Storing Woody Biomass

FACT SHEET 4.6

INTRODUCTION

In the southern United States, woody biomass for energy is typically harvested, pre-processed, transported, and used, all within several days. Storage capabilities are still needed, though. This is primarily due to supply and demand imbalances that relate to holidays, inclement weather, energy prices, and others[1]. Careful, well-thought-out storage of woody biomass harvested during excess production and delivery when demand exceeds supply is an important step to ensure a reliable, continuous supply of feedstock or raw material. In addition to highlighting woody biomass storage tips, this fact sheet provides a brief description of the advantages and disadvantages associated with storing biomass in its assorted forms.

Storing Logging Residues. There are several advantages to storing unconsolidated woody biomass immediately after harvest. When stored unconsolidated in mounded piles of moderate size, leaves and needles can fall, reducing the material's ash content[2]. Moreover, when woody biomass is stored in smaller piles, transpirational drying occurs (i.e. moisture escapes through leaves and other open wood surfaces). This process lowers the moisture content and fosters the desired outcome of "the drier the material, the higher the heating value." Transpirational drying occurs when biomass is stored in windrows as well, but it is not as efficient as small piles because foliage is not allowed to drop[2]. Please see Fact Sheet 4.4 for more information on drying. Additionally, when stored on the harvesting site, vital nutrients are released back into the soil. The major disadvantages to storing woody biomass immediately after harvest on-site are 1) the need for detailed inventory tracking, 2) the cost of forgoing reforestation until the piles of

LOGGING RESIDUE STORAGE TIPS[2]

1. Construct piles so they are mound shaped and not too tall.
2. Piles should be no larger than 10 ft wide at base and no taller than 6.5 ft.
3. Locate piles in an open, well-ventilated place so that wind and sun can help dry the material.
4. Locate piles on the harvested site so that nutrients from needles and foliage can be returned to the soil.
5. Stack residue at right angles to the direction of prevailing wind.
6. Cover pile with reinforced paperboard to protect from rain and snow.

Figure 1. Logging Residue Storage Tips

Ashton, S.; B. Jackson; R. Schroeder. 2007. Storing Woody Biomass. Pages 149–152.
In: Hubbard, W.; L. Biles; C. Mayfield; S. Ashton (Eds.). 2007. Sustainable Forestry for Bioenergy and Bio-based Products: Trainers Curriculum Notebook. Athens, GA: Southern Forest Research Partnership, Inc.

biomass have been removed, and 3) the cost and time-sensitivity of having a contractor return to the site to collect, pre-process, and transport the material to the wood-using facility *(Figure 1)*.

Storing Comminuted Material. Mills and other wood-using facilities keep chip or sawdust piles on-site or at nearby facilities when supply is low. The ideal storage period is determined by each facility's woody supply situation, but typically varies between two and six weeks[3] *(Image 1)* .


source: Corbis Corporation

Image 1. Chip Pile

Woody biomass is reduced in size in the forest and then transported for storage, or it is transported, reduced in size at the mill, and then stored. The resulting material, usually chips, is stored outside in large piles and under cover in large silos or bins. Chips stored in bins are typically to be used within several hours or days while silos are used for longer-term storage needs. Silos and bins protect against contamination while at the same time allowing for uniform feeding and metering of the material *(Figure 2)*.

While storing, comminuted biomass makes handling and transport relatively easy. If not managed carefully, the biomass will succumb to dry-matter loss and in some cases self-ignition[4]. High temperatures and acetic acid odor are signs that a chip pile is in danger of dry-matter loss and self-igniting[3]. Additionally, chip piles with excessive mold and fungi growth can lead to health risks for humans.

CHIPPED MATERIAL STORAGE TIPS[3]

1. Maintain pile height below 50 ft.
2. Restrict tractor spreading of just-delivered chips to a minimum.
3. Mix species of different deterioration rates only as needed, especially fast-deteriorating hardwoods and full-tree chips.
4. Store dirty or full-tree chips that contain bark and foliage in piles less than 25 ft high, and for less than 2-4 weeks.
5. Avoid mixing fine particles (e.g. sawdust, shavings, and chip fines) in chip piles, particularly where layering can occur.
6. Monitor pile temperature routinely.

Figure 2. Chipped Material Storage Tips

Dry-Matter Loss. Dry-matter loss, which is the degradation of lignin, cellulose, and hemicellulose, occurs when wet woody biomass, in any form, is not used immediately. The degree to which dry-matter loss occurs depends largely on the material's moisture content. Woody biomass having high moisture content is more susceptible to colonization by fungi and mold and at a faster rate[2]. These microorganisms, via metabolic activity, generate heat, which in turn accelerates oxidation, moisture adsorption, hydrolysis, pyrolysis, and other chemical processes resulting in dry-matter loss. Additionally, although rare, heat generation, in some cases, leads to self-ignition.

Two studies carried out in Sweden[5] [6]observed dry matter loss in stored woody biomass. Green chips stored in a large pile for seven months lost about 12 percent of their dry matter and bark stored in a large pile for six months lost about 26 percent of its dry matter. The dry-matter loss in the bark pile resulted in a 20 percent decrease in energy content.

Dry-matter loss is particularly a problem in chipped material because 1) chipping increases the area of exposed surfaces on which microbial activity can occur; 2) the small particle size gained by chipping restricts air flow and prevents heat dissipation; and 3) chipping releases the soluble contents of plant cells providing microbes with nutrients[2]. Increases in ash content due to dry-matter loss are also higher with chipped material, although the reasons for this remain unclear[2].

Health Risks. Fungi and bacteria begin colonization almost immediately after constructing a pile of woody biomass. This occurs regardless of comminution. The rate at which this occurs and the types of fungi and bacteria that exist depend on moisture content, wood composition, particle size, pile form, pile size, as well as storage duration[2]. Large piles of chipped material tend to have higher growth rates and varieties than other material piles. Handlers may want to take extra precaution when working with chip piles that have been stored for an extended time or chip piles that are clearly moldy. When handling this material, a ventilated helmet fitted with a filter effective against particles smaller than 5 µm in diameter will prevent the negative effects of exposure[2].

Storing Bundled Material. Woody biomass can be bundled and stored under cover to gain the advantages (ease of handling and transport) that come along with storing chipped material. At the same time this approach protects the material from the disadvantages that come along with chipped material: dry matter loss, moisture retention, heat generation, and health hazards[2]. Logging residues should be allowed to dry during the summer months before being bundled and stored[2].

Storage of woody biomass in various forms offers a solution to issues at the end-user location when demand exceeds supply, ensuring a continuous, year-round supply of feedstock. The most common form of storage in the Southeast is chip-pile storage. Shortening the storage time of chipped material will minimize the risk of chemical or microbial decomposition, minimizing the risk of dry-matter loss, heat generation, and health risks[6].

For more information, please refer to the Encyclopedia of Southern Bioenergy at http://www.forestencyclopedia.com/Encyclopedia/bioenergy.

ENDNOTES

1 Rupar, K.; Sanati, M. 2004. The release of terpenes during storage of biomass. Biomass and Bioenergy. 28(1): 29–34.

2 Richardson, J.; Bjorheden, R.; Hakkila, P.; Low, A.T.; and Smith, C.T. (Eds.). 2002. Bioenergy from Sustainable Forestry. Boston, MA: Kluwer Academic Publishers.

3 Fuller, W.S. 1985. Chip pile storage — a review of practices to avoid deterioration and economic losses. Tappi. 68(8): 48–51.

4 Nurmi, J. 1999. The storage of logging residue for fuel. Biomass and Bioenergy. 17(1): 41–47.

5 Thornqvist, T.; Jirjis, R. 1990. Changes in fuel chips during storage in large piles. Upsalla, Sweden: Swedish University of Agricultural Sciences, Department of Forest Products. Report No. 219.

6 Fredholm, R.; Jirjis, R. 1988. Seasonal storage of bark from wet stored logs. Uppsala, Sweden: Swedish University of Agricultural Sciences, Department of Forest Products. Report No. 200.

7 Wolfaardt, F.; Rabie, C. 2003. Evaluation of the microclimate in a stored softwood chip pile for biopulping. Holzforschung. 57(2003): 295–300.