Technological Processes: Bio-chemical

FACT SHEET 5.3

INTRODUCTION

Woody biomass is converted into useful forms of energy (i.e. solid, liquid, or gaseous fuels) as well as useful products (e.g. polymers, bio-plastics, char, pellets, and acids) using a number of different technological processes. Bio-chemical production processes depend on biological and chemical processes as a means of extracting or creating products and energy. This fact sheet briefly covers the three main bio-chemical conversion and production processes employed today for obtaining bio-based energy and products from woody biomass.

Aerobic Digesting (Composting). Sawdust and wood chips are the most common types of woody biomass used in aerobic digestion. In this process, organic wastes are collected from mill lagoons, where naturally occurring bacteria use oxygen to convert the waste into carbon dioxide, water, energy, and more bacteria. Additional feedstock and water mix with aerators daily to ensure constant turnover of the sludge. This process can be expensive as well as energy demanding because of the need for constant mixing. Nutrient-rich fertilizers and composts are the major product that results from aerobic digestion of woody biomass. (*Figure 1*)

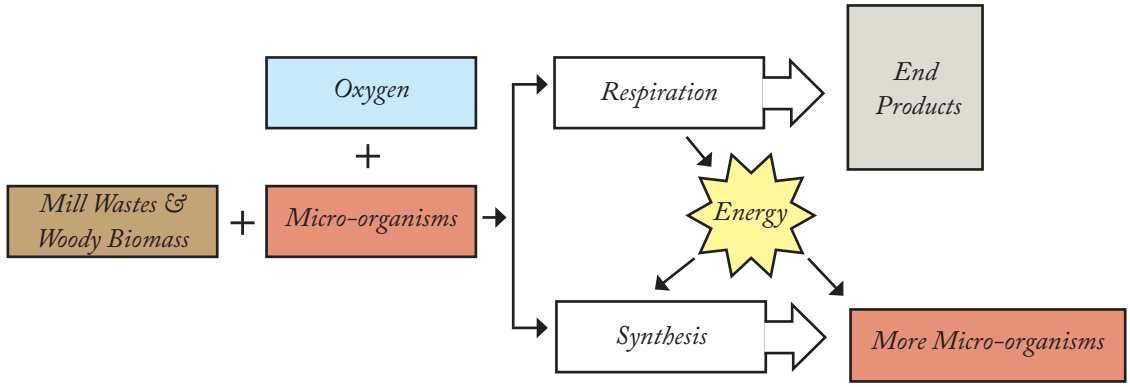

Figure 1. Aerobic Digestion Schematic

Cassidy, P.; S. Ashton. 2007. Technological Processes: Bio-chemical. Pages 173–176.
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.

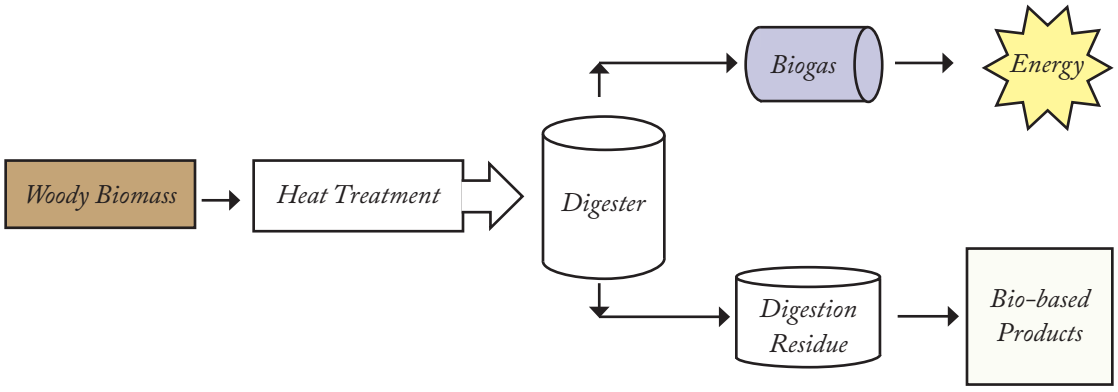

Figure 2. Anaerobic Digestion Schematic

Anaerobic Digestion. Anaerobic digestion is the decomposition of biomass by bacteria in the absence of oxygen. Biogas, or methane, is the primary product produced. Anaerobic digestion is governed by several factors, including temperature, retention time, chemical composition of the influent, and presence of toxicants. These factors, in turn, affect quantity and quality of the biogas produced.

Not all streams are appropriate for anaerobic digestion. The higher the fat content in the feedstock, the more biogas can be produced. Some feedstocks, such as feedstocks high in lignin, require longer retention times or higher concentrations of bacteria[1]. New technologies are looking to increase yields and decrease process time by adding ultrasound technologies to the process. Commonly referred to as sonication, waves disintegrate the solids in the influent. This, in turn, increases surface area and allows for more complete and quicker digestion[2] (*Figure 2*).

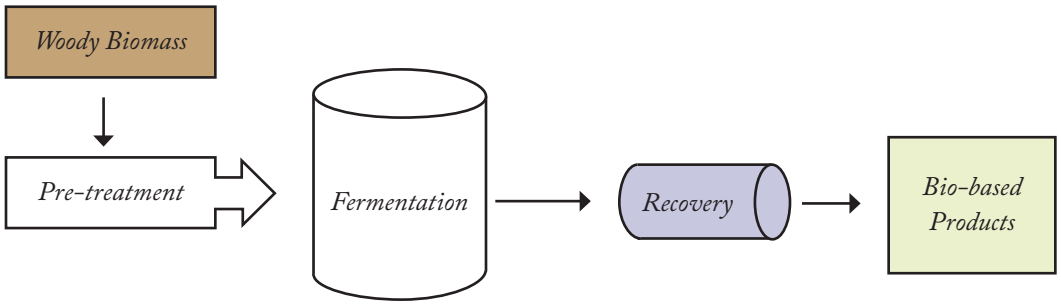

Figure 3. Fermentation Schematic

Fermentation. Fermentation is a biological process in which enzymes produced by microorganisms cause chemical reactions to occur. An enormous variety of bacteria, yeasts, and fungi exist to ferment sugars. These microorganisms digest sugars to produce the energy and chemicals they need for survival while giving off byproducts such as carbon dioxide, organic acids, hydrogen, ethanol, and other products. Producing commercial products through fermentation of lignocellulosic material is a multi-step process involving 1) pre-treatment and hydrolysis (deconstruction of a compound by reaction with water) of the material to release fermentable simple sugars; 2) fermentation of these sugars by living organisms to produce hydrocarbons; 3) recovery from the fermentation broth of the desired products; and 4) utilization of the byproducts[3]. (*Figure 3*)

Fermentation is also used to produce ethanol as well as commercial levels of therapeutic and research enzymes, antibiotics, and many more intermediate and specialty chemicals involved in the make-up of industrial and consumer products. The by-products of lignocellulosic fermentation are also valuable. Residual cellulose and lignin serve as boiler fuel for electricity or steam production. Gases such as carbon dioxide are often captured for sale to the beverage industry. Some recovery methods generate large volumes of solid materials such as gypsum, which is used as a soil amendment.

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

ENDNOTES

1 Simons, G. 2004. California's dairy power production program. National AGSTAR Conference. St. Louis, MO.

2 Yoshitani, J. 2003. Centralized systems and enhanced technology. Biocycle Renewable Energy from Organic Recycling Conference. Minneapolis, MN.

3 Van Hoek, P.; Aristidou, A.; Hahn, J.J.; Patist, A. 2003. Fermentation foes large scale. Biotechnology Progress. January 2003.