Wood…A New Look at an Old Fuel
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Wood

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Wood has been a traditional source of fuel for many years—as a heat source for warming the cave, tent or home and to provide heat for cooking. The use of wood as a fuel was not confined to the home but was also important in industry and transportation. In Michigan's heyday of lumbering, wood was used to heat the boilers which furnished steam for the sawmill. Wood burning locomotives were extensively used in the mid-to late-1800s.

The use of wood as a source of fuel began to decline in the late 1800s due to the availability of coal, and later oil, natural gas and electricity. This change occurred first in urban areas both for industrial and home uses. But the decline continued into rural areas where today only a small percentage of homes use wood as a primary heat source, although many have fireplaces (Figure 1). There were a number of reasons why the use of wood decreased, however, a shortage was not one of them. Rather, the availability and easier handling of oil, gas and electricity, development of easily controlled and efficient burners, high labor input for wood production, and adaptability of other fuels to mechanization were involved.

Today, we are faced with a general shortage of energy. Oil and gas deposits are either being depleted or becoming unavailable and coal, while abundant, creates serious environmental problems in mining and production. In searching for alternative sources of energy available to the homeowner, fuelwood should not be overlooked. It is unlikely that fuelwood will be the principal heat source for homes and industry in the near future, however, its use as a supplemental energy source can be expected to increase. In this bulletin, we will examine the heat value, purchasing, storage, and production characteristics of wood as a supplemental heat source in the home.

SUITABILITY OF WOOD

The historical use of wood as a fuel has not been due to its overall advantages when contrasted to those of other fuels, but instead is a reflection of its low cost and ready availability. This has been especially true in rural areas. However, a new look at wood reveals it does have definite advantages, particularly considering the unavailability of other forms of energy. Some advantages include:

a) clean, nearly pollution-free combustion
b) easy to ignite, burns rapidly
c) readily available, product of a renewable resource
d) low energy requirement for production
e) requires no special facilities for storage

To be sure, there are also disadvantages in the use of wood, and it is largely these problems which have favored the use of other fuels. It is now possible, however, that some of these drawbacks are less limiting than when alternative fuel sources were abundant and inexpensive. Disadvantages most commonly expressed include:

a) difficult to control rate of burning
b) relative low heat value per unit of volume
c) quality and heat value is variable
d) requires large area for storage
e) bulkiness and labor input restrict transportation over long distances
f) difficult to mechanize continuous feeding

It is possible that some of these disadvantages such as variability in the rate of burning can be overcome with improvements in design of burning units. Similarly, conversion to charcoal or chips might be helpful in improving quality and eliminating bulkiness. These considerations must await developmental changes in burning units and wood production techniques. Until such developments occur, we will continue to use wood in the traditional form as a fuel for fireplaces and for supplemental heating.

The heat value of wood is variable, being influenced by species and moisture content. Heat values in BTU's for species commonly used in Michigan are presented in Table I.

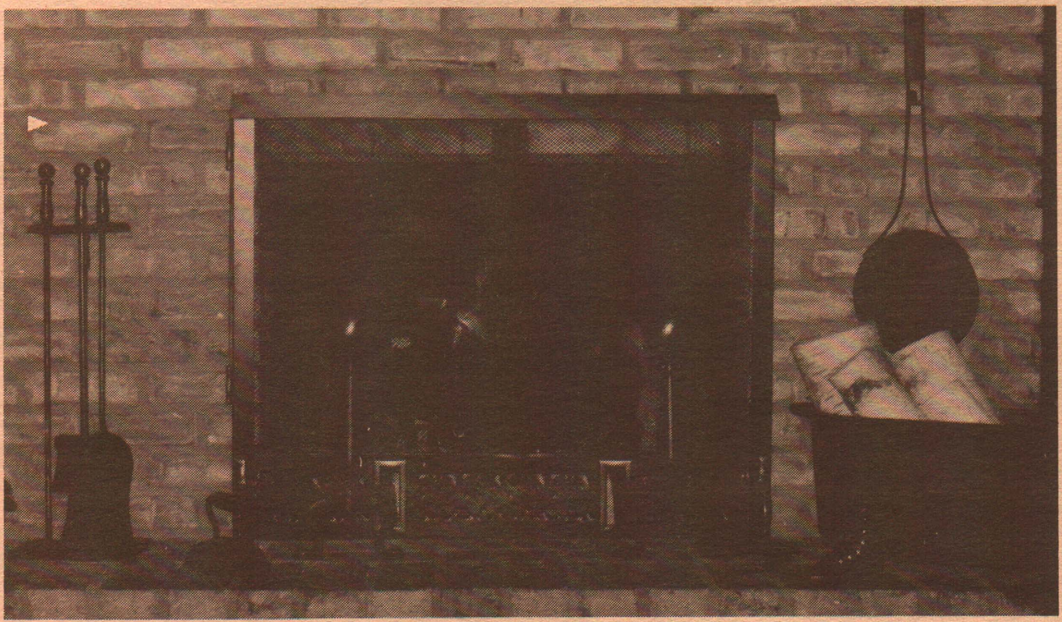

Figure 1. Fireplaces are common in many homes built within the past few years. Most are not depended on for a source of heat, but rather are constructed for decorative purposes.

Figure 2. Fuelwood is u face cord. The dimensions of a inches. Log lengths may vary

Table I. Approximate weight and heating value per standard cord (80 cubic feet of solid wood) of different woods in green and air-dry (20 percent moisture) conditon.

Woods	Weight, pounds		Available heat, million Btu		Equivalent in coal tons	
	Green	Air-dry	Green	Air-dry	Green	Air-dry
Ash	3,840	3,440	16.5	20.0	0.75	0.91
Aspen	3,440	2,160	10.3	12.5	0.47	0.57
Beech, American	4,320	3,760	17.3	21.8	0.79	0.99
Birch, yellow	4,560	3,680	17.3	21.3	0.79	0.97
Elm, American	4,320	2,900	14.3	17.2	0.65	0.78
Hickory, shagbark	5,040	4,240	20.7	24.6	0.94	1.12
Maple, red	4,000	3,200	15.0	18.6	0.68	0.85
Maple, sugar	4,480	3,680	18.4	21.3	0.84	0.97
Oak, red	5,120	3,680	17.9	21.3	0.81	0.97
Oak, white	5,040	3,920	19.2	22.7	0.87	1.04
Pine, eastern white	2,880	2,080	12.1	13.3	0.55	0.60

Data from the U.S. Forest Products Laboratory. Heat value of coal, under similar conditions of combustion, is considered to be 11,000 Btu.

usually sold in a unit referred to as a a face cord are 4 feet by 8 feet by 18 up to 24 inches in some areas.

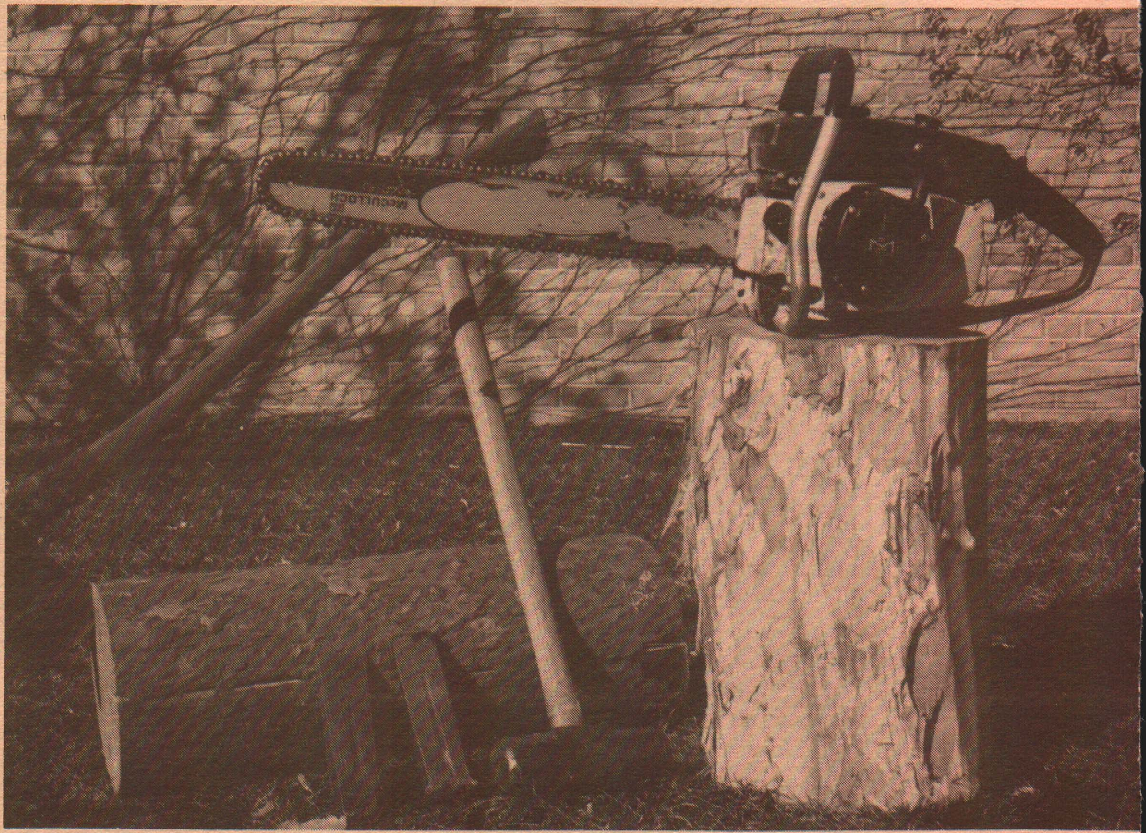

Figure 3. A minimum of tools is required to harvest your own wood. A chain saw makes for faster cutting, however a crosscut or bow saw may also be used. All of these tools can be obtained from local hardware or farm supply stores.

From the above table it is obvious that not all kinds of wood have equal heat value, and thus some will provide more heat than others. For this reason dense (heavy) hardwoods like oak and hickory are preferred over lighter hardwoods such as aspen or softwoods (conifers) like eastern white pine.

Effective heat values are also influenced by the amount of moisture in the wood. We are all aware that dry wood burns much easier and faster than wet wood, but in addition to differences in burning time, the available heat produced by wet (green) wood is much less. The effect of moisture content on heat value is illustrated in Table II.

Here's an example. Most seasoned wood is assumed to contain about 20 percent moisture. By comparison, wood that is freshly cut is in a wet or green condition and may have a moisture content ranging from 50 to 150 percent (ovendry basis), depending on species. From Table II, we can see that a pound of wood at this 20 percent moisture (air dry condition) contains 5710 BTU's. However,

Table II. Heat value (BTU) of 1 pound of wood as influenced by percent moisture.

Moisture content of wood Ovendry basis, %	Available heat, Btu*
0	7098
5	6701
10	6341
15	6011
20 (Air Dry Condition)	5710
25	5432
30	5176
40	4718
50	4322
75	3529
100	2934
150	2101
200	1546
250	1149

*Based on a higher calorific value of 8600 Btu, an initial wood temperature of 62°F, a flue-gas temperature of 450°F, an initial air temperature of 62°F, and 50 percent excess air. (From Panshin, **et al.** 1950, **Forest Products,** McGraw-Hill Co., New York)

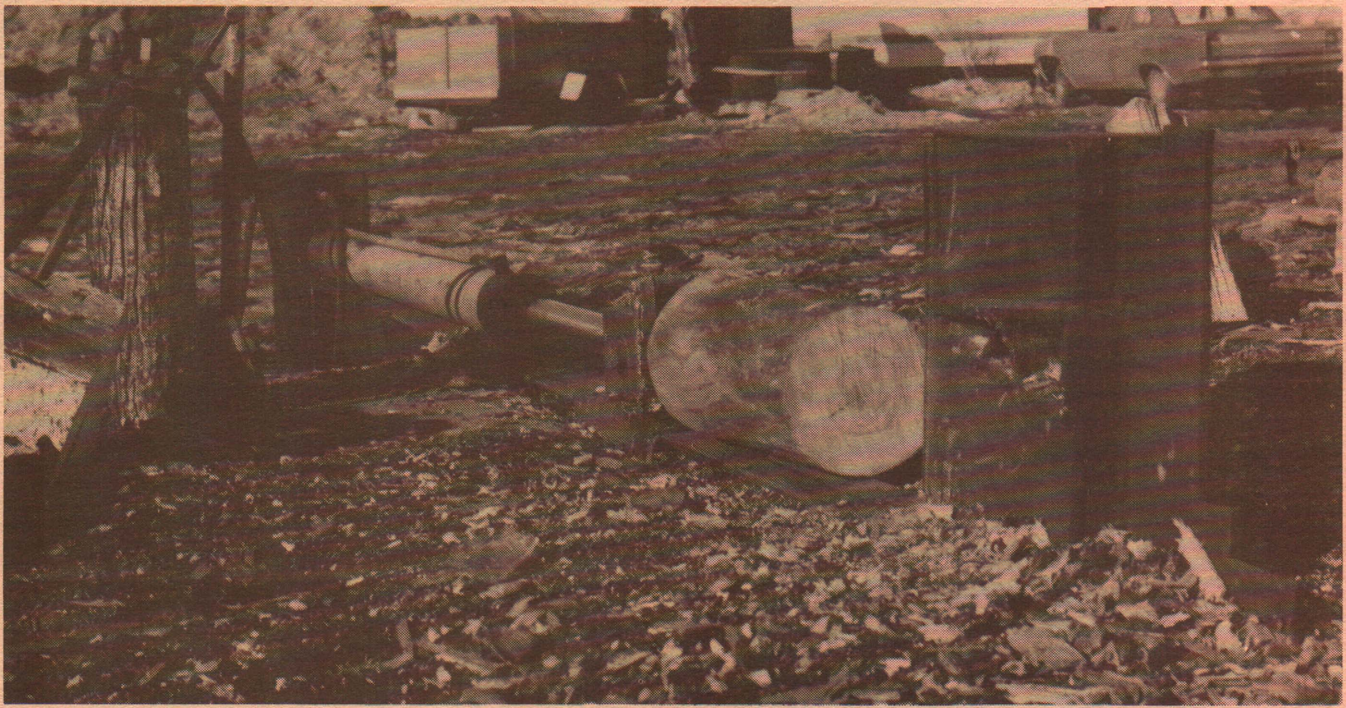

Figure 4. Where a large amount of wood is to be split, a power-operated splitting machine will reduce the amount of labor required while increasing the speed and ease of splitting. The hydraulic cylinder forces a block of wood against a stationary splitting wedge.

if the moisture content is 50 percent, only 4322 BTU's are present, reducing heat value approximately 24 percent. To further illustrate this point, 1¼ cords of wood with a moisture content of 50 percent would be required to produce the same amount of heat as 1 cord with a moisture content of 20 percent. The necessity of properly seasoning (drying) fuelwood is obvious. Suggestions for drying wood will be discussed later in this bulletin.

PURCHASING WOOD

The average homeowner does not produce his own wood but rather purchases it from private suppliers, supermarkets, local wood using plants such as saw-mills, or lawn and garden stores. Thus, he has little influence on the quality of the product aside from refusing to purchase from suppliers who do not sell wood of good quality. To obtain best value, consider a few guidelines when buying wood.

Sources - As a rule, individual producers usually sell wood at a lower overall cost than supermarkets or lawn and garden stores. This is because the producer acts as his own middleman and eliminates intermediate handling. Many producers advertise in local newspapers and are able to provide delivery on short notice. Wood-using industries such as some sawmills or wood disposal yards often sell wood to individuals. If these plants do not have other markets for slabs, trimmings, etc., the prices to homeowners are usually low.

Species - As discussed earlier, the heat value of wood varies by species. Dense hardwoods such as ash, beech, oak, sugar maple, yellow birch and hickory are excellent species. In contrast, elm, box elder, cottonwood, willow, pine, spruce and cedar burn well, but rapidly. The stove or fireplace will thus have to be filled more often.

We have discussed wet and dry as applied to wood, and have indicated that dry wood will burn easier and produce more heat. Unless you plan to mix dry and green (wet) wood in your stove or fireplace, buy only dry wood. For small-sized fires such as those in the typical modern fireplace, wet wood will be unacceptable.

Units - The common unit for buying and selling wood is the **cord.** A standard cord measures 4 ft. x 4 ft. x 8 ft. and contains 128 cubic feet. Actual solid wood content is about 80 cubic feet. When fuel wood is marketed, a full cord is seldom used, but instead a **face cord** (Figure 2) is a standard unit in the trade. The dimensions of a face cord are 4 ft. x 8 ft. x 18 inches. The inch figure (log length) may vary from 18 up to 24 inches depending on local requirements or practices. Occasionally, a face cord may be referred to as a **rick,** however, a rick does not have standard dimensions but simply refers to a stacked pile of wood. Rank and fireplace cord are also used to describe the amount of wood in a face cord.

Specialty woods - There are a few species of wood which are often sold at higher prices. These are often referred to as specialty woods, and for more or less obvious reasons command an increase in price. Paper or white birch and fruitwoods (cherry, pear and especially apple) are included. The white bark of paper birch is attractive in the wood basket and fireplace. Fruitwoods are fairly dense, thus they have good burning properties. In addition, they provide some variation in the color of the flame. Hues of blue together with the usual reddish-orange are often obtained. On occasion, a faint, pleasing odor may also be present. If you are buying wood solely for heat value, do not buy these woods. However, their occasional use in fireplaces or Franklin stoves may be worth the additional price.

Wood Storage

We have indicated that wood will produce more heat value per unit of volume when it is dry. Thus, wood should be stored in a dry place. The traditional "wood shed" was designed for this purpose. In most modern homes, wood is stored for a relatively short time in the garage or basement. Both are well adapted for storage of wood that will be used during the winter. Wood can be stored outdoors and still remain generally dry. Select a sunny location and stack the wood in ranks in such a way that air can circulate among the individual sticks. It should not be placed in direct contact with the ground. If the wood is green, stacking in this manner will help it dry more rapidly.

When wood is stacked properly its quality will remain good for a long period of time, particularly if it is kept dry. It may be attacked by a few species of wood boring insects, especially if left in the woodlot for a few months after cutting. Wood produced in the summer months is more likely to be infested with boring insects than that cut during the winter. Generally these insects will cause no problem if the wood is burned within a year or two. However, some insects such as carpenter ants or powder post beetles may be present in wood which is to be stored in the basement or garage. While uncommon, it is possible they could migrate from the fuel wood to wood used for structural support of the house, and thus could eventually cause damage.

A safe procedure to follow is avoid prolonged storage (more than one full year) in the house, or if longer storage is required, treat the wood with an insecticide if insects are present. Some insects such as elm bark beetles may be present in wood from diseased elm trees. However, they will not cause any damage to the house or other buildings.

Wood from diseased trees may be burned for fuel without any problems. There is no damage which will occur to wood used in construction of the house. Similarly the likelihood of infecting living trees from stored wood of diseased trees is small. However, as a precaution, such wood should be burned and not stored inside from one year to the next.

PRODUCING YOUR OWN

If you own a woodlot, or have access to wooded areas or other sources such as logging slash, municipal wood waste or in some cases public lands, producing your own supply of fuel wood may be an interesting experience. Not only may it mean saving a few dollars on the purchase of wood, but it can provide an excellent opportunity for the family to participate together in obtaining a portion of their fuel needs. At the same time, removing trees which are dead, disease infected, crooked, or otherwise damaged will improve the quality and value of the woodlot.

It is not difficult to produce wood. Only a few tools are required and their operation is fairly simple. For most, a chain saw, ax, splitting sledge and a couple of wedges are all the tools required (Figure 3). A few extras such as fuel, oil and files for the saw chain and ax will be required. Some form of transportation, such as a wagon, trailer or light truck will be needed to haul the wood.

If standing trees are to be used, the operation begins with felling. This should be done in such a way that a low stump results and minimal damage occurs to surrounding trees and to the tree being felled. After felling, trim small branches and twigs off the large branches. While an ax is preferable, a skilled operator may use the chain saw. Cut the log into standard fuel lengths starting at the small end and working toward the trunk (usually 18 inches for fireplace use). This procedure is continued until the entire branch and trunk of the tree are cut into sections.

It is usually necessary to split larger sections of wood into smaller pieces. Small diameter (5 to 8 inches) may be split with an ax or splitting sledge. With larger sections, it will be necessary to use one or two wedges. Mechanical power-operated splitting machines are available (Figure 4). While they work well, their use is not economically practical for small operations. Most wood will split rather easily if it is straight-grained. Similiarly, it is usually easier to split green wood than dry wood.

It is best to split larger sections into at least four or more pieces. Splitting into smaller sized pieces will make for rapid drying of the wood as well as making it easier to handle. Smaller diameter pieces will also burn better.

Following cutting and splitting, wood should be allowed to dry (season) to obtain maximum heat value. This usually requires several months. Most dense hardwoods require at least one year to properly season. The storage location and manner in which wood is stacked are important for proper drying. Stack in ranks so air can circulate freely between individual pieces. It should not be placed in direct contact with the soil as those pieces on the bottom will remain wet and some decay may start. Storage areas which are exposed to sunlight are preferable, although this is not absolutely necessary. Covered storage areas which are open on the sides are helpful in drying as this will prevent rewetting from rain or snow.

HINTS ON BURNING WOOD

1. Use dry, finely split (small pieces) for kindling a fire.
2. Start with small fire to pre-heat the flue to create a natural draft. Then add larger sticks after flue is heated.
3. Add wood to the fire a piece or two at a time, avoid heavy loading at any one time.
4. Mix some green or partially dried wood with dry wood to hold the fire longer.
5. Large unsplit pieces will hold fire longer than smaller finely split pieces.
6. Burning wood will often throw sparks, keep a spark screen closed at all times.
7. Be sure fire is completely out before closing the damper in the flue.

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