



Inverter drive cuts the cost of automation

Using an inverter drive instead of a servo means lower costs for versatile bottle fillers.

Location:

Bento Gonçalves,
Rio Grande do Sul, Brazil

Segment:

Machine Building

Challenge:

Costly electronic filling system limits machine market acceptance

Solution:

Frequency inverters PowerXL DA1 and DC1, HMI/PLC XV100, I/O modules XI/ON, RMQ titan pilot devices, DIL contactors

Results:

By designing a solution replacing a servo-controlled system with an inverter-driven system, Eaton helped IMSB make its high-performance machines much more affordable

“Eaton offered a complete automation and drives solution that surprised all of us in terms of performance and value for money.”

Osmar Vieira, IMSB

Bottle and pouch fillers with electronic adjustment for filling volume offer important benefits over machines with manual adjustment but, until now, higher cost has limited their adoption. In the latest IMSB machines, however, an Eaton inverter drive replaces the costly servo-controlled filling system, making these novel machines much more affordable.

Background

IMSB is now part of Aetna Group, a world leader in the development and manufacture of packaging equipment. The group, which specialises in end-of-line solutions, has seven subsidiaries around the world and six manufacturing plants, including the one in Brazil where IMSB equipment is produced. The Aetna Group has a presence in more than 120 countries and prides itself on providing personal service for its customers, wherever they are located, and on developing bespoke solutions that satisfy their requirements accurately and cost effectively.

The IMSB business unit specialises in the development and manufacture of equipment that includes rinsing, filling and capping machines. In addition to standard products, it offers customised solutions developed to meet the specific needs of customers in the food, pharmaceutical, home care and other sectors.

Challenge

With today's frequent changes in pack sizes and formats, flexibility is increasingly becoming a key requirement for production equipment. In the case of in-line volumetric bottle fillers of the type manufactured by IMSB, this means that end users want to be able to change filling volumes quickly and conveniently to suit different sizes of bottles.

While machines with manual adjustments do allow such changes to be made, setting a new filling volume accurately can take up to an hour, a delay which is difficult to accommodate in modern fast-paced production environments. Electronic adjustment provides a solution but, until now, it has been necessary to use costly servomotor-based systems to achieve the required accuracy without adversely affecting the machine throughput rate.



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IMSB knew that there was a large market for filling machines with electronic volume control if the cost could be brought closer to that of machines with manual control. The challenge was, therefore, to develop an innovative design that would make this possible.

Solution

In IMSB in-line volumetric bottle fillers, the volume of fluid dispensed into each bottle and the rate of flow is controlled by a cam-driven valve system, as shown in the picture. The cam must rotate to an accurately defined position for each bottle filled, then return to its rest position before the next bottle reaches the filling station. In the past, it had been considered that the only way to position the cam with the accuracy and speed required for this demanding application was to use a servomotor and its associated drive system.

When Eaton's expert motion application engineers were made aware of this arrangement, and also of IMSB's quest for a more cost-effective solution, they carefully analysed the requirements. On the basis of their analysis, they proposed the use of a PowerXL DA1 high performance inverter drive to control the cam, in conjunction with an optical encoder to continuously and accurately monitor the cam position. The DA1 was specifically chosen as it features advanced vector control algorithms and is therefore capable of providing the rapid response and high levels of accuracy required.

To complete the system and to make it easy for the end user to operate, the solution also included an Eaton XV100 unit, which combines the functions of a colour touch-screen HMI panel and a programmable controller (PLC) in a single compact and competitively priced unit. To keep the machine wiring as simple as possible, signals from the encoder and from other machine-mounted sensors are connected to the XV100 using remote input/

output units from the XI/ON range. The I/O module used with the encoder is a high-speed counter unit with a maximum count rate of 100 kHz, which easily meets the requirements of this application.

IMSB developed programs for the XV100 that adopt an intuitive recipe-based approach. This means that machine operators simply use the colour touch screen HMI to select the recipe corresponding to the type and size of bottle in use. The XV100 then automatically sets the appropriate mode of operation for the filling valve system and also the optimum speeds for the infeed and outfeed conveyors, each of which is controlled by an Eaton PowerXL DC1 inverter drive. The current arrangement offers 15 recipes, but the control system is capable of handling at least 100, should future expansion be required.

During the filling operations, the XV100 continuously monitors the information it is receiving from the encoder and uses this, in conjunction with information contained in the chosen recipe, to compute a speed reference signal for the DA1 inverter. To ensure the necessary speed of operation, this signal is sent to the inverter via a CANopen bus connection, along with start and stop signals.

The computation of the reference signal is handled in the XV100 using a special positioning function block written using the CoDeSys software development system. This function block was written by IMSB's engineers, who were already familiar with CoDeSys after using it on other projects, with assistance from software experts at Eaton.

Results

IMSB's reaction to the results achieved by the new system was that they were nothing short of amazing! The accuracy of the new filling system was evaluated by check weighing each bottle and, after an extended period of operation, this revealed that the accuracy was better than 99.5%. In addition, the repeatability and consistency of the filling operation easily exceeded the company's very exacting requirements.

These results were achieved at a cost level much lower than that of a servo-based filling system capable of providing similar performance. For end users of the IMSB machines, the result is that they can now buy a machine with electronic filling volume adjustment for little more than the cost of a machine with manual adjustment. This means that they switch between bottle sizes almost instantly, allowing them to operate much more flexibly and to provide an enhanced service to their customers.

Osmar Vieira, who as Production Supervisor is responsible for electrical engineering at IMSB, commented, "When we were using servo drives, the cost of automation was simply too high for many potential users of our machines. Eaton, however, offered a complete automation and drives solution that really surprised all of us in terms of performance and value for money. In fact, we are so satisfied that we are standardising on the Eaton solution for all future production of our volumetric filling machines.



IMSB specialises in the development and manufacture of equipment that includes rinsing, filling and capping machines.



A cam-driven valve system controls the filling volume in IMSB's bottle and pouch filling machines with electronic adjustment.



In its new generation of filling machines, PowerXL DA1 frequency inverter control the filling volume and DC1 devices set the optimum speed for the infeed and outfeed conveyors.



The positioning function block runs on Eaton's XV100 HMI/PLC, which can remotely be monitored and controlled.

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