

CaseStudy

Mixing a New Generation of High-Temperature, High-Viscosity Sealants and Adhesives



A pioneer in developing industrial sealants for tough conditions, IGS produces a wide variety of sealants that are easily applied and tolerate temperatures from -60°F to 2,900°F.

You run an innovative, fast-moving, mid-sized company. You have the people and the vision necessary to develop the new product lines that are vital for growth. But the mixing equipment currently on your plant floor simply will not handle the higher-viscosity formulations that today's applications require.

What's the answer? New product development must be based on customer needs matched with equipment capabilities — but you're not sure what new products and equipment will deliver the winning combination you're looking for. How does a company foresee the new products it can make and the equipment it will need to make it happen?

IGS Sealant Technology Group, **LOCATION?**, recently faced this marketing dilemma — and solved it with new equipment that made a new line of breakthrough products possible.

It all began when company managers visualized a line of sealants that would cure at temperatures approaching 3,000°F, in cycles faster than anything on the market. Their goals were

ambitious and their vision was clear, but IGS didn't have mixing equipment capable of handling the higher viscosities that these products required.

IGS – A Winning Record

Founded in 1961 by Kenneth Desch and family, IGS first earned customer trust and a reputation for high-quality products by manufacturing metal shims and gaskets. As customer needs changed, the company added sealants to its product line and began manufacturing specialized sealants and gasket materials that excelled under high temperature and pressure.

The sealants that IGS developed were soon favored by the pulp and paper industry and used extensively in chemical-processing equipment and turbines of all kinds. Applied as a liquid/paste compound, they cured into a leathery gasket at 400°F in two to four hours. Later, IGS took on another challenge — and opened a new market — by manufacturing high-shear refractory mortars.

To manufacture high-performance products like these, IGS has been mix-

ing difficult materials for decades. Silicone rubber, putty, hot melt adhesives, oxide ceramics and cement-type materials are all tough enough to challenge the most powerful mixer. So, IGS attacked the job with mixers that were known for robust engineering, especially in their drive systems, shafts and agitators.

“Twenty-five years ago, we started working with two Ross double planetary mixers,” says IGS General Manager Chuck Lytton. “As we grew, the viscosity of our formulations rose, and those mixers handled everything we threw at them.”

Planning for Fast Growth

Like many fast-growing companies with great technical strength, IGS recently focused its creative energy on developing new products and opening new markets for the 21st century. Already customers were demanding faster delivery of sealants — that required greater capacity and more flexible manufacturing on the plant floor. They wanted higher temperature tolerance and excellent performance

under more extreme conditions. The IGS management team was determined to respond to customer needs, so it drew up a plan for fast growth:

- Increase capacity by speeding up the manufacturing process;
- Expand the product line by introducing a new generation of sealants;
- Offset capital costs, improve equipment utilization and build another revenue stream by increasing the company's contract-manufacturing business.

Unfortunately, the team soon found that developing new applications would be impossible with the mixers that were currently on the plant floor.

"The new mastic blends we were working with were so dense and so viscous that you could stand on them with no trace of a footprint," recalls Lytton. "This material was so tough, it could break the blades off our double planetary mixers."

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Cutting Cycle Time From Hours to Minutes

Looking for equipment and process answers, the IGS management team turned to Charles Ross & Son Co., Hauppauge, N.Y. – its partner in mixing for 25 years.

"They do more than sell equipment," says Lytton. "Ross engineers listened to what we wanted to do, and they collaborated with us to develop a solution that fit our specific needs." The answer for IGS came in the form of a 450-liter, Ross/AMK Kneader Extruder. The Kneader Extruder — a design that was

pioneered by AMK, **LOCATION**, — operates with a masticating-action, high shear that is intensified with a close-tolerance mixing/extrusion screw, and much greater power than any change-can mixer. This combination of power and shear allows IGS to mix its products faster.

"It used to take us five hours to mix our sealant/gasket materials," explains Lytton. "But with our new Kneader Extruder, the same process takes only 28 minutes."

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The Mighty Extrusion Screw

The extrusion screw on a Kneader Extruder performs two important operations – one during mixing and the other during discharge.

During the mixing process, the screw rotates and carries material from one end of the mix trough to the other, driving it against the Sigma blades to increase compression and shear. The screw threads accentuate this effect with variable pitch combined with the upward slope in the screw shank in the zone of highest compression. The thread is also slotted (for "interrupted flight"), which promotes tearing and further increases compression.

During discharge, the screw turns in the opposite direction and forces the finished material out of the mixer. The material may be discharged through an extrusion die, into downstream piping, or directly into containers. For transport to remote filling equipment or storage vessels, the stream is diverted to an auxiliary pump that carries the material further downstream.

The extrusion screw is also valuable as a tool for charging certain additives, e.g., fumed silica and calcium carbonate. Although fillers are commonly added through the top of the mixer, they can also be injected near the extrusion barrel. The screw then carries the additive materials directly into the high-compression zone where they are quickly wetted out. In many cases, this accelerates the mixing process considerably.



The two powerful Sigma blades of the Kneader Extruder fold and compress dense material at lower temperatures – an important advantage for mixing heat-sensitive materials. The extrusion screw increases shear during mixing, then turns in reverse to accelerate discharge.

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Mixers for Higher Viscosities – A Selection Guide

Many process industries are experiencing increased demand for higher viscosities. The reasons range from government-imposed regulations to self-imposed standards for achieving higher levels of performance. Environmental regulations aimed at reducing VOCs have produced a new breed of water-based adhesives and sealants that are more viscous; customers are demanding faster-curing (more-viscous) sealants; and many manufacturers have reformulated their products to deliver superior performance — with a higher-solids formulation.



The double planetary mixer is a versatile work-horse for high-viscosity materials. With new blade designs (such as the HV blades shown here, courtesy of Charles Ross & Son Co.), double planetary mixers can handle viscosities of over five million cps.

Many variables influence the choice of a mixer for high-viscosity materials:

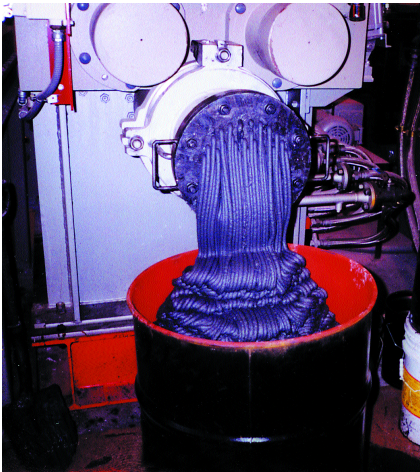
- The peak viscosity anticipated during the mixing cycle,
- The power needed to move the material,
- The level of shear required,
- The material's tolerance to heat.

The following table summarizes mixer capabilities, but testing is always recommended before the equipment purchase to confirm your selection and to perfect the technique that will optimize your process-line results. Be certain to test in a manufacturer's customer-service laboratory with a wide variety of mixing equipment and analytical instruments capable of quantitatively assessing your test results.

Selecting a Mixer Type for Higher-Viscosity Applications

Mixer Type	Key Attributes	Material Viscosity	Mixing Action	Typical Products
Multi-agitator, anchor-based mixers	Process flexibility and economy. Independent drive on each agitator.	Medium	Radial and axial flow – relies heavily upon the inherent flow characteristics of the material being mixed.	Epoxies, high-solids coatings, pharmaceuticals, cosmetic creams and lotions, salad dressings, toothpastes, and shampoos
Hybrid planetary mixers – planetary blade combined with high-speed disperser, both orbiting the mix vessel	Handle viscosities up to 1–2 million cps. Particularly appropriate for processes that begin with high-speed, low-viscosity dispersion and finish with a non-flowable end product.	High	Disperser applies shear while it orbits through the material. Relies upon the natural flow characteristics of the mix, but to a much lesser degree than anchor-based multi-agitator mixers.	Plastics, adhesives, thick-film inks, pharmaceutical granulations, food dispersions and specially engineered gasket materials
Double planetary mixers	Increasing shear and rapid dispersion. Variable-speed drive can deliver high torque at low rpm.	Higher (pastes and putty-like materials)	Orbital mixing pattern – achieves homogeneity regardless of the flow characteristics of the mix.	High-performance composites, silicones and epoxies, rubber additives, confectionery products, dental composites, hot melts, metal and ceramic powders
Kneaders and Kneader Extruders	Because of their power and close tolerances, they require minimal heat to soften the material and process the batch. An added extrusion screw allows easy discharge of the final product.	Extreme	Combines two powerful kneading blades. An extrusion screw can accelerate mixing by 10–15%.	Hot melt adhesives; high-temperature and high-pressure sealants and gasket materials; refractory mortar mixes; mastic sealants; and ceramic fiber-based products

Table adapted from Ross Technology Report, Vol. 2, No. 1, "Evolution in Change Can Mixing – The Next Millennium," www.rossmixing.com/



With the extrusion screw turning in reverse, this heavy sealant is discharged automatically from the mixer into bulk containers – eliminating the need to have an operator discharge the material by hand.

Because of its massive power and close tolerances, the Kneader Extruder is also capable of mixing highly viscous materials at temperatures much lower than those required by change-can mixers. The Kneader Extruder operates well below the threshold at which most polymers and resins degrade.

During the mixing cycle, the two Sigma mixing blades operate tangentially to each other in a horizontal mixing trough — rotating at differential speeds, producing an intense mixing and masticating action. The screw located beneath the two Sigma blades intensifies the shearing action of the blades and accelerates the process cycle. The rotating screw carries material along the trough, compressing and tearing it against the rotating Sigma blades above. (See sidebar, “The Mighty Extrusion Screw.”) After the cycle is finished, the screw reverses direction to discharge material from the mixer.

Making the Plant More Productive

IGS has expanded its product line and tripled the capacity of its sealants

manufacturing facility – more than meeting customer demand for tougher industrial sealants. The Kneader Extruder has also opened up a new horizon of product possibilities for IGS. The new *Seal It!*[™] line of industrial sealants successfully tolerates temperatures from -60°F to 2,900°F, and they are being used in applications ranging from turbines to heat exchangers and continuous casting lines.

“Demand for the *Seal It!* products is growing,” says Lytton. “We are meeting our delivery goals on every order, and we have more products in development.”

Specializing in products for extreme conditions, IGS is now manufacturing refractory mortar mixes that can withstand temperatures up to 2,900°F — tough enough to line the ladles used to dish up molten steel. The company is also making numerous lines of mastic sealants — including Silver Seal II, Temp-Tite II and Turbo Temp-Tite II — capable of standing up to aggressive chemicals, gases, steam and high pressure.

Lytton explains what made the difference: “We’re able to load more high-heat fibers into the product because the Kneader Extruder can handle the increased density. With a jacketed trough, we can circulate hot oil and control batch temperature closely. So, we no longer have to pre-heat resins in another tank.”

Making Strategic Equipment Choices

“Equipment selection is always based on a combination of experience, intuition and testing,” says Bill Purse, Ross senior engineer and Kneader Extruder product manager.

Chuck Lytton agrees. “To open up new possibilities in product development, you’ve got to consider new approaches to processing – or you’ll never find the breakthrough product that can put you on the fast track.”

Bill Purse offers this advice for anyone looking for new equipment choices, especially in demanding applications:

- Find an equipment manufacturer that makes a broad range of equipment that could solve your application needs.
- Make sure the manufacturers you consider have extensive experience in your application and a well-equipped customer-service laboratory.
- Test! In a controlled laboratory setting, test a variety of equipment using your own ingredients, simulating conditions on your process line. Assess your results with quantitative analytical instruments. Sometimes, subtle differences in your lab results will project out to a terrific difference in production and profitability! The lab also provides an excellent opportunity to tweak your process and optimize your mixing technique.
- If possible, test the equipment you are considering on your own process line, with a trial/rental machine. That can give you the best possible assurance that you are making a smart choice. • ASI

To learn more about the Ross/AMK Kneader Extruder, or to arrange a demonstration, contact Bogard Lagman, Executive VP, Charles Ross & Son Co., 710 Old Willets Path, Hauppauge, NY 11788. USA Tel: 800-243-ROSS. Overseas Tel: 631-234-0500. Fax: 631-234-0601. E-mail: sales@mixers.com/ Or Circle No. XX.

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