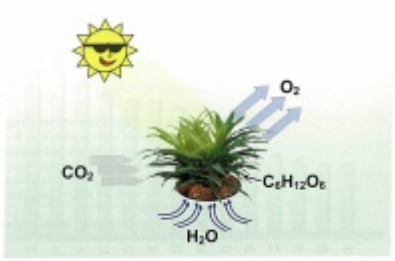
Homeowners: Wood Energy and Pellet Burning

From RVR

Wood Energy and Pellet Burning

To fully understand how wood pellet heating works, it is important to have a little bit of knowledge about the theory of wood heating.

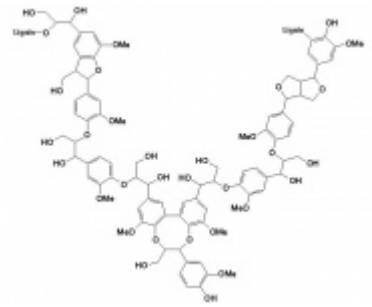
What is biomass (wood)?



Biomass (wood) is produced by photosynthesis. This takes place in the leaves of plants where chlorophyll is involved in the process of converting carbon dioxide and water into sugars and starches. These are also called carbohydrates. The process of conversion requires energy. This energy comes from sunlight. The energy contained in wood originates as solar energy.

Photosynthesis combines CO2 and H2O to produce carbohydrates and oxygen

What is wood?



Wood is hard, fibrous, lignified structural tissue produced in trees. The "raw material" for the lignin are the carbohydrates produced by photosynthesis.

Types of Wood

Wood is commonly classified as either softwood or hardwood. The wood from conifers (e.g. pine) is called softwood, and the wood from broad-leaved trees (e.g. oak) is called hardwood. These names are a bit misleading, as hardwoods are not necessarily hard, and softwoods are not necessarily soft. The well-known balsa (a hardwood) is actually softer than any commercial softwood. Conversely, some softwoods (e.g. yew) are harder than most hardwoods.

Examples of European hardwoods from evergreen trees include holly.Common deciduous European and North American hardwood species include the oaks (Quercus species), beech (Fagusspecies), ash (Fraxinus species), maple (Acer species) and cherry (Prunus species).

Important tropical hardwoods include teak (Tectona), mahogany (Swietenia), iroko (Chlorophora excelsa), ebony (Diospyros ebenum) and rubberwood (Hevea brasiliensis).

A hardwood tree

Wood Fuels

A softwood tree

Firewood

Wood Chip

Pellets

Briquettes

Wood fuels can take a number of forms. These include Firewood, Wood Chip, and densified wood such as Pellets or briquettes

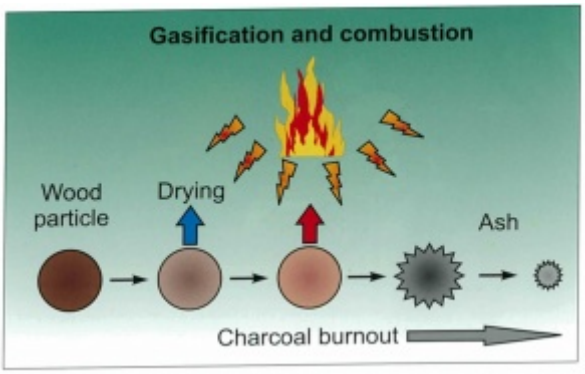
Energy Contained in Wood

Typically, freshly cut wood is as much 60% water. If you burn freshly cut wood, it will use nearly all the energy it contains to evaporate the water.

As a result, it is important to burn dried wood only. A log which is naturally air-dried will have about 12-18% moisture.

A wood pellet should always contain less than 10% as it is artificially dried.

How does wood burn?



There are several stages in wood combustion. These are heating, drying, gasification and charcoal burnout.

The wood is first heated and water evaporates from the surface. Heat is absorbed during this stage. The wetter the wood, the more heat is wasted in drying it. This is followed by gasification. The flames of a wood fire are due to combustion of gases released by gasification, not combustion of the wood itself.

There are two stages of gasification; pyrolysis and gasification.

Pyrolysis begins at about 150C. It absorbs some heat and does not require any oxygen. It produces tar compounds and gases such as CO and hydrocarbons.

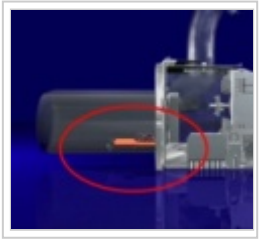
Gasification under the influence of oxygen starts at about 230C. Approximately 80% of the weight of the dry wood is converted to gas.

The remaining part becomes charcoal which is burned out between 500C and 700C. The incombustible impurities become the ash. The ash in wood is mainly due to soil and sand absorbed in bark and a smaller proportion comes from salts absorbed during the growth of the tree.

Burning pellets

Pellets burn using a similar process to the process described above.

The pellets drop into the pellet burner



A small element heats the pellets until they ignite

The pellets burn. More pellets are fed. Repeat.

Because the pellets generally have a very low bark and impurity content, they burn quite cleanly and leave behind a minimum amount of ash.

Further Reading

Read on about wood pellet boilers here: Homeowners:Wood_Pellet_Boilers