TWIN SCREW REPORT

2025

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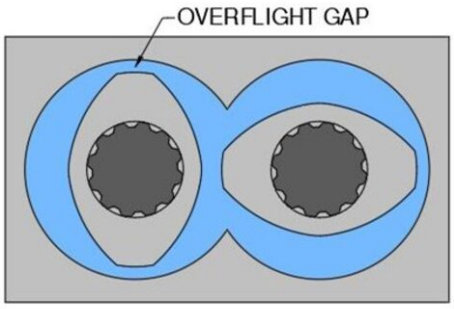
1 Know your kneaders- managing mixing intensity

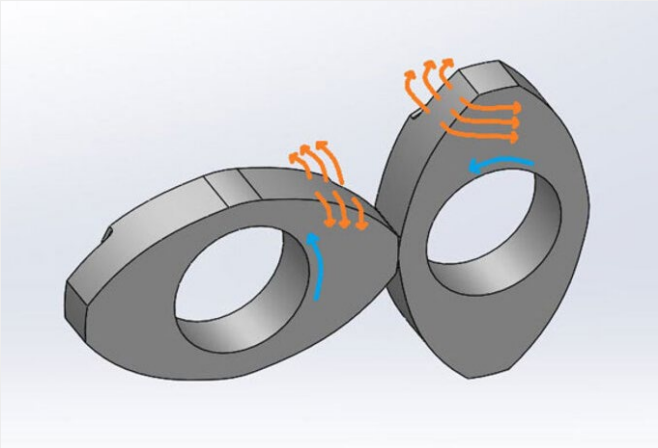
There are an infinite number of mixing elements that can be specified for a co-rotating, intermeshing twin screw extruder. By far, the kneader (or kneading element) is the most prevalent type. Therefore, it's important to understand how a kneader works.



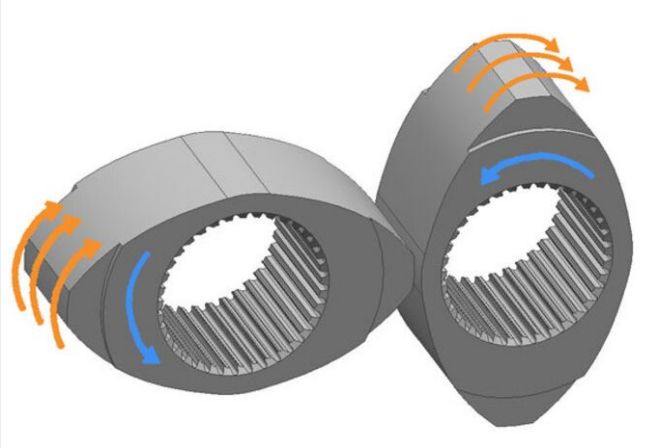
Kneaders are specified in the early part of the screw design to melt and mix materials, imparting energy from the motor into the materials being processed. As kneader elements rotate the material in the channel is forced up and over the kneader crest and between the barrel wall (the overflight gap) which results in extensional mixing and planar

shear effects; the primary dispersive mixing mechanism in a twin screw extruder.

A comparatively narrow kneader instead causes a division and recombination of the melt with minimal extensional mixing and planar shear; the distributive mixing mechanism. In addition to crest width, kneading elements can be staged to be forwarding, neutral or reversing. By changing the number and configuration of kneaders the screw design can be made to be shear intensive or passive, depending on the formulation.

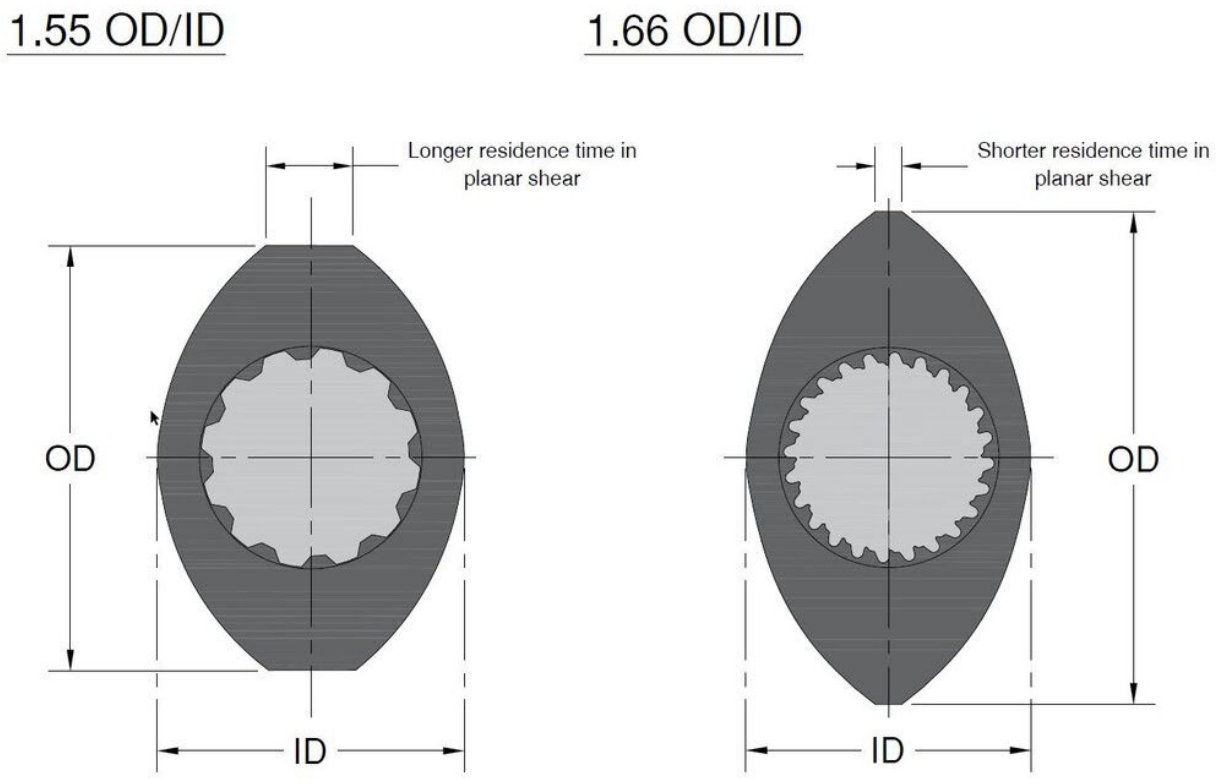


Narrow Kneader - Distributive mix Mechanism



Wide Kneader - Dispersive mix Mechanism

The OD/ID ratio (outside diameter (OD) divided by the inside diameter (ID) of each screw) also impacts the mixing experience in kneaders. A lower OD/ID ratio results in a wider crest and more residence time in the planar zone that occurs in the overflight gap. (and more intensive mixing) A higher OD/ID ratio has a narrower crest and less residence time in planar shear. (and less viscous heating)



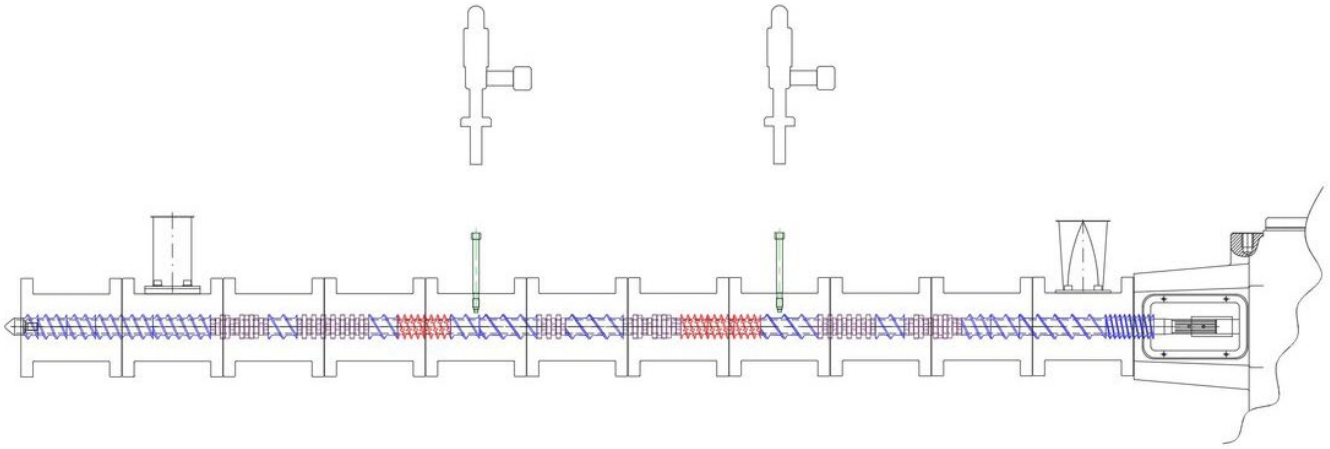
Comparative crest widths (exaggerated) for different OD/ID ratios

2 Injecting a fluid (or melt) into a ZSE-MAXX process

The co-rotating twin screw extruder (TSE) is a continuous mixing device where pellets, powders **and liquids** (the formulation) are metered into the TSE process section. A liquid (or melt) can be introduced at the main feed throat or into a downstream barrel section that is strategically positioned to inject prior to or into high division rate distributive mixers.

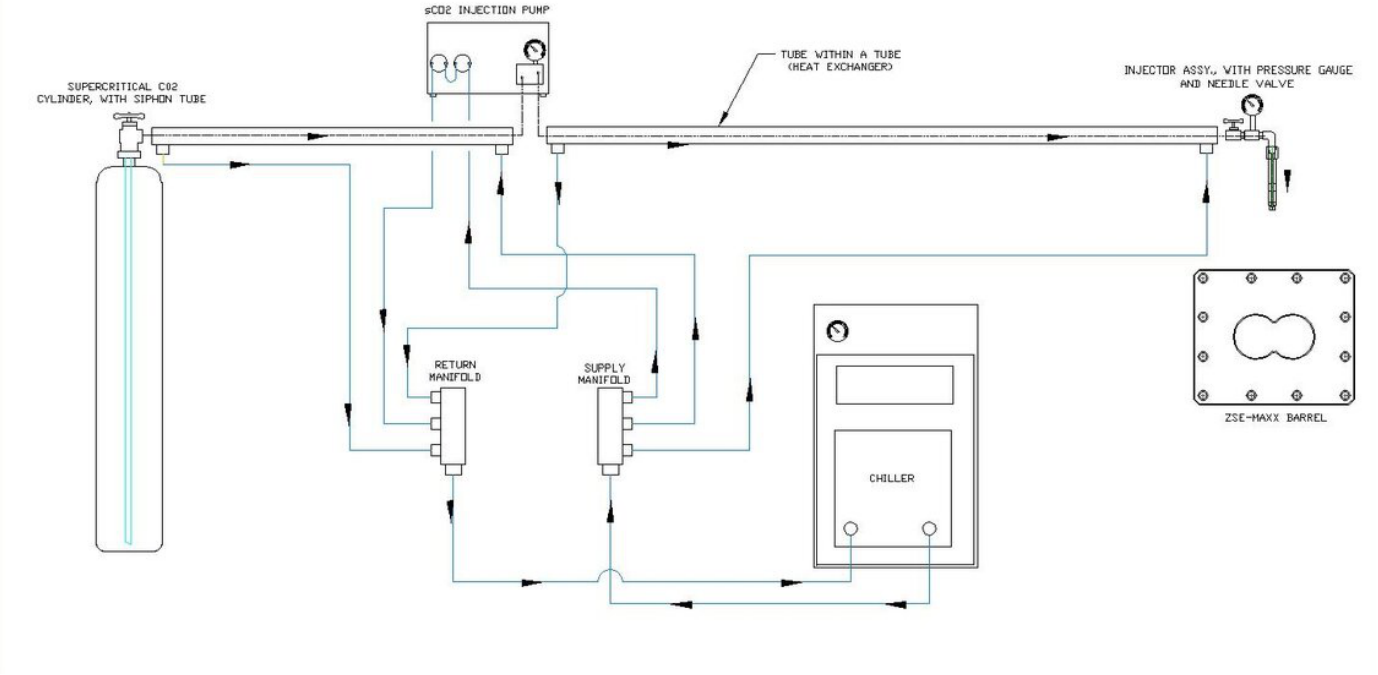
Example twin screw extruder with solids and liquid metering equipment

Various injection scenarios are possible. Mixing of complex, high-liquid phase formulations (i.e. 70%+) may require sequentially staged injection points to prevent pooling of the liquid in the screw channels. Once mixed, the formulation is then devolatilized, cooled and pumped into a die or gear pump.



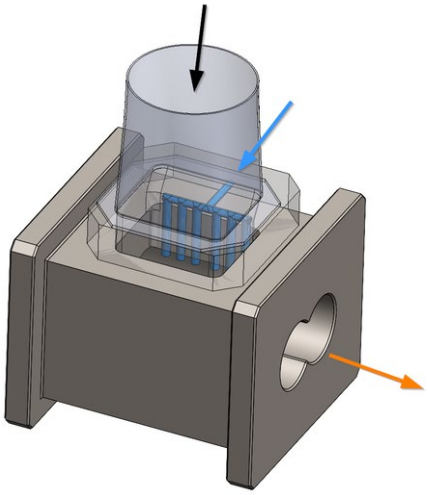
Screw design: feed, melt, mix, multi-stage injection, devol and pump

The screw design is matched to the intended process. For the injection of supercritical fluids a dynamic seal is integrated into the screw design to facilitate high-pressure injection.



sCO2 Injection system schematic for supercritical fluids

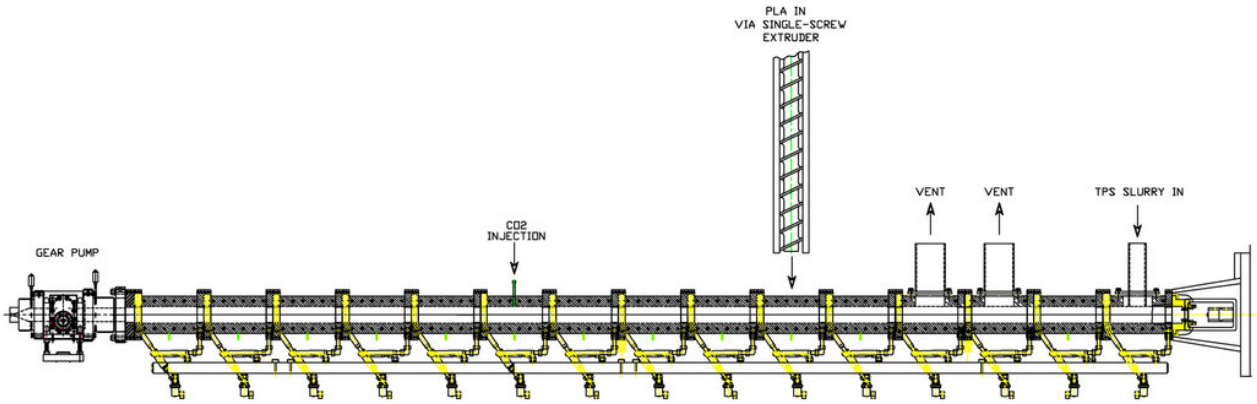
Screw design: melt, mix, sCO2 injection, cool and pump



Feed insert for plasticizer injection at feed throat

A liquid (i.e. plasticizer) can also be injected into an insert at the feed throat that sprays a plasticizer stream into a free-falling feedstock (i.e. FPVC pre-mix) to increase the attainable % in the formulation.

A single screw extruder can also be used to melt and pump a polymer into a ZSE-MAXX barrel section as part of unique, multi-functional systems. For instance, a Thermoplastics Starch (TPS) slurry is metered/pumped into the main feed throat with early vents positioned to devolatilize the water content. Then PLA is melted and pumped into a downstream barrel by a single screw extruder and mixed with the TPS. Supercritical CO2 can then be injected to facilitate foaming, and a gear pump is attached to the ZSE-MAXX discharge to manage discharge pressures. This process is depicted as follows:



Twin screw extruder with single screw melt feed and sCO2 injection

Various devices can be used to introduce feed streams into a ZSE-MAXX process section:

- Gear pump
- Screw pump
- Piston pump
- Peristaltic pump
- Diaphragm pump
- or….
- Single or twin screw extruder for melt feed (not really an injection pump)

Standard features for injection systems:

- Stainless steel reservoir with cover and drain valve
- Flexible hoses from pump to injector with pressure gauge and bleeder valve
- Stainless steel components with quick disconnects
- Components on common cart with casters and drip pan
- AC motor/drive

Typical options:

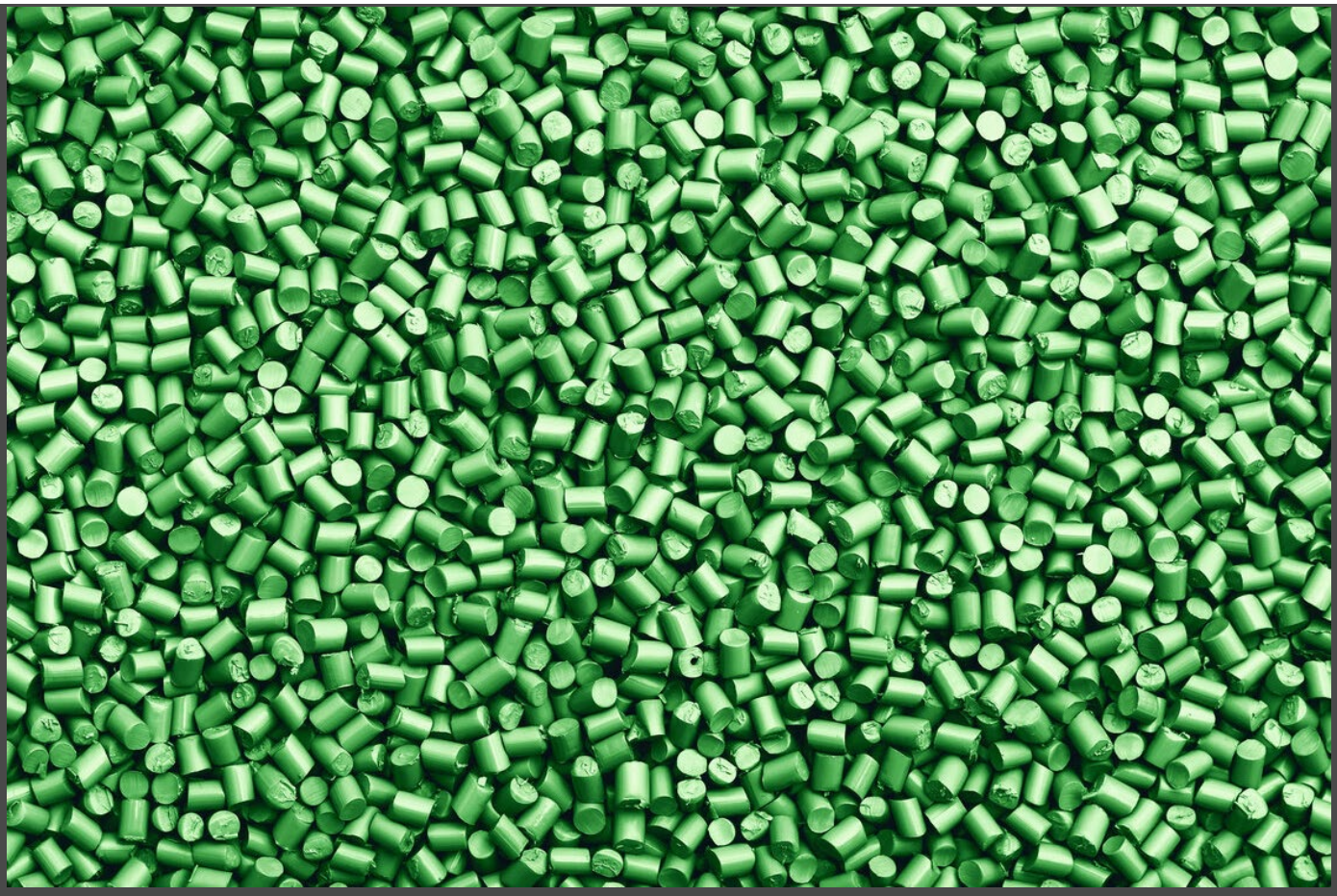
- Ambient, heated, melt/pump, supercritical fluids
- Controls: volumetric, loss-in-weight and mass-flow meter
- Level sensors
- FDA and XP environments/classification
- Single or multiple pump configuration
- Tank agitation
- Manual or automatic refill
- Nitrogen purge or pressurized reservoir
- Interface to drum or pre-melt station
- Refrigerator chilling for supercritical fluids

The Leistritz Extrusion USA process laboratory has most of the injection technologies denoted in this article.

Download a technical article describing injecting liquids into TSE:

- **Leistritz Liquid injection white paper 2025**

3 Leistritz Extrusion Bioplastics activities update & 5-minute interview with Plastics Industry Association



Based on government mandates and other environmental factors, the use of bioplastics is expanding exponentially. Leistritz Extrusion is a participant in the Bioplastics Division of the Plastics Industry Association. (PLASTICS) For a 5-minute update on the Mixing Polymers, Natural Fiber, and Bioplastics with Leistritz Extrusion Technology on the subject see:

Mixing Polymers, Natural Fiber and Bioplastics on YouTube

Leistritz Extrusion is also a member of The Center for Bioplastics and Biocomposites Consortium that brings together university researchers and industry members to push the boundaries of renewable resources.

More information

4 Test, don’t guess….. Leistritz Extrusion USA Process Laboratory is expanded

The Leistritz Extrusion USA process laboratory performs 100+ lab tests each year, and is continually upgraded to make it the most versatile twin screw lab in North America utilizing twin screw extruders. Recent additions to the Leistritz Extrusion USA process laboratory include:

- Gear pump metering system from drums for silicones and other high-viscosity materials
- Candle filter front-end attachment for in-line ultra-fine melt filtration
- Dry rotary claw vacuum pump with baffled condenser and condenser for devolatilization

The Leistritz process development laboratory includes:

- 6 twin screw extruders: ZSE-12 MAXX to ZSE 50 MAXX
- Strand, underwater and hot face pelletizing (air quench and water quench)
- 40+ feeders: pellets, powders, fibers, liquids, reclaim+++
- Downstream: film/sheet, tube/profile
- Film/sheet samples from 50 mm to 1 meter in width
- Up to 5-layer coex structures
- Lamination of substrates
- 3D filament extrusion

- Supercritical injection: foaming and stripping
- Devolatilization: 60/1 L/D, multi-stage, atmospheric and vacuum venting
- Multi-stage TSE system setups- string together 2 or 3 extruders in 1 system

Don’t hesitate to contact us to discuss your process development needs!

5 Technical tip: Preventative Maintenance Guidelines for twin screw extruders and side stuffers

The chart below shows PM guidelines for typical twin screw extruders for full production machines running 24/7. These intervals can be extended for machines such as lab extruders which don’t run nearly as many hours per week.

Twin-screw extruder

Maintenance check	Interval
Check oil level in gearbox at sight window	Once per week
Change gearbox oil	Depends on gearbox model, but generally every 4,000 hours

Clean or change oil filter	Every 3,000 hours, or whenever the Delta P gauge is HIGH
Check oil seals for leakage	Every 3 months
Clean main motor intake air filter	Depends on plant dust conditions
Clean air filters on control panels	Depends on plant dust conditions
Re-grease motor end bearings (if grease-able type)	Every 6 months
Check heaters for burnout condition (Ohms check)	Once per year
Check that thermocouples are firmly seated in adapter tubes	Once per year
Check cleanliness of barrel cooling liquid, replace lost rust inhibitor	Every 2 months
Check temperature of gearbox oil under load. Make sure oil cooler is getting adequate water flow and delivery pressure	Every 3 months
Pull screwset out, clean, and record O.D. measurements	Every 6 months

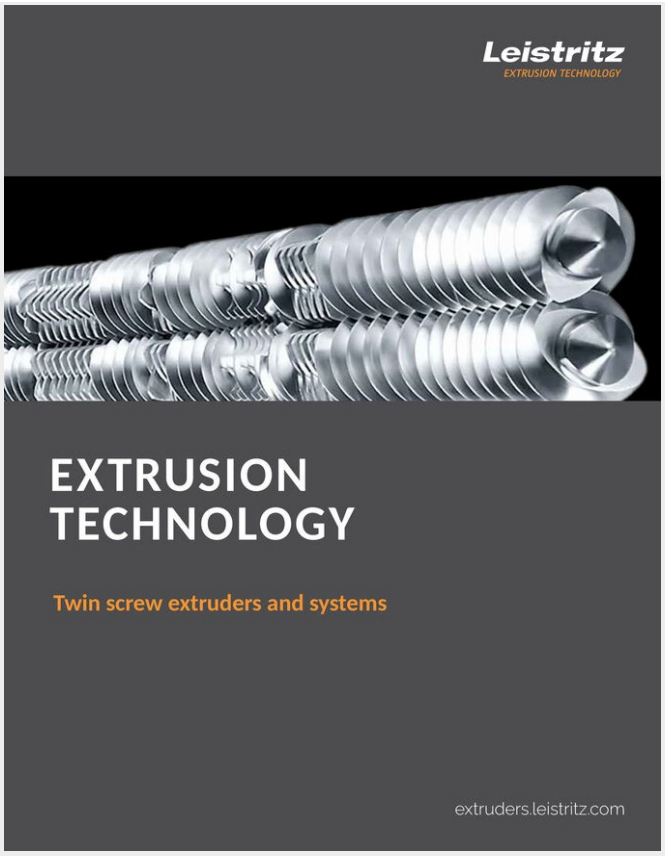
Clean barrel I.D., inspect bores for gouges/damage	Every 6 months
Check that barrel cooling bores are not plugged up (check flow)	Once per year
Inspect tail-shaft powder seals, replace if worn	Every 12 months
Inspect vacuum vent O-rings/gaskets, replace if deteriorated	Every 6 months
Check that pressure transducers are functioning and calibrated	Every 3 months
Make sure you have a copy of all drive parameter settings	Always

Side stuffer

Maintenance check	**Interval**
Check oil level in gearboxes (note there are 2 gearboxes in 1 side stuffer unit)	Every 6 months
Change gearbox oil	Every 6,000 hours for synthetic oil*
Check powder seals	Every 6 months
Remove augers (screws) and clean	Depends on material

Clean barrel I.D. with wire brush	Depends on material
Measure screw and barrel for wear	Once per year
Check that water jacket is not plugged up (check flow)	Once per year
Make sure you have a copy of all drive parameter settings	Always!

Note: the use of synthetic oil is highly recommended for twin screw gearboxes



6 Leistritz Extrusion technology overview brochure

This 16 page brochure describes the twin screw technologies and services available from Leistritz Extrusion.

Download the Leistritz Extrusion Technology brochure

7 Leistritz Extrusion 2025 Calendar of Events

January 20-22	AMI Thermoplastics Concentrates	Tampa, FL
February 4-6	Plastec West/MDM	Anaheim, CA
February 16-19	SPE International Polyolefins Conference	Galveston, TX
March 3-6	SPE ANTEC	Philadelphia, PA
March 11-14	PlastImagen	Mexico City, Mexico
April 29-30	**Leistritz Devolatilization Workshop**	**Branchburg, NJ – 1st time program**
May 20-21	Plastics Technology Extrusion Conference	Boston, MA
September 15-17	SPE CAD Retec	Cleveland, OH
November 9-12	AAPS PharmSci 360	San Antonio, TX
October 8-15	**K 25**	**Düsseldorf, Germany – big show**
November 12-13	AMI Compounding World Expo	Cleveland, OH
December 3-4	**Leistritz Twin Screw Extrusion Workshop**	**Branchburg, NJ**

For additional information on anything contained in this newsletter call 908/685-

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We look forward to serving you in the future

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