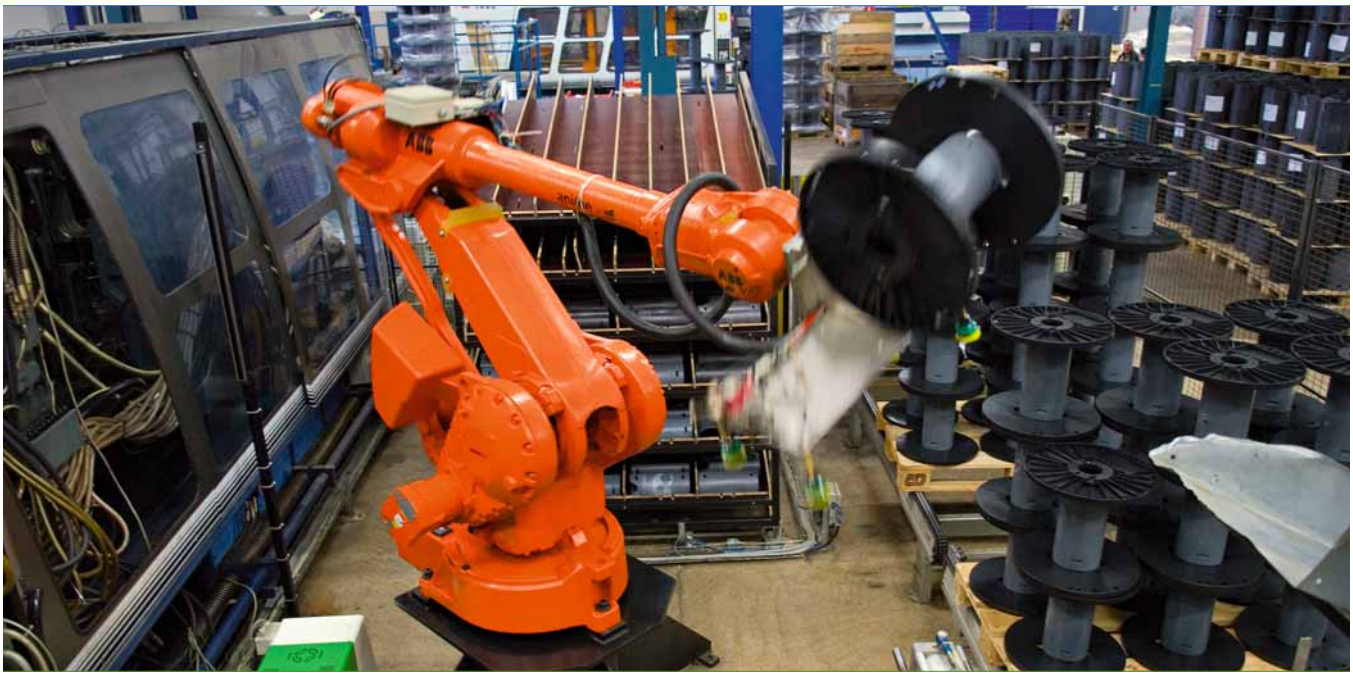
TOYO, a Japanese producer of injection molding machines, claims users can expect energy savings between 30 and 70 percent with electric machines. This can mean as much as $4,600 per year when comparing an 80 metric ton hydraulic injection molding machine with an electric-powered machine running at the same number of hours per year (cost for hydraulic oil and grease included). The hydraulic machine uses 5.65 kWh, while the electric machine uses only 1.85 kWh. Extrapolating these figures for several injection molding machines, the savings become quite significant.

Related to this finding is an increased awareness of the role electric motors

1 The IRB 4400 is extracting parts from the injection molding machine and assembling plastics reels at Axjo in Sweden. [Photo: Alexander Farnsworth]



play in industry. Cantex Inc., for example, is a leading producer of polyvinyl chloride (PVC) pipes in the United States. Cantex has upgraded three of its 18 extrusion lines at the plant with ABB industrial drives. The extrusion lines were formerly driven by non-ABB DC drives. The company increased production by 30 percent by retrofitting 75 kW, 90 kW and 110 kW ABB drives for the motors powering the mixing screws of three extrusions.

ABB's Machine Sync is an energy- and time-saving system that further increases the output of robot production by overlapping the workflow of the robot and machine.

Reducing waste

Another big trend in production processes is reducing waste, which incidentally is also one of the main benefits of working with robot cells. International Auto Components (IAC), a Tier-1 supplier[1] to the automotive industry, is one company that successfully reduced waste through the use of robots. Before installing the latest automated cell in its factory in Skara, Sweden, it had a defective parts rate (of those shipped to customers) of 150 parts per million. Following the robot installation, this number fell to 50 parts per million, a distinct advantage in the highly competitive auto industry. An improvement in quality means less scrap – and less waste of material.

"To compete on the world market from a high-cost country like Sweden, we have to be as efficient as possible. And these robots give us efficiency, quality and confidence in our products. Robots are a must-have in our industry," said Steve Hammond, the IAC factory manager in Skara.

Another example of how robots improve productivity can be found at First Engineering in Singapore. The company produces ultra-precision molds and plastic parts for use in high-tech products like hard disk drives and PC peripherals. Since First Engineering introduced a 6-axis ABB robot in its production, output has increased by 75 percent from about 170,000 to some 300,000 parts per month. Part quality has improved, labor costs have been reduced and the company is using energy more efficiently.

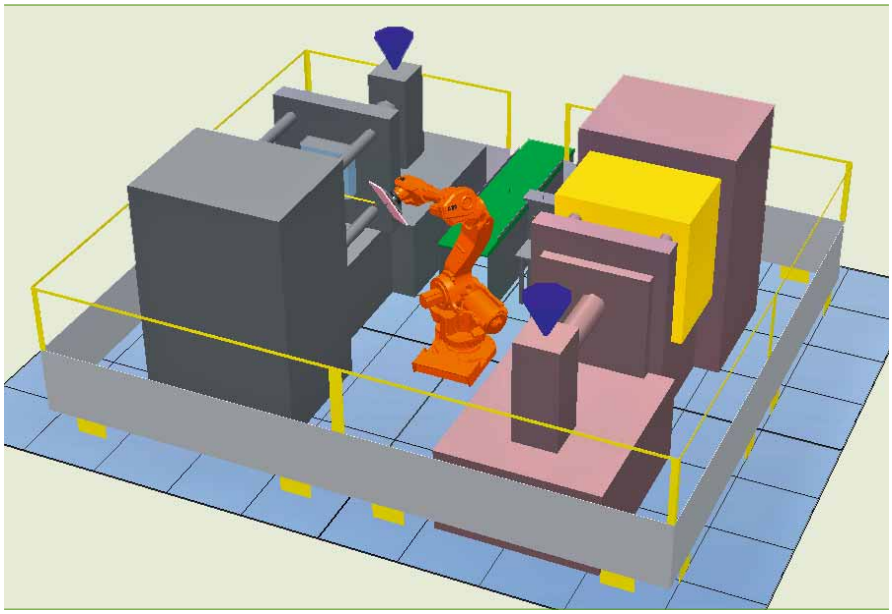
Using ABB's RobotStudio software tool to simulate the actions of a robot before it goes live is one example of lean manufacturing.

Optimized cycle time

There are other ways of conserving energy during the production process, of course. For example, ABB's Machine Sync is an energy- and time-saving system that further increases the output of robot production by overlapping the workflow of the robot and machine. This is done by coordinating the opening and closing of the machine to extract the plastic from the mold, thereby reducing cycle time and yielding more parts. This synchronization also reduces robot wear and helps avoid collisions. In a typical case involving an IRB 6650 shelf robot and a 3,000 metric ton injection molding machine molding a typical automotive part, the savings in extraction time using synchronized early-enter and early-closing is 10 percent. Ex-

2 At IAC in Tidaholm, Sweden, two IRB 2400 robots are used for waterjet cutting of interior auto parts. [Photo: Pontus Johansson]

3 ABB's RobotStudio software tool allows the application engineer to program the robot's motion first in a virtual 3-D world on a computer.



Footnote

[1] Tier-1 suppliers are companies that sell products directly to original equipment manufacturers, who are in this case the car makers.

Factbox A life-cycle analysis approach

In the plastics industry, "energy efficiency" is a term used to describe a variety of issues including scrap reduction (less waste, therefore less energy used); material savings in paints, coatings and sealing components; and increasing productivity by minimizing cycle time. It involves a life-cycle-analysis approach, taking into account every step, from obtaining the raw material to the recycling of a plastic part.

Smart painting

In Australia, paint specialists D&M specialize in painting small auto parts. Three IRB 5400 robots working 12-hour shifts not only have boosted productivity by 80 percent, they've reduced paint consumption by some 35 percent using ABB's special Pattern Control Bell (Robobel 951), developed specifically to reduce waste.

Fiskars in Finland is another company that has seen great benefits with automated spraying. Fiskars manufactures, among other things, state-of-the-art axes. The blade has Teflon coating to make it lighter and easier to use. The IRB 540 robot used for spraying the blade is so accurate it uses 30 percent less Teflon than the previous solution. The process is thus not only safer for employees but also more environmentally friendly.

Efficient packaging solutions

ABB offers several robots specially designed for picking, packing, and palletizing – basic operations in the food and beverage industry. Of special interest is the FlexPicker robot. The FlexPicker can help food manufacturers dramatically reduce product waste – a major resource and energy eater – and increase productivity.

Pretzel manufacturer Roland Murten AG experienced a significant reduction in scrap, with breakage of its delicate product dropping from 15 percent to 2.3 percent, allowing the company to cut power consumption on its main production line by some 12 percent (a savings of $17,000 per year). Walter Fuchs, head of production at Roland Murten, said, "You have to take more than just procurement costs into account. The savings in operational costs also need to be factored in, and in our case we achieved significant reductions in costs for staff, energy and wastage."

Robots are a tool for improving total efficiency – the heart of the matter when it comes to eco-friendly production and sustainability. Ben Miyares, vice president of industry relations for the Packaging Machinery Manufacturers Institute (PMMI) and keynote speaker at the 2007 ABB Global Packaging Forum, said, "We need to stop thinking about pricing in terms of what a robot costs, and instead look at the total cost of operations."

Auto parts painted by ABB robots at D&M in Melbourne, Australia

trapolating this number for a machine running around the clock all year round, with an extract time of 10 seconds and a complete cycle time of 30 seconds, 35,000 more parts can be produced.

Lightening the load

Another major trend affecting the plastics industry is the automotive industry's push to produce lighter vehicles, which in turn consume less energy. This poses a great challenge for the automotive industry, as well as its sub-suppliers, to move from today's primarily steel- and aluminum-based materials to lighter magnesium and plastic composite materials.

New techniques are being explored that combine composite materials with glass fiber, fabrics and metals to achieve properties similar to metal with respect to stiffness, impact strength and aging. To produce such parts requires working with fiber, metal and textile inserts, and also demands a controlled means of moving plastic parts between several different processes that involve stamp presses, molding machines and secondary molding.

This can only be achieved with 6-axis robots, since the parts must be precisely positioned all through the process. Hence, 6-axis robots play a crucial role when it comes to developing smartly designed, environmentally friendly products.

New products and methodologies are helping customers surpass business goals while lowering environmental impact.

Lean manufacturing

Laser, water-jet or mechanical cutting is used for cleaning, deburring[2] and drilling of molded, thermo-formed or foamed parts. These cutting techniques are often used for trimming automobile interiors and exterior parts like carpets and bumpers, and in the process of air-bag scoring, as well as white goods[3] and large parts like chairs, bins, etc. Getting it right still requires much trial and error, wasted

energy and a lot of scrapped plastic parts, all of which could be avoided through simulation of the process.

Simulating the actions of a robot before it goes live is one example of lean manufacturing. ABB's RobotStudio software tool allows the application engineer to program the robot's motion first in a virtual 3-D world on a computer, tweak all the steps and then transfer the information directly to the robot. The benefit: no trial and error waste, which translates into materials savings and therefore energy savings.

Swedish company ABB Kabeldon installed an assembly line to manufacture different variants of fuse-switch disconnectors. The system integrator AVT-Specma used RobotStudio to simulate the complex process, which saved not only a considerable amount of energy and materials, but also a significant amount of time for both the integrator and the customer. All tests were conducted in a virtual environment before the program was loaded to the robot controllers.

Raw material savings

Plastics of all shapes and sizes are given their final finish in the paint shop, where there is certainly potential for energy savings and waste reduction. Paint application is a difficult industrial process but it is an area in which ABB has ample experience.

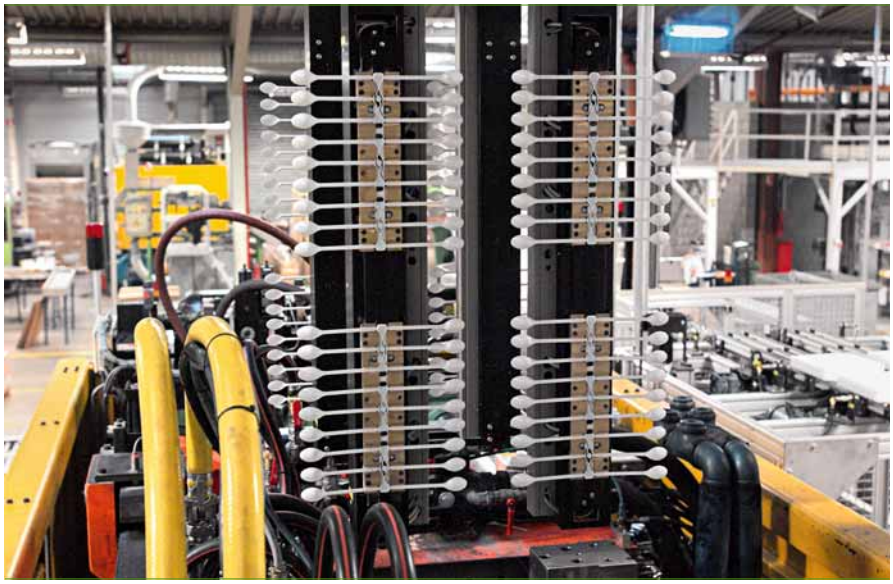
With a robot, it is possible to optimize the whole painting process and minimize the use of paint. ABB has developed an air recirculation system combined with a state-of-the-art energy-saving process in the paint booth, which is fully compliant with environmental regulations. This solution combines air recirculation, solvent disposal and energy savings. It reduces the amount of fresh air used, and thus the energy consumed, by a factor of 10. Automated systems can achieve as much as 30 percent paint savings compared with human operators [1].

The new non-electrostatic atomizer Robobel021-MINI reduces paint consumption by up to 30 percent. It is compact and lightweight, suitable for general industry where small painting robots paint small plastic parts. New painting methodologies double the flow rate per atomizer, making it possible to reduce the number of paint atomizers and painting robots by half. The paint booth can thus be downsized by 50 percent, and the time required for the painting process is cut in half, leading to savings in energy, paint consumption and CO_2 emissions. These new products and methodologies are helping customers surpass business goals while lowering environmental impact.

Every step of the process

From almost any aspect of the production process, whether it's injection molding, blow molding, extrusion or downstream applications such as cutting and painting, robot automation has a role to play in improving energy efficiency. Hence, energy can be saved in every step of producing a plastic product, and all savings are important, whether they are optimized cycle times, saved raw material, reduced scrap or enabling production of lightweight products – green thinking, indeed.

IRB 6650 taking spoons out of an injection molding machine at deSter in Belgium



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Footnotes

[2] Deburring is the removal of burrs (ie, protruding edges) from a casted or machined part.

[3] "White goods" is a general term for household appliances.

Reference

[1] **Mills, P.** (July 1996). Applying robotics to your paint line. Product Finishing Magazine.

Further reading

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