

Ask Joe! Column

Toll Processing, is it for you?

Guest article by Rick Ritter, Bill Mitchell, Dennis Sarno & Dan Bopp of Wedco Inc

What is “Toll Processing?”

Toll processing can be defined as performing a service on a customer’s product for a fee. In other words, for example say customer X would like to blend product A with product B at a 5% level by weight. He does not have the proper equipment to perform this function. He then sends product A and product B in separate containers to a toll processor. The materials are blended producing product C, placed in a new container, and sent back to customer X. Customer X pays a service fee to the toll processor usually in terms of \$/lb. of material processed.

What are the Advantages of “Toll Processing?”

There are many advantages and benefits of having products processed by a toll processing company. In many cases, the required process may be new to the company or they lack that particular capacity in their manufacturing facility. For example, company X may have produced product A for years for a specific market, but find that now they have a new market if they can only grind it finer, dry it, blend it with another product or package it differently. A toll processing company can give them the capacity or processing method they require to address this new market in a timely manor.

It is safe to say the advantages for outside processing are as varied as the applications, but listed below are some of the most common:

- No capital investment or depreciation.
- No extended lead times for equipment delivery and installations.
- No detailed engineering requirements.
- No floor space required.
- No maintenance requirement.
- No spare parts requirement.
- No additional personnel required.
- No new permits required for dust house discharge.
- Predictable costs.
- Quick turn around times.
- Working with a team of professionals who will strive to earn and keep you business.

In addition to these advantages, toll processing companies can be very good consultants. Typically a “Toller“ has processed a wide variety of materials under many conditions. This experience has provided a wealth of information concerning the many twists and turns associated with processing various materials. This information can prove very valuable in helping you to decide the best method in reaching your goals for a given size distribution, moisture content, or quality control procedure.

What Types of Services can be performed?

Toll processing can cover a number of services performed in the powders processing industries. Some of the more common services are:

1.0 Size Reduction - Size reduction can vary widely from pre-breaking/shredding to ultra fine grinding.

Size Reduction Grade	Particle Size (mm)
Coarse	< 100
Medium-Coarse	10
Medium-Fine	1
Fine	0.1
Superfine	0.025
Ultrafine	0.010
Colloid	0.005

There are many different types of size reduction systems to accomplish these requirements. Many factors effect the selection of the proper size reduction equipment for the application. Typically hardness and temperature limitations are a primary concern. In general hardness is associated with the Mohs Hardness Scale.

	Mohs Scale	Mineral
Soft	1	Talcum
	2	Salt
	3	Limestone
Medium Hard	4	Dolomite
	5	Apatite
	6	Feldspar
Hard	7	Quartz
	8	Topaz
	9	Corundum
	10	Diamond

Each system has its particular place such as materials it can process and particle range it can grind to. There is no universal grinding system that can do it all. It is very important that a toll processor has a variety of milling systems that will allow him to process material on the appropriate system as defined by the material, particle size requirement, abrasiveness, heat sensitivity, moisture sensitivity, explosiveness, etc. There are several categories of milling systems, and each has its particular characteristics.

1.1 Shredding - The process of reducing materials such as plastics purgings, wood scrap, cable, rubber scrap, used tires, etc. from bulk form to a 2-6" chip. The equipment required to perform this operation is normally large in size with intermeshing hooks and tines which tend to tear and cut the material. These units are driven by high horsepower electric or diesel power plants and rely on low speed and high torque to shred tough Materials. Typical application for this technology is in the scrap recycling business areas. Shredding is often a precursor to further size reduction.

1.2 Granulating/Rotary Knife Grinder - The granulator or knife grinder is the next step in size reduction if you need to reduce the material to j" - 1" size. The granulator normally consists of a set of rotating knives turning within a set of fixed knives. The fixed knives will most likely be two or three in number while the rotating assembly can have any number of blades depending on the size and function of the machine. The principle of the machine is to cut the material between the fixed knives and the rotating knives.

This type of machine will utilize a perforated metal screen below the knives to retain the material until it reaches the proper size. The screens are available in different sizes to allow for granulating to your particular requirement. The machines are available in sizes ranging from 2-3 horsepower up to hundreds of horsepower. They can be specially designed for a particular application such as recycling of thin plastic film or reducing full bales of rubber. Each application has its particular needs.

1.3. High Speed Impact Mills - This type of mill has many variations and can be used for grinding materials to the coarse to fine range, typically 10 - 200 mesh. Included in this category would be hammer mills, cage mills, pin-mills, turbo-mills, etc. They are available in sizes ranging from laboratory scale to production units. This type of mill relies on high speed impact of a rotating assembly with the material to be ground. This variety of grinding mill will normally rely on an integral retaining screen or actual rotating speed to control the size of the final product. One variation dubbed the counter-rotating pin-mill actually has two rotating assemblies that travel in opposite directions. This concept provides for a much higher relative tip speed or impact action. The end result will be the ability to grind materials finer than the single rotating pin-mill.

1.4 Air Classifying Mill - This is an air-swept mill that relies on high-speed impact for grinding, and an integral air-classification system. The air-classification system has an independently driven classifier wheel to control final particle size. The speed of the classifier wheel, and the flow of air through it, is adjustable to allow for changing the particle size. The range of particle size normally produced on this type machine is 150-400 mesh. The performance of air-classified mill can be enhanced through the use of heated or chilled air.

1.5 Attrition/Disc Mills - Attrition mills are normally configured with one stationary disc and one rotating disc. The discs will have some type of grinding surface such as machined teeth. The distance between the discs can be adjusted to allow for more or less grinding which changes the final particle size. The number, depth, and shape of the grinding teeth can also be varied to change the grinding results.

This type of grinding mill is commonly used for reducing polyethylene to a powder for the rotational molding industry. The system is commonly assembled to include in-line mechanical classification by shaker-type sieves with integral recycling of oversize particles. Large production systems can be several hundred horsepower and may incorporate double grinding chambers in one system. The grinding action is more of a shear or cutting action versus the impact action of a high-speed impact mill.

1.6 Jet Mills - In order to meet the requirements of the various industries, a toll processor must have the capabilities to produce ultra-fine grades of materials. Jet mills are a highly efficient method of producing powder products in this grade of particle size. The basic premise of the jet mill is to utilize the energy of a compressed gas to perform the grinding. The gas accelerates the material causing high speed particle on particle collisions. As a result the material grinds against itself ensuring product quality. With the expansion of the compressed gas a cooling effect takes place allowing heat sensitive materials to be processed without degradation.

Jet Mills are also commonly utilized for grinding abrasive products, producing a narrow particle size distributions and ensure product purity. There are three basic designs of Jet Mills: Fluid-Bed, Opposed-Jet, and Multiple-Port types. Some of these designs incorporate the use of a variable speed classifying wheel to control particle size.

1.7 Cryogenic Grinding - Size reduction with the assistance of liquid nitrogen or liquid carbon dioxide for heat control is a necessary capability for a toll processor. Many of the materials, which require size reduction, are not naturally brittle or have a heat sensitivity that can only be controlled through the use of cryogenic fluids. Certain materials can be ground at ambient temperatures to coarse particle sizes but require the cooling to be ground to fine sizes.

The use of cryogenics allows the toll processor to adjust the grinding temperature to any level required down to -300 eF if needed. These systems can also be utilized to grind materials that may have an inert gas atmosphere requirement. Cryogenic Grinding is a technology, which is adaptable to most types of grinding mills. A toll processor must have several types of mill at his disposal with cryogenic capability. There is no universal cryogenic grinding system that will give you the best results in every situation. Each mill type will grind certain products to certain sizes better than any other will. Knowing which system to use in each instance is the key to successful operation.

The equipment systems for cryogenic grinding are significantly different from those used for ambient grinding. The actual grinding mill functions are unchanged but the materials of construction, system sizing, controls, power requirements, safety, and operating procedures can be very different. Operators must be thoroughly trained on liquid nitrogen safety and the operation of cryogenic systems. There is also a requirement for a large vacuum insulated storage tank and the ongoing supply of cryogen from an industrial gas supplier.

2.0 Blending - A requirement of a supplier maybe to supply a product that is a mixture of multiple materials combined and repackaged as a new product. A toll processor offers a supplier an affordable alternative to installing costly equipment that would be used intermittently. Not only does a supplier save on the cost of equipment, but also allows for material to be purchased in bulk quantity for additional savings. As in all processes there are many alternatives in blending equipment. Proper selection of equipment is essential to produce a required end product. Certain equipment can cause more degradation or generate more fines than is acceptable. Other types of blenders can generate friction that can be detrimental to a heat sensitive product.

In most powder blending applications two types of blenders are utilized, mechanical-agitation type or a vessel-rotating type. The mechanical-agitation type employs a motor drive agitator while the vessel remains stationary. Examples of this type blender would be a ribbon blender or a conical screw blender. These types of blenders are capable of handling cohesive powders and allow for the addition of liquid. In some instances these blenders can be operated in a continuous mode. The V-mixer or double-cone mixer is a vessel-rotating type of blender. These are batch-type blenders, where the various components are charged into the vessel and sealed. The mixing process is accomplished by having the entire vessel rotating causing the powder to blend itself.

3.0 Classification - In the powder processing industry the demand for material with finer and sharper distributions are becoming the normal requirement. Many times the only way to accomplish this is to externally remove the unwanted fraction. A toll processor can offer these services and provide added value to existing products. Depending on the requirement, separation or classification can be accomplished by two different methods.

The use of sieves is the simplest and is primarily used for the coarse through fine grades of material. Sieving incorporates the use of screens of a particular size or mesh. Typically these units utilize vibration or air fluidization to maintain flow through the equipment. An advantage of this type separation is the ability to stack multiple screens thus providing various grades of product. The second alternative is air classification. Air classification uses the aerodynamic drag forces of the air to separate the particles. Many air classifiers use a vaned wheel for control of the particle size distributions. This technology is used for requirements in the fine to ultra fine grades of powder.

4.0 Compounding - Compounding refers to the melt mixing of a thermoplastic resin in an effort to enhance the polymer's final properties. Simple compounding can be achieved with the use of a Banbury-type mixer or a single screw extruder. More complex formulations may require more sophisticated equipment such as a continuous mixer or a twin screw extruder.

Toll processing offers the customer the ability to compound its specific formulations without having the large capital investment tied up in their own equipment. This is particularly advantageous during the product developmental phase when the end market demand is uncertain. Toll processors usually offer a range and size of equipment, which is suitable for trial runs through commercial production. This wide compliment of both auxiliary and primary equipment enables the toll processor the flexibility to reconfigure its lines to run a wide variety of materials.

5.0 Packaging - In an ever-changing business climate, customers are getting more sophisticated and critical about the material that they are provided. This is also true in the packaging types that they are demanding. Because of the wide variety of customers that a toll processor services, most have the capability to custom package the product in an array of packaging types. Most toll processors have the ability to both receive and ship materials in bulk railcars, bulk trucks, ocean containers, gaylord boxes, super sacks, drums and conventional bags. All these types can be custom labeled depending on the customer's specific requirements.

6.0 Procurement - The term procurement is when the toll processor purchases the specific raw materials that its customer needs to have processed. Once the processing has taken place, the customer is charged both the tolling fee and the raw material costs that went into the material that they are buying. This arrangement can be very advantageous, especially to a small customer where cash flow is important and their orders are relatively small. A toll processor can leverage its buying power to achieve larger discounts, which can be shared with the customer. This type of arrangement helps to build a strong relationship and loyalty between the customer and toll processor.

7.0 Warehousing - Since toll processors deal with a large number of customers, there is the need for adequate storage facilities to hold both the raw materials and finished product that they manufacture. As an added value to their customers, toll processors often offer additional warehousing and storage to their customers beyond the normal processing turnaround. This enables the customer to limit the freight costs involved while shipping the processed materials directly to their plant or end customer while bypassing a centralized warehouse.

8.0 Testing Services - Since toll processors are always looking for new business, it is essential that they incorporate pilot testing equipment in their facilities. These scaled down versions of commercial equipment allow the customer to run economical quantities of material for evaluation prior to going to full-scale production. By running these small tests, the toll processor can evaluate the material in a controlled environment and can often predict how a material will behave if it reaches commercial quantities. With this type information, future equipment modifications can be realized and processing parameters can be defined. Pertinent data such as expected throughput rate and estimated tolling cost can be given to the customer at this time to help them define their product costs.

9.0 Analytical Services - Quality assurance is an integral part of toll processing. With the variety of materials being handled a toll processor must have the capabilities to analyze the end product to the customers standards. A fully equipped analytical laboratory is required to meet these strict demands. The laboratory should offer a variety of instruments including air jet sieves, "Ro-Tap" sieves, and laser diffraction equipment for both wet and dry analysis. In addition specialty instruments such as Hegman or NIPRI gauges, which are primarily used for the paint and ink industries, should be available. A properly equipped analytical laboratory will insure that the material being processed will meet a customer's quality assurance standard.

Selecting a "Toll Processing" Company

Selecting a company to process your product is not as simple as choosing the one who is closest and/or cheapest. Bear in mind that it is likely that the processor you select will be the final sentry between product defects and your customer. In essence, the custom processor is an extension of your company and your "partner in quality".

Assuming you have found the company that can handle your specific processing needs, it is critical to review quality assurance and quality control procedures. The potential for problems in any process is great whether done outside or in house. Only the most experienced and diligent companies will be able to avoid contamination, off-spec material, over-weight or under-weight, late shipments and the like. The ability to trace your product from the time of arrival through the time of departure is critical. This is standard procedure for many custom processors.

When possible, a visit to a processing plant is a good idea. This should give you a clear picture of what your product will be exposed to and how it will be processed. In the vast majority of cases, a feasibility test will be required to determine pricing for large batches or continuous runs. If possible, try to have detailed specifications on maximum particle size, distribution or average size, moisture content, bulk density, temperature limitations, etc. Having this information will speed up the testing procedure considerably.

The final decision on contracting out your material processing and your choice of a processor, will be based on whether or not they will make your life easier, reduce your risk, give you a competitive advantage, and add to you bottom line. Many companies large and small find this option fits their needs.

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Welcome to Ask Joe!, a monthly column by our resident materials handling guru, Joe Marinelli of Solids Handling Technologies. Joe addresses the issues that bug you the most. And Joe knows!! Formerly with Jenike & Johanson, Solids Flow and Peabody TecTank, Joe is an expert on materials handling.

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Guest articles for the **Ask Joe!** Column are always welcome, for more information please contact Joe Marinelli directly at his email address: joe@solidshandlingtech.com.

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