Technology Bulletin

Granulating Scrap Successfully

By: David Miller, General Manager of Size Reduction

Understanding the Job

The secret to effective use of granulated scrap in plastics processing is uniformity. Clean, uniform granulate, produced at high output rates, with minimal energy consumption, noise generation, and maintenance requirements, is critical to efficient and profitable operation.

There are literally dozens of different granulator designs available, each of which may offer benefits in certain circumstances. Ideally, a granulator should be specified to process scrap of a particular size and material type at a particular rate. But realistically, granulators are used to do not only their specified jobs, but also to offer some versatility in processing other, similar materials.

Correct granulator selection aligns and balances a whole range of factors with the properties and physical form of the feedstock:

- Infeed hopper (side, front, doors, dimensions)
- Loading method: (manual, conveyor or robot-fed)
- Cutting chamber size and configuration
- Rotor size (width, diameter, number of blades)
- Cutting blade clearances (moving blades to fixed blades)
- Screen hole diameter
- Regrind evacuation method

Selecting the correct granulator

To more fully understand the importance of the four fundamentals of drying, read the following real-life stories. These scenarios are typical of what we hear regularly on Conair's service line. Each begins with a customer quote/problem report, Conair's diagnosis, and a recommendation for improving future performance and efficiency.

Before you read our solutions and suggestions, consider taking a moment to think through each of the problems reported and consider the potential causes.

1. What do you want to grind?

Consider the type of part or sprue/runner system, the type of material (hard or soft, brittle or tough, filled or unfilled, high/low-melt-temperature) and the temperature of parts being granulated. These issues will help determine the appropriate rotor design, motor horsepower, soundproofing requirements, and means of regrind removal. Brittle engineering materials, for instance, shatter on impact, so they are better processed by closed rotors running at relatively low speeds. Softer, energy absorbing materials, and heat-sensitive materials, are more often ground with high-speed open rotors. Low-speed rotors are generally quieter and subject to less wear when filled materials are being processed.

2. What size is the part or scrap?

The physical size, shape and wall thickness of parts or runners should be considered in order to determine feed-hopper and cutting chamber dimensions and configuration. Your granulator should offer a feed hopper and cutting chamber and rotor/knife assembly that are sized to handle the largest possible part without the need for pre-cutting. The feed hopper should also be configured to safely accept parts using the selected infeed method (robotic, conveyor, manual) through the top or side, with guarding where needed to ensure personnel safety. Today's granulators generally use variations of a "tangential" cutting chamber. Tangential chambers have rotors that are positioned at an offset from the feed opening so that parts meet the rotor knives on the downward portion of their cutting circle. Super tangential cutting chambers are a larger variation on the same theme, with a larger opening (relative to the downstroke of the rotor) that allows for bigger "bites" and pulls the scrap down into the cutting chamber rather than allowing it to bounce on top of the rotor.

Complementing the size and design of the cutting chamber is the design of the rotor/knife assembly. The rotor holds rotating knives that cut plastic parts by shearing them against stationary knives built into the edges of the cutting chamber. The number of blades in a rotor may be varied to meet application requirements. For example, many granulators are equipped with three-bladed rotors as standard. However, five-bladed rotors offer an option for circumstances in which additional throughput is needed (e.g., five blades cut more, per rotor revolution, than three) or when harder materials or bulkier parts are the norm (five-bladed rotors take more, smaller bites per revolution).

3. How much do you want to granulate?

The designed capacity or throughput (lb/ or kg/hr) is typically expressed as a range, since it can vary greatly depending on the size, density, and material composition of the infeed scrap. In the case of large central grinders – or a press-side unit that must serve multiple machines – ensuring adequate throughput is critical, since both are likely to be run at or near capacity on a continuing basis. The required throughput will determine motor horsepower, rotor design, number and design of rotating and bed knives, screen size and means of regrind removal.

Generally, it is best to over-specify size and horsepower. In addition to sizing the feed hopper, cutting chamber, and rotor to handle the largest parts at necessary rates, be sure to size regrind evacuation capabilities as well. If you plan to granulate large amounts of material, consider automatic evacuation options, not only to improve grinder efficiency, but also to reduce dependence on manual labor.

Speaking of automatic evacuation, your choice of evacuation method can make a difference in regrind quality. To best preserve regrind quality and consistency, use of a vacuum-powered evacuation system is preferable, since it moves the regrind more gently. The alternative, a positive-pressure system or blower-type system, exposes the regrind to contact with the air-pump impeller, which can result in more breakage and fines.

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4. How will you feed the granulator?

To pick the right feed hopper design, consider the size and shape of the scrap to be fed, and whether feeding will be automated or manual. For manual feeding, the primary concerns will be operator ergonomics and safety. Hoppers open to the front of the unit for easy feeding and are designed to eliminate flyback and prevent operators from reaching the cutting chamber when the unit is operating. Robot-fed hoppers are open at the top so that parts can be dropped straight down. Some hoppers can be configured to allow either of these feeding methods, while large, central granulators can accept parts from belt conveyors. A host of special-purpose hoppers allow efficient feeding of pipe, profiles, film, sheet or thermoforming skeletons. Augers force-feed large, spider-like runners into the cutting chamber.

5. What will you do with the regrind?

Will the regrind be combined with virgin material or reprocessed alone? The answer to that question dictates the required quality and uniformity of the regrind, along with screen size and evacuation method. When regrind is being blended with virgin, accurate proportioning and processing consistency depend on achieving a uniform particle size with a minimum of fines and longs. Doing that demands consistency—sharp knives, careful adjustment of the spacing between rotor and bed knives, and proper screen hole sizes. Selection of proper screen-hole sizes varies with the application: regrind for injection molding typically requires smaller screen sizes (5-6 mm and up) while regrind used in high-volume extrusion and blow molding applications can utilize larger screen sizes (8-10 mm and up).

6. What are your special needs?

Most plastics processing plants present at least some unique challenges when it comes to handling scrap, grinding it and returning it to the process. These might include limitations on where the granulator can be located, along with varying requirements for parts and materials to be handled, cleanliness, controls, safety, and noise. As your consideration of available options becomes more focused, it pays to work closely with a granulator supplier that has a broad product line, a thorough understanding of your entire production process, and the ability to deliver you a granulator with the right mix of features for your needs. They are best able to help you decide between central and beside-the-press installations, special controls, safeties, alarms, level indicators, sound attenuation, portability, and many other options.

Understanding your equipment options

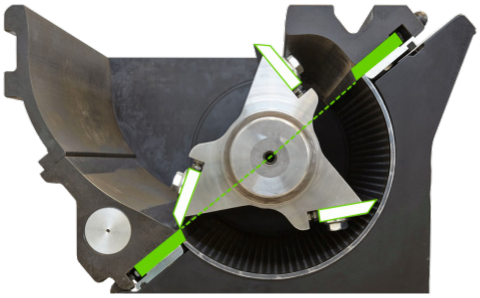
Like everything in the field of plastics processing, granulator technology continues to evolve. This evolution has resulted in a range of newer granulator features that can offer great advantages in terms of regrind quality and consistency, productivity and throughput, durability and maintenance, safety and cost savings.

The principal value of a granulator is in the quality and consistency of the regrind that it can produce, particularly when that material is to be fed back into production, where consistent granule sizing ensures the consistent melt, plastication and flow essential for quality molding. But producing consistent granule sizes—and doing so efficiently and with necessary throughput—takes a lot more than just selecting the right screen size, because not all granulators that produce similar granule sizes are equally productive, easy to maintain, durable, or safe.

Consider how these factors and features could make a difference in your granulation operations:

1. More screen area.

Granulators that offer more screen area around the rotor (e.g., 180 degrees) generally support higher throughputs, because granulate that has been cut into the proper size has more opportunity to fall into the hopper per rotor cycle. Granulators that maximize screen area also optimize the use of available motor horsepower and electrical consumption. To process the same amount of material through a similar granulator with less screen area (e.g., 120 degrees), more horsepower, more rpms, and therefore more electrical consumption would be required.

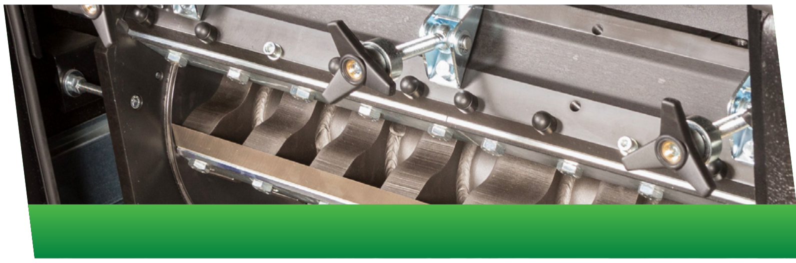


2. Cutting chamber temperature control.

The ability to control cutting-chamber temperature is another important factor in maintaining high-granulator throughput, especially if a grinder runs long cycles, processes -hot-scrap, or processes low-melt-temperature materials. Any of these conditions can cause scrap to melt or smear, rather than grind cleanly. So, for consistently hard-working, high-cycling granulation—or for effective granulation of hot scrap, look for granulators that offer water-cooled cutting chambers.

3. Easy-adjusting knives.

Up to 75% of granulate quality problems are attributable to knife sharpness and alignment problems, which can be addressed through regular maintenance and controlled tooling/sharpening practices. The problem, however, is that many granulator designs, especially older ones, make knife removal, replacement, and adjustment difficult. It can be a time-consuming exercise and many processors put it off for as long as possible to avoid costly downtime. Today's granulators make knife replacement and alignment far easier, with features ranging from rotor locks, to added safeties, to benchtop fixtures that enable easy, reliable "pre-alignment" of knives before they are fastened into place on the rotor. Features that make knife replacement easier, while assuring far more consistent alignment, make maintaining sharp knives and producing quality granulate a lot easier for everyone.



4. Tool-free chassis and rotor access.

The latest granulators offer quick, tool-free access to the rotor chassis, with drop-down screen cradles that enable you to lower the granulator screen for inspection, adjustment, or cleaning of the rotor assembly. Cutting chamber access is also simplified thanks to hinged, tilting hopper designs and power-assist features to ensure that one person can safely open even the largest hoppers.

5. Hardened cutting chamber.

Among granulators of the size and type you need, look for those that are built with features that offer enhanced durability and easy maintenance. For maximum wear resistance and easier repair, look for granulators with internal components (cutting chambers and rotors) made of hardened, machined steel. Specially hardened steels resist wear better than cast steels and are often much easier to repair.

6. Oversized rotor bearings and mounts.

These features offer a big plus, since the strength and stability of the rotor and its components are essential to maintaining optimal geometry in the cutting chamber, where every component is subjected to extremely high levels of stress and vibration. In less-robust grinder designs, bearing failure is a primary cause of misalignment and reduced performance in the cutting chamber.

7. Protective rotor-end disks.

Bearings and rotor shafts should also be protected by a rotor-end disk that isolates them from exposure to granulate, dust, or fibers that might otherwise find their way into rotating machinery or interfere with proper lubrication.

8. Safety switches and rotor locks.

Granulators are powerful machines, so features that protect user safety are paramount. Among the most important are safeties (switches or locks) that reliably disable operation when the granulator is open and prevent the movement of the rotor during screen access, cleaning and knife maintenance. These not only protect maintenance personnel from injury, but make knife maintenance far easier and safer to perform.

Rotor locks and other safety features ensure that operators and maintenance personnel can clean and maintain granulators without risk of injury.