Retrofitting a Rotary Press to Better Productivity

While retrofitting is not always the first inclination for plant managers struggling to maintain older equipment, retrofitting is a strategy companies can consider. Aptar is an example of where a company improved its quality and uptime by partnering with a motion control company to retrofit an underperforming rubber making machine.

APTARGROUP, INC., a maker of, among other things, drug delivery solutions for the healthcare and pharmaceutical industry, uses rotary presses as part of a typical rubber-making process to develop rubber washers for its asthma inhalers.

The rubber washer inside Aptar's asthma inhalers compresses to control the quantity of medication being dispensed to patients. To ensure the inhaler's washer meets strict medical regulations while delivering the correct dosage of medication, production managers must control the tolerances for the manufacturing of the washer.

First, a machine at one of Aptar's factories extrudes synthetic rubber in a continuous band, which then enters the rotary press, also known as a Rotocure. The Rotocure vulcanizes (or cures) the rubber band to strengthen it by changing its molecular structure. The accuracy of the continuous pressure applied by the main roll is critical to the quality of the rubber product produced.

A set of cylinders, or actuators, also control the alignment of the rubber band on the machine's central axis. Once vulcanized, the press controls the rubber band's thickness and quality as the rubber is re-rolled before transfer to a punching press. Typically, the control cylinder in the machine consists of two single-acting cylinders powered at a constant pressure, without any control loop for position or pressure.

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Press Can Be Used for Decades

There are many of these rotary presses in service today. And the continuous rubber-making process has not changed much over the course of 20 years. Once a company buys a rotary press, with regular maintenance, the equipment can remain in service for decades. In spite of the level of service performed by Aptar to keep one of its 15-year-old Rotocures running at a production facility in France, the machine began experiencing problems in 2014.

A mechanical offset on one end of the cylinder moved a metallic strip to the centre of the roll, but the movement was not accurately maintained. In fact, the rubber band tilted uncontrollably from one side to the other of the main cylinder during the process. The uncontrolled movement led to two consequences:

- First, since the band was poorly positioned, the pressure applied on one extremity was different than the pressure applied on the other. This led to an important quality loss on both sides. To compensate, Aptar had to drastically reduce the width of the rubber band by 15 percent on each side. This meant

Moog's newly designed system consists of a short stroke, low-friction cylinder with a servo valve.

One of Aptar's Rotocures vulcanizes a rubber band to change its molecular structure for making rubber washers.

it was producing a smaller width of rubber band from which to punch washers per operating hour.

- Second, Aptar used a stainless steel *holding belt* to grasp the rubber band and control the spread of the heat during the vulcanization phase. During the inspection process, plant managers realized the machine's holding belt was tilting up to 3 centimetres at various times. The tilting applied uneven stresses on the belt and caused the belt to break every four months at a cost of €30,000 per repair, plus plant managers typically lost four hours of production time to replace the belt.

Plant managers at Aptar considered purchasing a new rotary press to eliminate the cost and time to continually replace the belt. But rubber-making technology has not changed much in 20 years. And they determined a new machine's technology would be much like the old press they were struggling to use.

A mechanical offset on one end of the Rotocure's cylinder moved a metallic strip to the center of the roll, but does not accurately maintain the movement.

The press controls the rubber band's thickness and quality.

A Retrofit to the Old Press

Since the maintenance issue with the press involved a motion-control challenge, plant managers turned to Moog Inc., a motion-control expert and a company that they had dealt with in the past. Moog's engineers examined the situation and suggested a retrofit of the existing Rotocure. Moog's engineering team set about designing a new solution for the press.

As the integrator for the retrofit project, Moog approached local business partners to supply a hydraulic power unit, manifolds and cylinders. As Moog began the work of retrofitting the rotary press, its engineers found the machine's kinematics were not adapted.

To remedy this, Moog enlisted the help of a mechanical engineering partner and designed new bar links to provide rotary movement to both sides of the main roll and modified the frame of the rotary press. Once completed, Moog and its team calculated the mechanical stress to check the frame's stiffness.

Moog designed a complete system comprised of a short stroke and low-friction cylinder (Ø160 x Ø110 x 100) with a D633 pilot servo valve, mounted on a highly compact manifold that fit within the envelope of the original machine's housing. The frame of the rotary press was 1m wide, and Moog was able to fit two cylinders with mounted servo valves inside this dimension.

A Production Increase with New Controls

Moog's software control engineer then commissioned the position and pressure

control loops on a Moog Servo Controller (MSC II). Ironically, the control loop Moog developed to remedy the tilting was too precise. So the engineers created a sinusoidal movement to allow for a smooth oscillation of the belt and a very small degree of tilting, which prevents a wear patter from developing in the rubber band.

With the assistance of its automation partner, Moog reworked the PLC program to provide Aptar's plant manager with:

- Direct control of the pressure control loop (linearized on the vulcanization band pressure)
- Direct control on the tilting control loop, along with a highly valuable real-time graphical view
- Calibration functions
- New manual functions

As part of its role as the integrator for the project, Moog helped Aptar create a specification document and contractual objectives for the retrofit, so Aptar could monitor costs and make sure the project remained on schedule. During the six-month project to retrofit Aptar's rotary press, Moog's project manager handled the technical aspects of the work and monitored key performance indicators including the planned cost versus actual cost, project schedule and estimate to project completion.

The tilting experienced by the machine was reduced from 3 centimetres to ±0.1 mm.

Although Moog experienced some unpredictable events during the commissioning of the retrofitted rotary press, such as a longer fluid cleaning process than predicted, Moog finished the project on time. Moog and Aptar restarted the rotary press successfully in June 2015. The tilting experienced by the machine was reduced from 3 centimetres to ±0.1 mm (± 4 mi), while the force is controlled at ±0.2 tf (±2 kN). Both values exceeded Aptar's targets.

Moog's new design for the rotary press allows Aptar to increase the usable rubber band width by up to 95 percent, which represents a productivity improvement of 25 percent compared to the original machine. By eliminating the tilting of the belt, Aptar no longer faces costly belt breakdowns either. After the success of retrofitting its rotary press, Aptar is now thinking about upgrading a second machine based on the same design concept.

About the author: Xavier Sebastiani is a sales engineer for Moog Industrial Group. He has eight years experience in systems integration and sales for industries ranging from automotive to aerospace, in France and the UK, and has developed a particular expertise in the renovation of industrial machines. He holds a bachelors in mechanical engineering from Université Paul Sabatier Toulouse and a masters in management from SKEMA Business School. He can be reached at xsebastiani@moog.com.