



## Comminution of Forest Based Tree Biomass

*In pulp and paper making, biorefinery processes and energy production, forest biomass has to be comminuted. Homogeneous particle size is a must for optimized pulp quality and also in small-scale energy production. Chip size and shape effect on the flowability of the material and storage process. Chip quality, in terms of chips size, is affected by wood freshness, drying and icing and machine type, wear and configuration. Chippers and grinders are typically used in the comminution of tree-based assortments. Diesel operated mobile machinery is used commonly in energy production whereas stationary electrically operated chippers are used at pulp mills, but stationary grinders located at a power plant are also used.*

### PARTICLE SIZE MATTERS

To utilize a tree in pulp and papermaking, biorefinery processes or in energy production, the particle size has to be reduced, i.e. wood has to be comminuted. In pulping, homogeneous particle size is a must for optimized pulp quality and process yield. Particle size requirements at heat and/or power plants, especially in small ones, are strict to guarantee that material feeding systems and combustion processes are performed at high efficiency.

Chip size and shape have also effect on the flowability of the material and on the circulation of air in a chip pile, which has effect on chip drying and deteriorating in a pile, for example. Chip quality, in terms of chips size, is affected by wood freshness, drying and icing and machine type, wear and configuration.

### COMMINUTION MACHINES

Chippers and grinders are typically used in the comminution of tree-based assortments. Diesel operated mobile machinery is used commonly in energy production whereas stationary electrically operated chippers are used at pulp mills, but stationary grinders located at a power plant are also used.

Some limitations on the machine structure are set by requirements the mobility brings for machinery installed on wheels: the mobile machine has to be easy to use and overhaul in different operational and environmental conditions, the machine has to be robust, the feeding system is manual and the weight, for example is limited in mobile machines.

This results that mobile chippers produce more irregular chips, compared with the stationary equipment installed at pulp mills.

### Chippers

A chipper uses sharp knives to cut a tree to small pieces. Chippers are used in pulp manufacturing to reduce particle size. Mobile versions of chippers can be used to chip roundwood and forest residue bundles in a terminal.

In a disc chipper, sharp knives are mounted on a flat disc. The wood is pressed against the disc and the knife cuts the chip that passes the slot located next to the knife. A disc chipper produces homogeneous chip quality but is mostly suitable for clean roundwood comminution.

In a drum chipper, knives are mounted on an exterior face of a horizontal drum. The wood is pressed against the drum and as it rotates, the knife cut the chip and the pocket located next to the knife collects the chip. In addition to roundwood, a drum chipper is suitable for processing logging residues.

Compared with a drum chipper, a disc chipper produces more uniform particle size distribution because the angle the knife cuts the wood remains the same through the cutting operation. In a drum chipper, instead, the angle the knife meets the wood changes with the tree cross section resulting in a non-uniform particle size and shape.

A chipper is prone to impurities such as sand and stones those damage and blunt knives. When knives become blunt, smaller chips and fines are produced and chipper energy consumption increases.

### Grinders

Grinders (the term 'crusher' is also used) utilize blunt tools, installed on a rotor, to comminute wood. Repeated

impact caused by these tools break the wood structure and reduce particle size. Grinders aren't very prone to impurities and thus are suitable for stumps and other materials that may contain high amount of sand and stones.

On the grounds of the feeding system, wood grinders can be classified to horizontal grinders and tub grinders (vertical grinders). Tub grinders are better in processing short and very contaminated materials.

Grinders can also be classified as low-speed grinders and high-speed grinders. Low-speed grinders are more suitable for more contaminated materials but high-speed grinders provide higher capacity.

Compared with a chipper, a grinder produces more inhomogeneous particle size and shape, and the energy consumption of the grinder is higher. The term 'hog fuel' is used for energy wood manufactured using blunt tools as it is in a grinder.

#### Chunkers

A chunker (screw chipper and disc chunker) can be used to produce large wood particles, chunkwood, to be utilized in energy production.

A sharp cutting blade having the shape of a screw cuts the roundwood to small pieces. The edge of the screw is sharp and when roundwood is pressed against, it cuts the wood to pieces.

The particle size the chunker produces can be changed by changing the angle of the helical cutting edge. A chunker produces particles of uniform length (50-250 mm) but variable cross-sectional area - the biggest having the

diameter of the tree cut. A chunker is suitable only for the comminution of delimbed roundwood or slabs from a sawmill.

#### Chredders

Particle size reduction in a shredder is based on cutting: Cutting blades are attached to the slowly rotating shaft. A wood particle is pinched between cutting blade and anvil resulting in decreased particle size.

The rotational speed of the shaft can be very slow, that protects the machine against impurities, but high speed shredders for clean material processing are also available. Shredders are widely used in waste wood processing but can also be used for stump processing.

Depending on the machine configuration, a shredder can produce wide range of particle sizes and thus it can be used as primary comminution stage prior to grinding or as fine-shredder.

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