

Drive & Control profile

Not shaken or stirred: Rexroth helps create new options for materials mixing



Resodyn's innovative ResonantAcoustic® Mixing (RAM) technique blends various types of materials in faster, more precise ways than attainable by traditional methods, while avoiding the purity- and safety-related drawbacks that result from impellers or blades.

Rexroth drives and controls enable novel, impeller-free ResonantAcoustic® mixing technology

Mixing is a critical step in creating everything from pharmaceuticals and cosmetics to rocket fuels. Traditionally, manufacturers have used a broad range of technologies to mix materials: stirring, using an impeller, and the vigorous shaking most familiar in paint mixing. But, generally speaking, for many applications,

these processes mix too unevenly for precise specifications, take long periods of time to mix and require a plethora of hardware configurations and operating conditions to reach the desired product outcome.

Now, better alternatives exist, thanks to a novel mechanical

Challenge:

- Achieve precision timing to take motors in and out of phase during mixing to create resonance at exactly the right frequency
- Blend multiple programming languages for communication between drives, motors, embedded PLC and Resodyn "black box" controller
- Simplify machine construction, reduce cabling, production time and machine cost
- Maximize energy efficiency

Rexroth Solution:

- IndraDyn MAF liquid-cooled rotary motors
- IndraDrive M digital intelligent servo drives (supply unit and drive system) with SERCOS III
- IndraLogic MLD embedded PLC controller

Results:

- Precision mixing for wide range of materials within demanding specifications and tolerances
- Considerable machine production cost savings
- Substantial energy savings from regenerative drives
- Huge reduction in mixing time
- Drive and control platform established for larger RAM 55 mixer

resonance-based technology developed by industrial engineering and design firm, Resodyn Acoustic Mixers (www.resodynmixers.com Butte, MT), with drive and control support from Bosch Rexroth Corporation (www.boschrexroth-us.com Charlotte, NC). Resodyn Acoustic Mixers' innovative ResonantAcoustic® Mixing (RAM) technique relies on low-frequency, high-intensity acoustic energy at nominally 60 Hz to fluidize the mix and create a phenomenon called acoustic streaming and micromixing within the material. RAM blends various types of materials in precise ways unattainable by traditional methods, while avoiding the purity- and safety-related drawbacks of using impellers or blades. RAM technology is also much faster than traditional mixing and has also mixed materials where conventional mixers have failed.

The unique RAM process requires exceptional control of the machine's powerful electric motors and drives, which produce resonant acoustics by spinning pairs of offsetting eccentric masses. By changing the phase angle of the offset between the pairs of eccentrics, the amplitude of the mixing chamber motion is controlled. The vibration generated causes the mixture to interact in tune with the container, producing the fluidization that permits even mixing throughout. Taking the motors in and out of phase with each other can create accelerations up to 100 g and results in an almost unlimited number of mixing actions.

RAM 5: The next generation

Resodyn recently decided to upgrade its [RAM 5 resonant mixing platform](#), which was limited to volumes of approximately 5 gallons, to a

recently launched 55-gallon version, extending RAM technology's inherent advantages. "We had a great concept, and we wanted to take it to the next level where we could control the machine's production time, cost, and complexity while saving our customers as much energy as possible during mixing," said Resodyn Senior Engineer Brian Seaholm.

Resodyn's first priority was to streamline the machine: limiting the number of machine components, reducing communications cabling and improving the machine's control capabilities. But that would mean updating and simplifying the RAM 5 programming and communications protocols. And because RAM 5 operation depended on a unique Resodyn "black box" computer, multiple communications protocols would be required between the computer and the RAM 5 drives and motors.

To meet the challenge, Resodyn called upon its capable, experienced machine control partner, Bosch Rexroth. The company had already contributed EcoDrive electric drive technology to the first generation

RAM 5. And, as Seaholm said, "Only Bosch Rexroth has the products for precise synchronization of RAM motors, with speed and angle constantly changing. That's important because maintaining resonance, an enabling feature of the RAM technology, requires precise control of different specific vibration frequencies, and because uncontrolled resonance can do serious damage to the machine itself."

Resodyn also teamed up with well-established fabricator and Rexroth automation distributor, Northwest Motion (www.nwmotion.com) of Issaquah, WA. Northwest Motion had the machine programming background needed to handle multiple communications protocols, and they'd already helped one client create a cement mixer using similar resonant technology.

New drive and controls platform powers RAM 5 renewal

The first step in updating the RAM 5 was Resodyn's choice of Rexroth IndraDrive M digital intelligent servo drives, which integrate a modular power supply unit and drive system, and offer regenerative power



75 grams of polyethylene pellets are combined with .1 grams of carbon black in 8 seconds. The larger particles mill the carbon black, and the acoustic energy created with RAM provides a uniform coating on the polymer pellets. This same process can take up to 6-8 hours in a conventional tumble mixer.

capabilities to divert kinetic energy from the machine's servo motors back to the AC line. That way, excess power could generate energy instead of excess heat as the unit instantly shifts from consuming power to producing it. The IndraDrive platform provides a compact solution and Resodyn knew it was ideal for motors in this multi-axis system. In addition, IndraDrive supports the multiple communication protocols that are required to communicate between the RAM's black box and interface PC.

The Rexroth servo drives were married with four Rexroth IndraDyn MAF liquid-cooled high-speed rotary motors, part of the IndraDyn A motor family. These motors have a maximum speed of 11,000 rpm and synchronize the eccentric masses in two pairs to impart force to the RAM system.

Multilingual motion control

With the Rexroth drives and motor platform selected, the next step was to ensure a smooth "conversation"

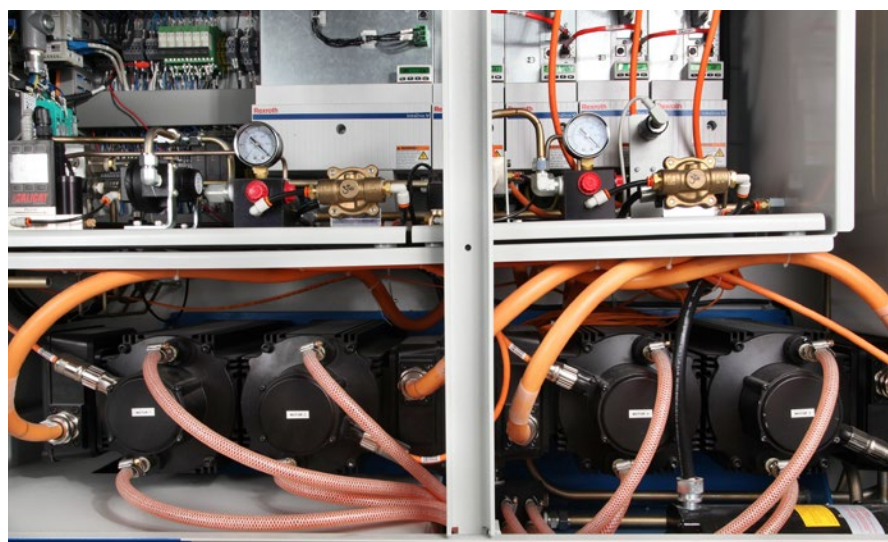


Rexroth IndraDrive M digital intelligent servo drives offer regenerative power capabilities to divert kinetic energy from the machine's servo motors back to the AC line and contain an embedded Rexroth MLD PLC, specifically designed for open automation and ideal for multiple communications protocols.

between the communications languages and protocols controlling RAM 5 mixing. The key was the Rexroth MLD programmable logic controller (PLC), embedded directly in the drive for added simplicity and reduced fabrication time and costs.

This PLC is specifically designed for open automation and flexibility of communication design—ideal for a machine that would require multiple protocols. "We needed Rexroth components to be controlled and synchronized in conjunction with our own computer controls, and their PLC supported this," said Seaholm. "So the biggest factor in making everything work was the programming skill and experience of Northwest Motion and Rexroth together."

The team chose SERCOS III for the main bus to keep the IndraDrives synchronized for exact positioning. Control between the Resodyn "black box," the RAM's PC, and the Rexroth master drive relies on OPC Server and RS232, sensing and responding to minute changes in the resonant condition. Encoder emulation allows the drives to report back to the "black box." Interestingly, machine control and I/O rely on analog signals as well as digital, with an analog link



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reduced each RAM unit's electronics costs by thousands of dollars. These savings have carried forward to the newly launched Resodyn RAM 55 technology.

Bigger RAM 5 provides big user advantages

Rexroth and Northwest Motion allow Resodyn's RAM 5 to offer impressive benefits, including more precise, even mixing; mixing at various scales which include: macroscopic, microscopic, and even down to the molecular levels; and cleaner, more reliable operation. RAM mixing makes it easier for manufacturers to meet strict pharmaceutical or cosmetics regulations, since there's no impeller to keep clean and no need to open chemical containers for mixing. Seaholm notes that the RAM 5 produces huge time savings over traditional mixing—reducing one application from hours to minutes—and that recipe-based input makes it easier for end-users to switch parameters between each mixing job. Finally, users benefit from the IndraDrive regenerative advantage and near power factor of unity, substantially reducing energy costs. "We can help manufacturers get a competitive edge," Seaholm said. And with the super-sized RAM 55, Resodyn is poised to literally shake up the world of industrial mixing.

Resodyn recently launched a 55-gallon version of the RAM 5 mixer, enabling larger volume mixtures without increasing the footprint or intricacy of the original machine.

between the "black box" and the drives as well. According to Seaholm, this not only helped keep mixing within demanding specs, but was also important for recipe-based operation, with the operator inputting complete acceleration set point and timing instructions at the start of each job depending on the mixture. Finally, an Ethernet-based OPC Server connects the operator to the Rexroth embedded PLC via the PC-based HMI.

Harmonious partnership

Getting all controls and components working in harmony took dedication and a close working relationship between Rexroth and Northwest Motion. Engineers from both companies came to Resodyn's headquarters to work on programming code and communications, helping ensure Resodyn got the most from the Rexroth components, including writing sample code for machine setup and testing. Seaholm estimates that Rexroth's IndraDrive-based platform

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