Paper Converter Increases Roll Converting Process by 300% with New Automated Cutting Equipment & Roll Finishing System Featuring Force/Torque Sensors

Norkol Converting Corporation is one of the nation's leading independently owned converters and distributors of commercial printing papers. Founded in 1968, the company's corporate location in Northlake, Illinois has full production capabilities and state-of-the-art machinery for winding, trimming and sheeting. The company utilizes traditional slitter re-wind equipment that unwinds, slits and then re-winds paper to new dimensions. These conventional re-winders, while typically producing new widths of paper with clean cuts, work at an inefficient slow pace.

"Re-winders have been used for years in the paper converting industry and although they do the job we are constantly researching and adopting the newest technologies to help us remain competitive," said Mike Maloy, president of Norkol Converting Corporation. "Our original re-winders take between 30 to 40 minutes to process one roll so we were very excited when we were introduced to new technology that processes four to six rolls per hour without the need to unwind and rewind."

The company turned to system integrator Mapleroc Industries of Portland, Maine and their automation partners ABB Robotics, a leading robotics manufacturer and ATI Industrial Automation an engineering-based robotic accessory developer to implement a new cutting and finishing system to speed up their process. Together the partners developed and integrated a new, fully automated cutting and finishing system using Mapleroc's RollRazor® cutting technology, which features a highly-engineered cutting blade capable of cutting as much as 300% more paper in one hour than traditional re-winders. As part of the new application the system features a state-of-the-art Robotic Roll Finishing System utilizing an ABB IRB 6620 class robot equipped with a force-controlled machining package with ATI Force/Torque Sensors.

"ATI Force/Torque Sensors integrated into the robot wrist measures the forces and torques giving the robot a sense of touch," said Dwayne Perry, PE chief sensor technologist for ATI Industrial Automation. "Robots integrated with these sensors make it possible to automate

many different difficult assembly, machining, and finishing tasks that previously required skilled personnel or complex assembly machines allowing manufacturers to cut costs and improve employee safety.”

RollRazor®

Developed by Mapleroc, the RollRazor utilizes a finely honed and engineered blade to cut parent rolls of paper in their rolled state in one pass, cutting them to press-ready roll sizes in 3 minutes all without the need to un-wind and re-wind the paper. It is the fastest paper roll converting machine currently available. The system is capable of handling all grades of paper including: Tissue, napkin, cigarette, Bible, coated, uncoated, cardboard, and kraft papers.

“In addition to vastly increasing cutting speed, the RollRazor’s circular blade generates virtually no heat; cutting seamlessly in one pass through the roll and thereby maintaining the paper quality of the mill wound roll,” said Todd Morrison, president of Mapleroc Industries. “This avoids possible errors inherent in the un-winding and re-winding process, such as wrinkling and tension problems.” Pressrooms today cannot afford upsets on press due to inconsistent roll quality. RollRazor® ensures consistent mill-wound rolls with all the “original” manufactured specs still built-in to the press-ready rolls”.

Mapleroc estimates that mills or paper convertors can triple production output, improve efficiency by 2.7 times and reduce operating costs by as much as 72% using this new system.

Robotic Roll Finishing System

Traditional slitter rewinding equipment makes a clean cut and the new rolls do not require any additional finishing. The RollRazor blade cuts through the entire roll with a circular saw blade. Because not all rolls are wound the same, not all cuts come out the same. In an effort to remove the “witness lines” that are left over from the cutting process and producing a consistent looking roll, these edges then require sanding to meet the customer’s requirements. To complete the robotic cutting application, Mapleroc, ABB and ATI partnered to develop a roll finishing solution to automatically sand and smooth these edges. The newly developed Robotic Roll Finishing System creates a fully-automated, high-precision force-controlled roll-finishing station.

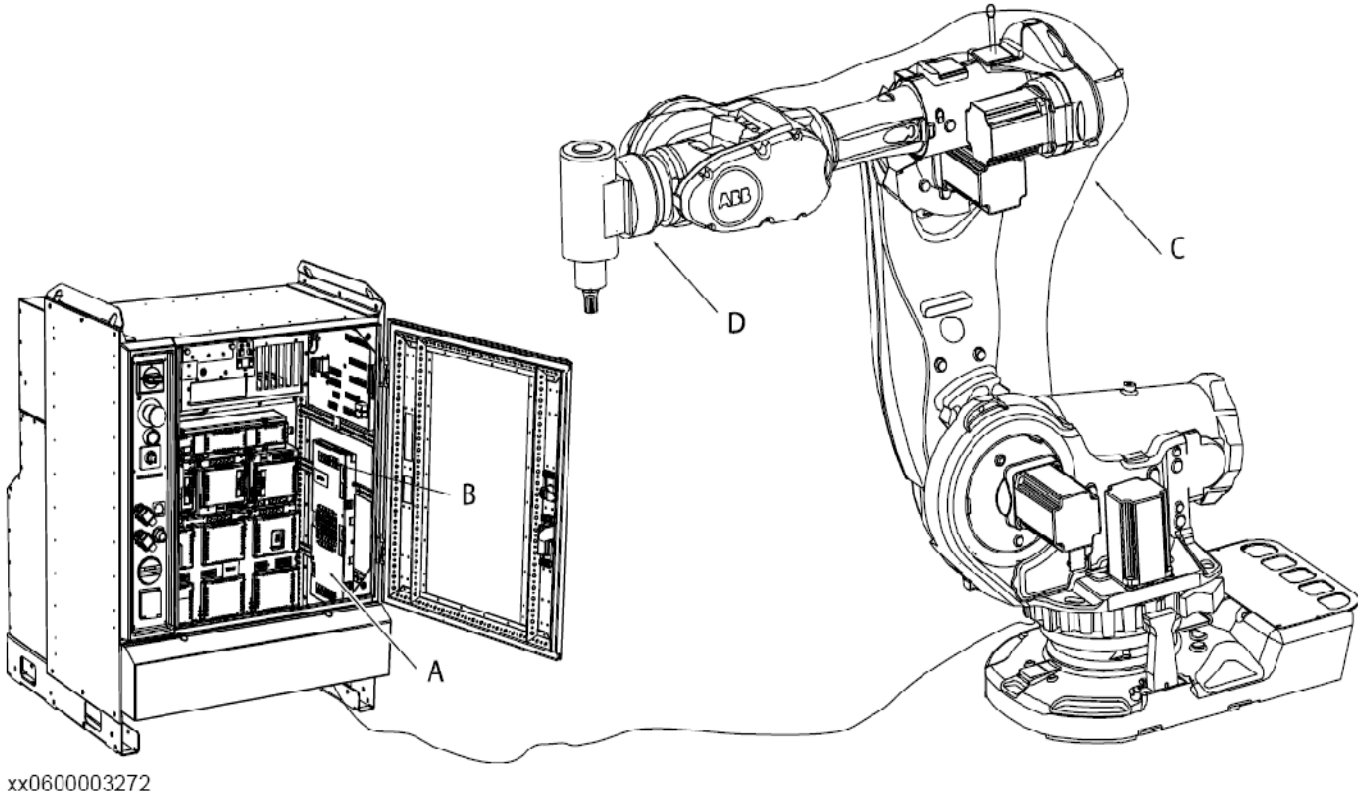
“We worked with Mapleroc and ATI jointly to turn the Mapleroc finishing center into a workable concept of an unmanned, fully-robotized system,” said Slawomir Smolec, business unit manager for robot automation at ABB Robotics. “The resulting Robotic Roll Finishing System utilizes an ABB IRB 6620 class robot equipped with a force-controlled machining package from ABB.”

“The IRB 6620 robot is equipped with an end-of-arm roll finishing tool and an integrated dust collection system,” added Adrian Kiss, engineering manager of ABB Robotics. “As the robot sands the rolls an integrated dust collection system removes the excess paper using a vacuum system.”

The IRB 6620 is a flexible and agile 6 axis robot with a large working envelope. It features an extremely compact design, has a reach of 2.2m and can handle payloads of up to 150kg.

With the cut roll moved into place the robot equipped with the sanding head smooths the edges utilizing the ATI Force/Torque sensor technology to provide force feedback. This enables the robot to feel and have a sense of touch just as a human would. This sense of touch allows the robot to make quick adjustments in real-time to maintain a constant contact force; all the while mantaining an average finishing temperature of 85 degrees. Together, the robot and sensor make this finishing task possible.

The system uses ABB’s force control package featuring the force/torque sensors integrated on to the robot wrist and where the signals from the force/torque sensor are interpreted directly into the motion control of the robot. The package includes ABB’s RobotWare Force Control Machining software with a user-friendly machining GUI. The hardware includes an Axis Computer (figure A), Data acquisition board for the sensor (figure B), cabling between the sensor and controller (figure C), and ATI’s force and torque sensor (figure D).



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Multi-Axis Force/Torque Sensors

The key to smoothly sanding the paper rolls to meet the high standards Norkol's customers require is the system's sensor technology. The Multi-Axis Force/Torque sensors measure all six components of force and torque. It consists of a transducer, shielded high-flex cable, and an interface card specially designed to work in the ABB robot.

How It Works

When you apply a load to the transducer it causes microscopic strains to develop on its internal beams. Silicon strain gages placed on these beams react to the strains and electronics measure this reaction. Software analyzes the measurements and is able to report and transmit the information about the amount of load that is being applied. Simply put, the transducer bends microscopically; it measures that bending and the software determines and transmits that information to the robot. The sensors are giving the robot force feedback, such as the unit is pushing too hard or moving to the left or right.

Force/Torque Sensor Technology vs a Load Cell

"A common question we hear when customers are considering various force sensing solutions is how our sensors differ from load cell force sensing," said ATI's Dwayne Perry. "The three important advantages our product has over load cells are the elimination of crosstalk between measurement axes, a wide range of interfacing options making connections simple, and the ability to withstand overloads up to 20 times the sensor's measurement range."

Perry elaborates that ATI's Force/Torque Sensors are largely immune to crosstalk. Load cells typically measure just one or two axes of loading, which can unintentionally react to loads on other axes, resulting in undesirable crosstalk. Six degree of freedom transducers don't have this type of crosstalk problem. Another advantage with the ATI sensors is the availability of

connecting to a wide range of industrial interfacing options including Ethernet, EtherNet/IP, USB, PCI bus, PCMCIA, RS-232, analog voltage, and more. The sensors come as a complete system making it simple for the customer to connect to their equipment where load cells usually have only one or two ways of connecting requiring external electronics bought separately and usually only use analog voltages. Finally, and perhaps most importantly, Perry adds that load cells can only withstand 150% to 200% of an axis's rated range increasing the chances of it failing where force/torque sensors' overload capacities generally run from 5 times to greater than 20 times depending on the selected calibration.

Additional Force Control Applications

In addition to the robotic roll finishing application force control is ideal for many other applications including difficult assembly, machining, and finishing tasks that previously required skilled personnel or complex assembly machines. Force/torque sensors are used throughout the industry for product testing, robotic assembly, grinding and polishing. Force control provides excellent robotic contour following, such as in grinding or deburring, to insure the correct force is being applied. It is also used for robotic material handling to verify product weight and collision-free placement. In research, ATI's sensors are currently being used in robotic surgery, haptics, rehabilitation, neurology and many other applications.

Cutting & Finishing Benefits & Results

Utilizing the new RollRazor cutting technology has significantly sped up Norkol's converting process and reduced their costs. The company estimates that with the new equipment they can produce one press-ready roll in 6 minutes where it originally would take approximately 30 minutes to process. For the company, this translates to increased production which in turn lowers their cost per ton and cost of labor. The new equipment increases plant flexibility, maintains original mill roll quality, guarantees original sheet orientation and web tension and can also convert wet or damaged rolls.

The Robotic Roll Finishing System with its force/ torque sensing capability eliminates safety risks for employees and offers manufacturers a quick and efficient method of finishing the roll to the standards required by the customer. The system allows the robots to address all roll sizes and unfinished surfaces automatically, eliminating the need for manual set-up. With this new system everything is embedded in the robot control thereby eliminating the need for an

expensive programmable logic controller (PLC) which typically would be used to regulate pressure and prevent the paper from burning or melting.

“Our goal at Mapleroc is to manufacture roll converting equipment with the best available technologies that improves our customer’s runability and printability of their paper. We are doing this while dramatically lowering the cost of roll converting.” commented Mapleroc’s Todd Morrison.

“We have been very pleased with the new cutting and finishing system as it is faster and eliminates problems for most applications. We are currently evaluating and considering replacing additional re-winders with this more efficient system,” said Mike Maloy of Norkol.

More information on companies mentioned in this article

ABB Robotics- www.abb.com

ATI Industrial Automation- www.ati-ia.com

Mapleroc- www.rollrazor.com

Norkol- www.norkol.com