Exciting new options exist for the successful recycling of construction and demolition debris.

Numerous communities are attaining remarkable levels of waste recovery by processing construction and demolition debris. And, as discussed in this article, new processing systems have been developed that reduce processing costs and generate high-quality recovered material. This article focuses on the technology used to process construction and demolition debris. The following article examines the various types of equipment used to process construction and demolition materials.

Process technology
The processing strategy for construction and demolition (C&D) debris, and thus the equipment for sorting and size reduction, is primarily determined by the composition of the construction and demolition debris and the end uses for the recovered material. Composition refers not only to the type of material, but also to the form in which it is received (clean or mixed). Most C&D recovery facilities charge tipping fees that vary by the degree of cleanliness or the mix of the incoming materials.

Historically, C&D processing has involved the recovery of a few select materials through the use of low or intermediate technology. This is changing; more and more operations are employing higher technology to recover a greater portion of the waste stream.

Low technology
The traditional means of recovery uses little or no process technology. These include:

Salvaging. Salvaging can be considered a low technology where source separation is performed at the C&D site. Contractors sometimes separate items that can be sold or dumped at little or no cost. Metals, concrete and dirt are items frequently targeted by contractors.

Dump and pick. This is an old, common practice for the recovery of a limited amount of material. The primary reason for dumping and picking is to reduce the general bulkiness of C&D material. In this method, material is simply dumped on the ground and run over with heavy equipment. During the process, workers hand pick items that can be recycled.

Introduction to advanced technologies
Before embarking on a discussion of intermediate and high technology processing, a few general comments need to be made.

Most C&D processing systems are modular by design and can be added to or subtracted from as needed to address the components of a particular waste stream. For example, some C&D processors receive only rubble (soil, rock, concrete, asphalt, etc.) and therefore need only an impactor, front-end loader and possibly some screening equipment.

The density of C&D debris varies dramatically. Material composed mainly of rubble can approach densities of 2,000 pounds per cubic yard. Conversely, material con-

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taining large amounts of brush, insulation or drywall can have densities as low as 250 pounds per cubic yard. If a single number is needed for an approximate density for mixed C&D waste, 1,000 pounds per cubic yard is a reasonable estimate.

Regardless of the processing technology used, all mixed material should be presorted as much as possible by judicious tipping and picking with front-end loaders, etc. Generally, bulky items that are often presorted include major pieces of rubble or wood, white goods, furniture, and undesirable materials, such as carpet and tires.

It is important to note that with all mixed loads, the cost of separation versus disposal of the mixed fraction must be weighed. Certain loads may be so contaminated or mixed that separation may not be viable and disposal may be the only economic alternative.

**Intermediate technology**

This technology works well for operations that accept only one or two types of C&D debris. This debris consists of a large percentage (80 percent to 90 percent) of a relatively small number of fairly clean materials (e.g., rubble, wood). This debris is considered clean if large volumes are delivered for processing in a form that is easily separable into single waste types. In other words, the different materials can be dumped into separate piles or pre-sorted with a front-end loader. Roadway and site conversion projects generate waste that fits into this category.

A typical approximate composition of the material received by weight is:

- rubble, 40 percent
- concrete/asphalt/soil/rock, 20 percent
- wood, 30 percent
- metals/plastics, 10 percent

An expensive processing system is not needed for clean, separated material, because the primary reduction equipment alone can provide quality end products. Primary reduction equipment used to shred this material has large throughput capacities. Impactors and jaw crushers used to crush rubble can process anywhere from 50 to 400 tons per hour, depending on machine size and the characteristics of the rubble. The throughput of the hammermills and stump grinders used to shred wood typically range between 10 tons and 50 tons per hour.

The typical system capacity for this type of debris can range between 50 tons and 200 tons per hour. The sorting components of the system give access to the mixed material fraction of the waste stream. The type and nature of the mixed material determines one of two basic processing strategies:

- sort and separate, then crush and reduce
- crush and reduce, then sort and separate.

The decision to sort first or to crush first depends on the nature of the mixed material. Clean rubble and wood can be fed directly to an impactor and hammermill for reduction. In cases where mixed material contains any significant amount of plastics, paper, rags or other contaminants (paint, lead pipe, etc.), it makes sense to sort and separate and then crush and reduce. The combination of a disc screen and trommel can remove the fine soil and small rocks. Any contaminants, oversized rubble, and ferrous and non-ferrous metals can be removed with magnets and by picking, leaving medium-size rock and wood to be reduced.

In cases where this material is fairly clean with a large portion (80 percent to 90 percent) consisting of rubble and wood, it may be acceptable to crush and reduce, and then sort and separate.

**High technology**

This type of technology is used by operations which attempt to process most or all of the C&D material. A good example of a commingled stream is waste generated from building and C&D activities.

A typical composition of commingled C&D waste, by volume, might be:

- rubble, 25 percent
- wood, 33 percent
- metals 20 percent

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Commingled C&D debris requires more hand sorting, which can lower system throughput dramatically. Facilities that receive urban building demolition waste and process 500 tons per day or more would be considered fairly large. The cost of such a facility can range from $3 million to $5 million.

In almost all cases, it is important that commingled C&D debris be sorted and separated before being crushed. This debris may contain asbestos, paint, lead pipe, etc. that could become fragmented if crushed, thus contaminating large amounts of material or causing environmental concerns.

After the bulky material is removed by presorting, the mixed material is introduced to the system for separation and sorting. Building demolition processors have found that an effective first step for mixed material processing is to separate the soil and rocks before hand picking the cleaned and uncrushed recyclables (sort and separate, then crush and reduce). This can be achieved by a specially designed trommel or disc screen system to separate two fractions of soil and rocks. Additional screening and air classification can be performed, if needed. Hand pickers then recover the various recyclables on a sorting platform.

In some instances, this type of process has been shown to increase the efficiency of hand pickers and improve the recovery rate of recyclable materials, such as wood, metals and corrugated paperboard. In addition, the soil and rock fractions tend to be free of pieces of plastic, paper and other materials that are undesirable for fill or aggregate material. The recovered wood fraction can be shredded into a marketable form. Crushing, screening and further classification of the cleaned rock can be performed, if required by local markets.

When the remaining wood is mixed with rock, a flotation tank is sometimes used to separate the wood (which floats) from the rock (which sinks). With large amounts of rubble material, the water tends to clean the product, which is beneficial. It should be noted that an air classifier could also be used to separate the lighter wood from the heavier rock. An air system costs more to operate because of the 50-h.p. to 75-h.p. blower that is required.

Depending on the type of material and the local environmental regulations, however, the wash water from a flotation tank may require treatment before discharge to a sewer or septic system. This could be costly and make the air system more attractive. It should also be noted that a flotation tank is not effective for separating mixed materials that contain numerous components (e.g., wallboard, insulation, wood, rubble, ceiling tile), because they typically contain more fibrous contaminants, which become soggy.