Granulation for post-consumer plastics recycling

by Robert M. Chagnon

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For many recycling collectors, granulators offer improved processing capabilities for scrap plastics.

A growing number of recycling programs are adding scrap plastics to their list of materials collected. To offset the transportation problems of shipping this lightweight, bulky material, many recycling collectors are using granulators to process scrap plastics. In addition, granulated material often receives a premium over baled or loose material. A brief overview of the granulation process and how it applies to processing high density polyethylene (HDPE) milk jugs and polyethylene terephthalate (PET) soft drink bottles is presented below.

The granulator

The purpose of a granulator is to reduce material to a uniform and consistent size so it can be reclaimed for use in any of the various plastics manufacturing processes - extrusion, injection molding, thermoforming and blow molding.

A granulator is a very simple piece of equipment whose technology has been refined by leading manufacturers to meet the specific requirements of processing equipment and, more recently, post-consumer recycling facilities.

Granulators have three major components:

- the hopper, designed to accept the subject feedstock
- the cutting chamber, where size reduction takes place
- the base, where granulated material is collected.

To determine the proper size granulator required, the type and form of the material and the desired throughput capacity must be clearly defined. A granulator's throughput capabilities are measured in pounds per hour.

HDPE milk containers and PET bottles

When the feedstock is HDPE and PET, the vast majority will consist of one-gallon milk containers and two-liter soft drink bottles. Seven one-gallon milk containers equal one pound, and six two-liter soft drink bottles equal one pound.

Several factors, generally equally weighted, must be considered to determine the throughput capability of a granulator. These factors are:

- hopper opening and configuration
- rotor design and knife configuration
- available screen area and hole size
- horsepower
- method of evacuation.

Assuming that a typical recycling facility will want to granulate two-liter PET soft drink bottles at a rate of 1,000 pounds per hour and want a single granulator for the job:

- 1 pound = 6 PET soft drink bottles
- 1,000 pounds = 6,000 PET soft drink bottles
- 6,000 bottles per hour = 100 bottles per minute = 1 2/3 bottles per second.

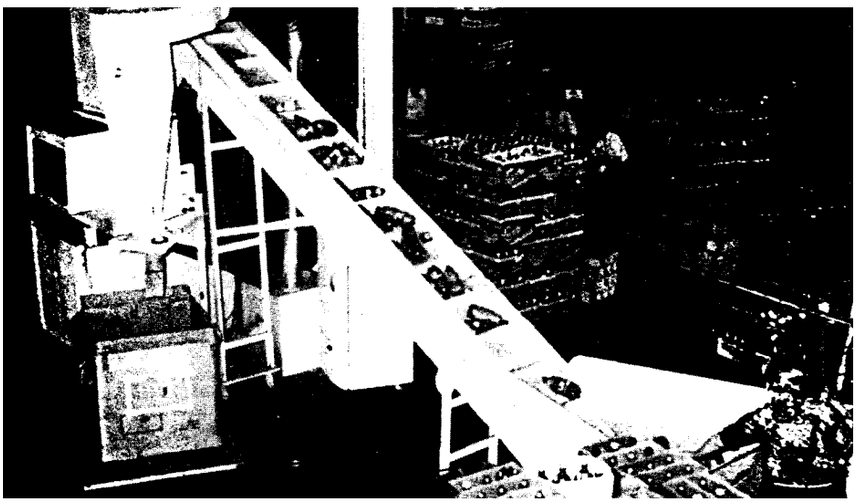
Since no individual has ever claimed to be capable of feeding materials consistently at this rate, other means must be considered. Two proven methods are conveyor belt and air stream transport of the material to the granulator. Both are viable because of the degree of consistency and reduced staffing requirements they offer.

The proper rotor design is essential. An open rotor will increase and help prevent heat build-up in the cutting chamber because of better air flow. HDPE has been known to plasticize (melt) in cutting chambers bers.

A slant knife design rotor with counter angled rotor to bed knives provides cleaner, more uniform granulate with less dust and fines.

An absolute necessity is to feed the blown bottles to the cutting chamber on a tangent. A tangential feed cutting chamber presents the feedstock to the downstroke of the rotor and eliminates "rotor-bounce."

Open screen area and the diameter of the holes in the screen will determine how quickly the granulated product can exit



A conveyor belt or air stream transport is critical to feed plastic bottles at a rate consistent with a granulator's requirements.

the cutting chamber. To process 1,000 pounds per hour, an open screen area of a minimum of 325 square inches with 3/8" diameter holes is required.

The motor must be of sufficient size to prevent seizing or jamming. A 50 h.p. motor is recommended for the 1,000-pound-per-hour load capacity.

Knife selection is a very important factor. A knife with a cutting edge that features a relatively steep 40 degree angle is the proper choice for PET and HDPE material; it provides a clean and more efficient cutting action, rather than a tearing effect. A D2 steel is recommended for extended life over standard chrome vanadium (HR3) steel composition.

Evacuating the regrind from the base of the granulator is crucial. A blower and cyclone for instantaneous and constant evacuation is the preferred method. This combination serves to enhance air flow through the granulator, thus alleviating heat build-up, and will increase throughput. For discharge of the material into a container placed next to the granulator, a minimum size 5 h.p. blower must be used

Other important features to look for when evaluating different manufacturers' granulators include:

- Rotor bearings mounted outboard of the cutting chamber to prevent grease from contaminating the regrind and keep dust and fines from fouling the bearing.
- Integral noise control for sound reduction to 85 dB(A) or less.
- Built-in safety features to reduce any potential for injury to personnel.
- Ease of access to cutting chamber for clean-out or servicing.
- Compliance with OSHA and ANSI specifications in addition to any and all relevant electrical codes.
- Magnets on the infeed to protect knives.

Granulation and collection: the future

Mounting a granulator on a recycling collection vehicle and bringing it to the generators of waste plastics is one of the current issues being addressed by various groups in the plastics recycling industry. The topic is controversial and many of the questions being raised lack definitive answers at this time.

It is, however, an accepted fact that volume is the single most difficult facet of plastics collection. Uncompacted plastics make up more than one-third of the volume on recycling vehicles, but total a mere 5 percent of recyclables by weight. Since collection costs represent the largest percentage of the total cost of a recycling program, volume takes on added significance.

Consider the following numbers:

- Uncompacted density of PET/HDPE = 35 pounds per cubic yard
- Compacted density of PET/HDPE = 100 pounds per cubic yard
- Granulated density of PET = 826 pounds per cubic yard
- Granulated density of HDPE = 513 pounds per cubic yard.

(A 5/16" diameter hole size screen was used for this test.)

While these numbers make a strong argument about the viability of truck-mounted granulators, many other factors need consideration:

- increased collection time
- separation of plastics before granulation
- power sources for equipment
- grinding capacity requirements
- size limitations on equipment
- maintenance of the equipment.

Despite these considerations, many people in the recycling industry believe that granulators will soon play a major role in the collection of scrap plastic materials where they are generated. RR

This article was reviewed by Sidney Rankin and Jose Fernandes of the Center for Plastics Recycling Research at Rutgers University and Andy Stephens of Eaglebrook Plastics in Chicago.