Drive & Control
profile

Framing the right bag-forming solution

NuLine created a unique IBC bag-forming machine using an extensive array of Rexroth aluminum structural framing, linear components and a comprehensive Rexroth drive and control platform.

New intermediate bulk container bag-forming machine uses broad range of Rexroth technology

Among the various shipping and storage containers utilized in today's logistics industry, intermediate bulk containers (IBCs) are pallet-sized containers, square or rectangular in shape, that are made from materials including corrugated fiberboard and are typically used for bulk material shipping and storage. When these materials include liquids—anything from cooking oil or paints to eggs for baking applications—large polyethylene plastic bags, capable of holding up to 300 gallons, are used to line the container.

Fabricating these IBC liner bags requires machines that are both large in scale and precise in operation. NuLine Manufacturing (www.nulinemfg.com, Denver, CO), is one of the few firms in North America with experience building these machines. The company recently constructed the newest version of the

Challenge:

Build a machine to efficiently fabricate liquid bag liners for intermediate bulk containers, using new design concepts to save development time and provide a more efficient and cleanly-designed machine.

Rexroth Solution:

- Aluminum structural framing
- IndraMotion MLC motion-logic in controller automation platform
- IndraControl L45 controller
- VEP HMI
- IndraDrive Cs compact drives
- IndraDyn MSK electric motors
- Dynamic linear guides

Results:

- Aluminum structural framing provides entire machine structure and exterior
- Aluminum framing enables faster machine design and assembly
- Framing also makes it easier to modify machine during assembly, compared to welding
- IndraMotion MLC controller and IndraDrive Cs drives control entire 20-axis machine, including eight third-party motors
- Finished machine exhibits a new, clean, aesthetically appealing design

machine incorporating an extensive array of drive, control, linear motion and structural technology from Bosch Rexroth (www.boschrexroth-us.com, Charlotte, NC).

New concept for bag-forming machine

NuLine is a comprehensive engineering/manufacturing firm that specializes in equipment to produce shaped or complex packages, pouches or bags. When approached about building a new machine, NuLine took a fresh approach to engineering the design and selecting the system's components.

The company sought to design a machine that had a better, more "clean" overall design and appearance, with exterior guarding, transparent upper panels, solid-colored lower panels and safety doors throughout. NuLine wanted a modular system that could be designed, assembled and tested in its Colorado shop, and then disassembled for shipment.

"Although there are components and technology approaches in this machine that we've utilized in past bag-forming machines, this is really a new design from the ground up, especially in the use of Rexroth aluminum profiles," said Greg Herivel, President of NuLine and the chief designer for the machine.

NuLine worked with AAP Automation (www.aapautomation.com Englewood, CO) a Rexroth distributor and engineering integration partner, to plan and select key machine components.

The Rexroth IndraMotion MLC automation platform running on the Rexroth L45 controller, provided a complete machine automation solution to support 20 axes of motion and extensive I/O requirements.

Multiple plastic sheets formed into one bag

NuLine's machine forms flat sheets of roll-fed polyethylene into the cube or rectangular bag shape. At the front end of the machine is the main unwind station with four rolls: two rolls feed the upper layer of the bag, and two rolls feed the lower layer of the bag. Those two layers are separated by approximately three feet, as various steps are taken to process those layers.

Two stations then add "fitments" to the bag, which are attachments such as nozzles or spouts that enable the end-user to fill the bag with liquid. One station punches holes in the bag in the appropriate location (depending on the bag's design and use). The fitment load and seal station has three linear components that insert the fitments into the holes, and then seals them in place.

Next is the gusset unwind station, which also has four rolls of polyethylene feeding the process. As the material is introduced into the machine, it is folded in half lengthwise and introduced in between the upper and lower webs being indexed from the main unwind stations.

After this forming step, two seal stations complete the bag formation: the longitudinal station seals the upper layers to one side of the gusset and the lower layers to the other side of the gusset, to form the bag cube. Then the angular seal station seals the upper side and lower side of the gusset at 45 degree angles (similar to the way milk cartons or paper bags are sealed) to seal the bag.

Complete Rexroth drives and controls platform

NuLine's machine has a total of 20 axes of motion—12 servos and linear modules using Rexroth motors, along with eight third-party motors, all driven by Rexroth IndraDrive Cs electric drives and controlled by the Rexroth IndraMotion MLC PLC system.

“Working with NuLine, we determined that virtually everything on this machine, all the servo drives, the unwind control, the HMI, the fitment feeds, could be controlled by the IndraMotion MLC PLC,” said Alex Runge, Vice President, AAP Automation.

Rexroth’s IndraMotion MLC is an integrated, controller-based motion logic platform that combines innovative software and firmware capabilities with printing and converting industry-specific technology functions. “The new Rexroth controller has the horsepower on the I/O side and it’s always had what we needed on the motion control,” said NuLine’s Herivel. For example, the MLC has the processing power to support both the machine’s high axis count and its extensive I/O network, which is utilized in key stations such as the gusset unwind and bag assembly stations.

The MLC’s motion logic capabilities enable NuLine to exercise precise, repeatable control of the web tension on the polyethylene material as it is processed, even though it is malleable and stretchy. “It’s allowed us to get that electronic gear ratio that we needed to control the web” Herivel said.

Rexroth’s IndraControl L45 is the machine’s scalable controller hardware platform. It has extensive I/O interfaces and support for multiple bus architectures such as Profibus (used on NuLine’s machine for I/O) and Sercos III (for drive communication). Rexroth also provided a Rexroth VEP HMI for operator control.

A single drive platform was chosen for the machine: the compact, cost-effective IndraDrive Cs electric drives. The Cs drives support both the Rexroth motors and eight third-party motors on the main unwind and gusset unwind stations. “They’re reliable, they work well with third-party systems, and their compact size helped us save space on the control cabinet’s footprint,” Runge said. Rexroth IndraDyn MSK electric motors, covering a range of motor sizes, power the majority of the axes on the machine, including the fitment feed actuators, nip rolls and head drives.

The Cs drives also support regenerative bus sharing, to reduce the amount of energy required to operate the machine. “This Rexroth technology is becoming more widely adopted for multiple reasons,” said AAP’s Runge.

“It’s energy-efficient, plus it vastly reduces the amount of cooling needed for the control cabinet, since you’re not generating heat by bleeding off energy through resistors, and you keep costs down by eliminating components like resistors and circuit breakers,” Runge said.

Using aluminum profiles “from the ground up”

One of the most distinctive and original aspects of NuLine’s design is the use of Rexroth aluminum structural framing for virtually the entire machine, including the main structural elements holding all the operating components of the machine.

According to Herivel, this decision was made for both functional and aesthetic reasons. In the past, structural elements were fabricated from welded steel. All the components and sub-assemblies, as well as items

Within the machine, extensive use was made of Rexroth aluminum structural framing to provide the machine’s load-bearing structure, as well as external enclosure and framing.

NuLine selected Rexroth aluminum structural framing in part to create a clean, modern, streamlined appearance for the machine's exterior enclosure elements.

such as wiring trays, were attached either by steel welding or drilling holes and using physical fasteners—time-consuming, labor intensive work that complicated NuLine's ability to modify the machine during assembly.

"The Rexroth framing gave us the flexibility to make changes that we never had before," Herivel said. "If we wanted to change how we mounted a subassembly, we just unbolt it from one location and bolt it on in the new location."

With over 120 sizes and types of profiles, Rexroth aluminum structural framing offers the world's largest modular profile system for a wide variety of applications. Featuring an extensive range of profiles, connectors and accessories, its unique T-slot design is engineered for high strength-to-weight ratios, fast assembly, easy reconfiguration and superior fit and finish. Plus, the system's bolt-together technology saves significant design and assembly time.

NuLine ordered a full supply of framing profiles in standard sizes, then set up a fabrication station in their shop, to quickly produce or modify profiles and framing structures as needed during assembly.

"We designed everything around the slots in the framing—one common frame that we could use throughout the whole length of the machine," Herivel said.

For example, once the structural framing design for the gusset unwind station was completed, NuLine could use substantially the same design for the main unwind station, saving engineering time and making fabrication and assembly of the profiles simpler.

NuLine also wanted to use Rexroth's aluminum structural framing to improve the machine's overall appearance; previous versions using painted steel tended to be very industrial looking. Herivel's goal: create a machine that looked completely different from anything the company had done before.

"I was certain that if we could go forward with a design that incorporated the framing from the ground up, it's going to give a more modern, fluid looking machine and a better appearance," he said. "All you see on the outside of the machine are clear plastic panels and lower panels that were all fixed and a solid color—and that's what the Rexroth framing allowed us to create."

The machine also uses another component from the aluminum structural framing portfolio—three dynamic linear guides. These are used in the fitment load and seal stations to properly move and insert the fitments into position in the bag, which are then sealed in place with an impulse welder. Dynamic linear guides provide precise linear motion and are easy to integrate in frames, peripheral machine configurations and transport solutions.

Machine configuration

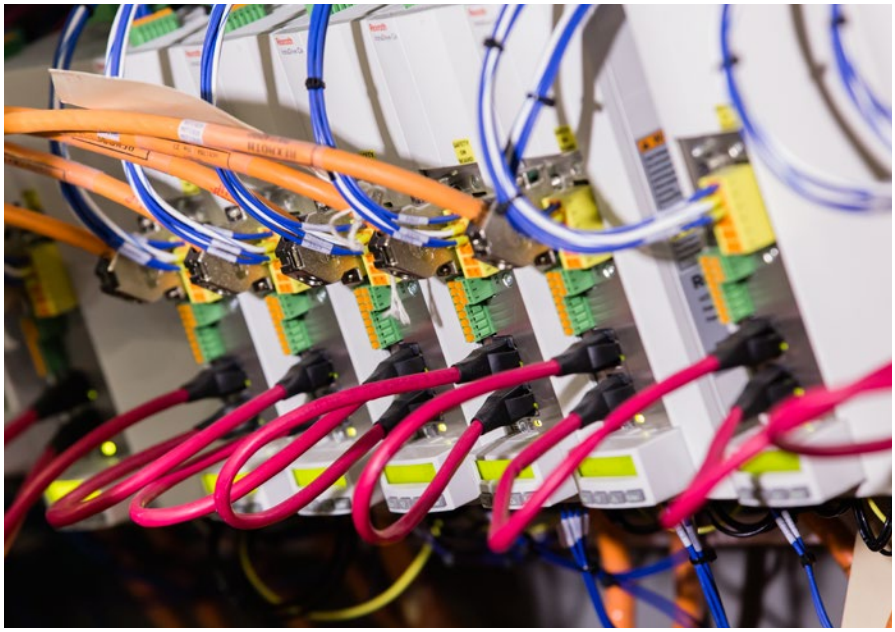
Fabrication of the main machine framing and integration of all the system components proceeded faster and more smoothly compared with similar-sized NuLine projects in the past. Herivel attributes this improvement to the Rexroth framing products, and the support AAP provided for programming the MLC controller.

“From a controller perspective, this was the most integrated machine NuLine has ever built, with one controller handling the whole machine,” said Runge. “So we actually had a programmer on-site programming the MLC; we were able to begin programming the controller and motion sequences in tandem with rest of the machine development.”

The use of the Rexroth structural framing has enabled NuLine to create a modular machine that can be easily separated for shipping and final installation.

Ultimately, NuLine is highly satisfied with the performance of all the Rexroth components on the machine, and Herivel believes that aluminum structural framing technology can provide a much wider range of uses:

“I think this machine demonstrates that an all-aluminum profile machine, utilizing technology like Rexroth’s structural framing, provides a solution that combines functionality, ease of machine assembly and good aesthetics in one package.”



Compact IndraDrive Cs electric drives with bus-sharing capabilities power both Rexroth MSK motors and eight third-party motors used on the main unwind and gusset unwind stations.

Do you have an application worthy of a case study?
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