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Fuel Values Of Idaho Woods

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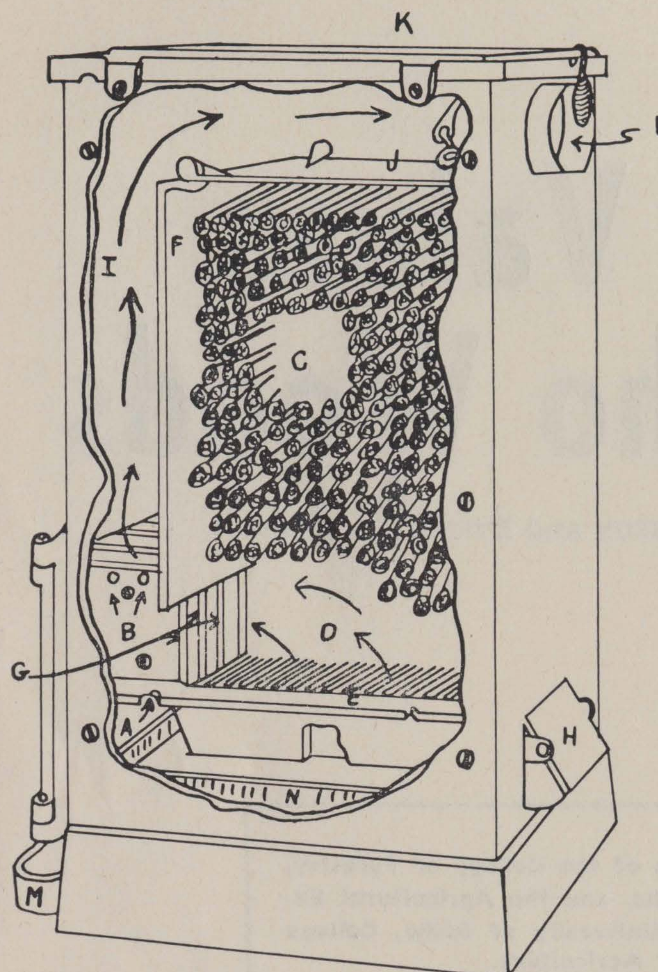

A—Secondary air

B—Gas ports or tuyeres

C—Fuel magazine

D—Combustion zone

E—Grates

F—Front plate—fuel magazine

G—Passages for gasses

H—Ash pit damper

I—Front heater plate

J—Lid—fuel magazine

K—Lid—outside

L—Flue opening

M—Humidifier

N—Ash pan

Figure 1.—This cutaway diagram illustrates the principles of construction used in manufacturing slow-combustion wood stoves and furnaces. Though different makes vary in detail, they are all based upon the principles of a large fuel chamber and a slow, well-regulated draft. This permits charring of the wood and nearly complete burning of the gases driven off in combustion. Such heating units are very efficient.

(From a drawing by Northeastern Forest Experiment Station)

Fuel Values of Idaho Woods

Vernon H. Burlison and Everett L. Ellis*

There are several reasons why wood is good fuel for home heating. We will list them, then take a closer look at the important ones.

Wood is economical to use.

Wood is a convenient fuel.

Wood is a clean fuel to handle. It also produces little ash and no clinkers.

Wood ignites easily and gives a quick, hot flame.

Fuelwood cutting improves the woodland.

Wood does have a few disadvantages that we should recognize before we go further:

It is bulky and requires a larger storage space than other fuels. If your heating unit would take you through the winter on five cords[1], you would need 640 cubic feet of space, or a room about 10 x 9 x 7 feet, to store a winter's fuel supply.

Also, due to its bulkiness, wood ceases to be an economical fuel if it has to be transported very far from the source of supply.

The fuel value of wood varies with species and with moisture content. Therefore, wood is not a uniform fuel if different species are mixed or if the moisture content varies.

Tars may accumulate in chimney if combustion in fire chamber is not properly regulated. This creates the risk of a dangerous chimney fire.

Wood Is Economical to Use

We pointed out that one of its disadvantages affects the economy of wood as a fuel. The effect is due to transportation costs if wood has to be hauled very far. If you live near enough to an available supply, this is no problem. Your heating unit is then the main factor that will determine whether or not wood is economical for you. Downdraft, slow-combustion home heating units are now available that greatly reduce fuel requirements because of their increased efficiency. People who are using stoves or furnaces of this design report they are using only 1/3 to 1/2 the wood they formerly needed, or 3 to 5 cords to heat an average-sized home during the winter period. This means you can burn wood at a very nominal cost. Wood is a particularly economical fuel for you if you own a woodland. You can cut your own wood with practically no cash outlay.

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*Extension Forester and Assistant Professor, Wood Utilization, respectively. The authors acknowledge valuable cooperation from the late Dr. E. E. Hubert, Research Pathologist, Forestry, in assembling data on fuel ratings of various Idaho woods.

[1]Since the cord is a variable measure, all references in this bulletin assume a cord to contain 80 cubic feet of solid wood, an average figure for the standard cord stack with dimensions of 4 ft. x 4 ft. x 8 ft.

Wood Is a Convenient Fuel

The convenience of wood for fuel is also affected by the type of heating unit you use. Slow-combustion stoves and furnaces require stoking only one to three times daily, depending upon the severity of the weather. Their heat can be automatically regulated with thermostatic controls. Thus, you can heat your home with wood at a saving and still have the convenience of automatic heat.

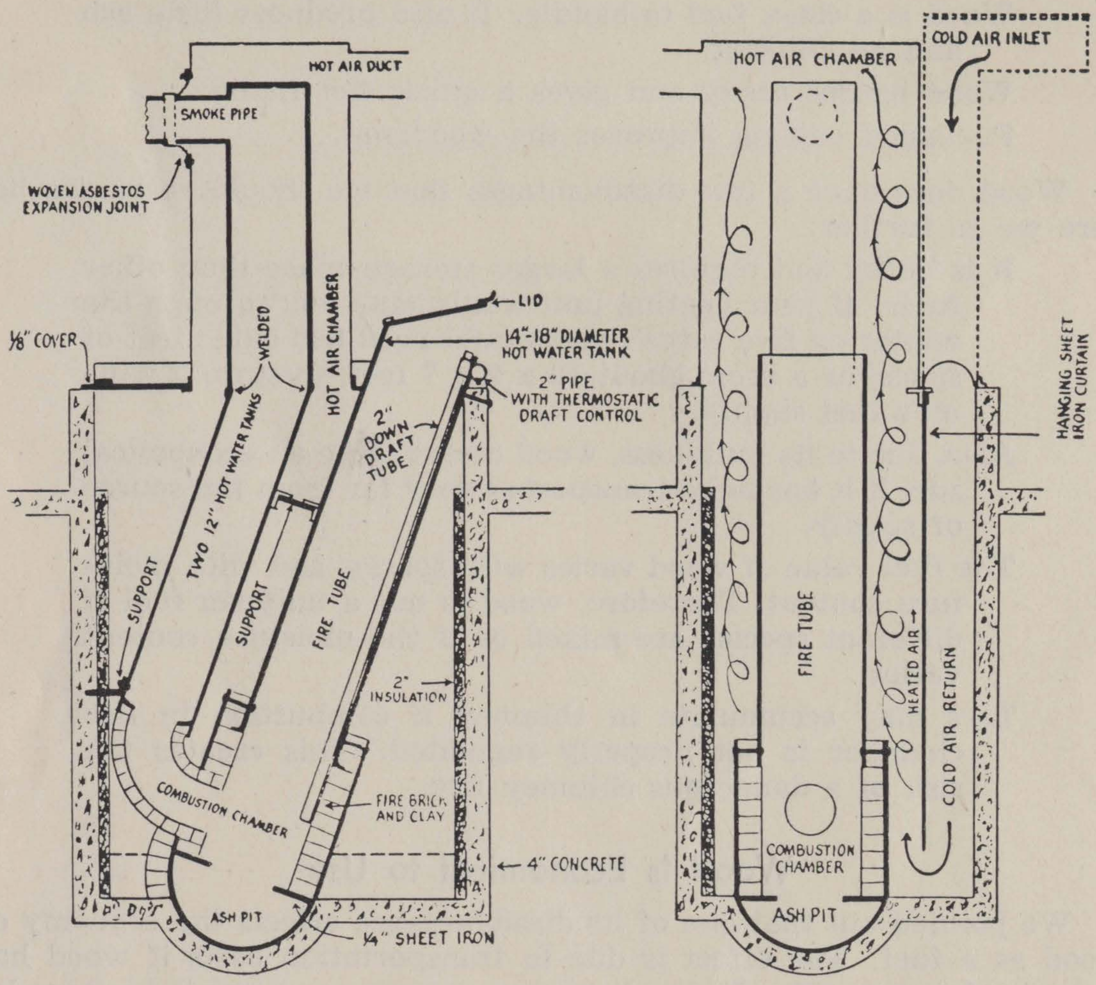

Figure 2.—These diagrams illustrate a homemade slow-combustion wood-burning furnace. Several have been built and are in use in northern Idaho. The cost of materials is low since old hot water tanks and other scrap iron can be used in construction. This furnace was designed and first built by Dr. C. E. Jenkins of New Hampshire. Plans and specifications may be obtained from the Northeastern Wood Utilization Council, Box 1577, New Haven 6, Connecticut. A manufactured furnace very similar in design is now available.

(Drawing from Idaho Farmer, June 3, 1954)

Wood Is a Clean Fuel

When wood burns in an efficient stove or furnace, there is very little soot in its smoke. Wood leaves only a small amount of ash, about 1 percent of its oven-dry weight. You have only 20 pounds of ash per ton of wood burned. To say it another way, you get about 17 pounds of ash from a cord of light wood like Engelmann spruce and around 35 pounds from a cord of dense wood, such as black locust. You get from 200 to 300 pounds of ash per ton from coal, depending upon its quality. Wood ash has some fertilizer value and may be spread on your garden or lawn with beneficial effects.

The fact that wood ignites easily and gives a quick, hot flame makes it a desirable fireplace fuel. In cabin stoves and for campfires this is a point in wood's favor.

Cutting Fuel Improves the Woodland

Cutting fuelwood gives you a good chance to improve your woodland. Any species makes good fuel if the wood is dry. Trees you can use for fuelwood need not be straight nor entirely sound. Dead trees that are still reasonably sound make good fuel. When you cut fuel from your woodland for your own use or for sale, select trees that are undesirable for most other uses. Weed out the defective trees and leave the good ones to make products with higher value.

You can use the table below to estimate the amount of fuelwood in your woodland, or to estimate the number of trees you need to select for your fuel needs. The cords-per-tree values in this table are averages, so they are not accurate for individual trees, but are satisfactory for estimating total volume of a number of trees. They are based on cubic foot volumes of medium height trees of several important softwood species[2]. We assume that an average cord contains 80 cubic feet of wood.

DBH[1]	Cords per tree	Number trees to make a cord	DBH	Cords per tree	Number trees to make a cord
inches			inches		
4	0.015	67	18	0.75	1.3
6	0.044	23	20	1.00	1.00
8	0.095	10.5	22	1.22	0.82
10	0.172	5.8	24	1.5	0.67
12	0.282	3.5	26	1.8	0.54
14	0.411	2.4	28	2.2	0.46
16	0.586	1.7	30	2.5	0.40

Factors That Affect Wood Fuel Values

The moisture content of wood affects the heat value obtained. As the moisture content goes up, the heat value goes down. Green wood of different species will have 5 to 25 percent lower fuel value than air-dry wood. Therefore, you should season fuelwood and keep it dry to get the maximum heat value from it.

[1] Diameter outside bark at 4½ feet above ground level.

[2] Second-growth yield, stand and volume tables for the western white pine type, by Irvine T. Haig; and preliminary yield table for second-growth western yellow pine in the Inland Empire, by C. Edward Behre.

The heat value of wood is roughly proportional to its dry weight. A cord of aspen will provide only a little more than half the heat available from a cord of black locust. That is because a cord of locust wood weighs almost twice as much as a cord of aspen. This means that you can meet your fuel needs with fewer cords of the heavier species, though pound for pound one species gives just about as much heat as the next. Also, with a heavy wood, you do not have to refuel the stove or furnace as often.

Pitch has a very high heat value. That is why you find pitchy wood makes such a hot fire. The heat value you obtain from wood with a high pitch content is greater than its weight indicates in comparison to other species. Pitch is characteristic only of certain species. In Idaho, the pines and Douglas fir are the only trees likely to contain enough pitch to make a difference in fuel value.

The most important factor affecting the heat value you get from wood is the efficiency of your stove or furnace. To burn wood efficiently, a heating unit needs a large fuel chamber where the wood can be closely packed and slowly burned. The slow-combustion types of stoves and furnaces are designed to fit this need. We have discussed their effect upon the economy and convenience of wood as fuel.

You can greatly improve the wood-burning efficiency of most coal furnaces and some stoves. The small size of the fuel chamber in many coal stoves makes them unsatisfactory wood burners. To remodel a coal heating unit for wood burning, usually you will remove the grates and cover the bottom of the ash pit with fire brick. If the grates are not removed, it helps to cover them with sheet metal. Then keep bottom drafts and ash pit door tightly closed so the whole fuel charge cannot burn at one time. Provide draft by a metal sleeve from the top of unit or through the ventilator of the fuel door. You may have difficulty getting a thermostatic control to work satisfactorily on some older model heating units. The risk of improperly adjusted combustion is an accumulation of tars in your chimney and the danger of a chimney fire. Hence, stoves and furnaces designed to burn wood are not only more efficient, but are usually much safer than models they have outdated.

We should mention fireplaces before leaving the subject of how the heating unit affects the heat value of wood. Fireplaces are popular in modern homes. They contribute a great deal to the satisfaction of modern family living. But as a heating unit, the fireplace is at the bottom of the list for efficiency.

Weights and Relative Fuel Values of Idaho Woods

We have noted that the moisture content of wood affects the amount of heat we obtain. Moisture is important from another standpoint: the amount of extra weight we are handling in green wood. On the average, our Idaho species lose approximately 1000 pounds per cord in seasoning from green weight to air-dry weight. This loss ranges from about 320 pounds per cord for western red cedar to 1760 for cottonwood. The average weight loss in drying per cord for conifers is 915 pounds, and that for hardwoods, 1160 pounds. This extra weight in green wood means it is advantageous to stack wood where we cut it and let it season there. A good practice is to cut wood during the winter or early spring. Stack it in the woods on stringers and let it season until early fall.

Since we have mentioned that dead trees make good fuel, you likely wonder how their moisture content compares with that of green or air-dry wood. Of course in standing dead and down timber, you will find wide variation in moisture content and resulting variation in weight. In general, standing trees that have been dead only a few years will have weights approximating the green weights of their species. Standing trees that have been dead long enough to lose all their bark will usually approach the air-dry weights of their species. Down trees that are in contact with the ground normally will have a high moisture content. Down trees that are 18 inches or more off the ground commonly will approach air-dry weights for their species.

This table gives green and air-dry weights of several tree species with their relative fuel values.

TREE SPECIES	Weight per cord[1] Green	Air-dry, 12% moisture	Relative fuel values compared to Douglas Fir
	Pounds	Pounds	
Ash, green	3840	3280	132
Aspen	3440	2080	84
Birch, paper	4000	3040	123
Cottonwood and poplar	3840	2080	84
Douglas fir	2880	2480	100
Elm	4400	2880	116
Fir, grand	3680	2160	87
Hemlock, western	3280	2320	94
Larch, western	3840	2880	116
Locust, black	4640	3840	155
Pine, lodgepole	3120	2320	94
Pine, ponderosa	3600	2240	90
Pine, western white	2800	2160	87
Redcedar, western	2160	1840	74
Spruce, Engelmann	3120	1840	74

Black locust and a few other introduced species are included because they have been used in many Idaho farm woodlot plantings.

Relative fuel values merely compare the heat available from the different species with some known or standard quantity. They could be set up on several bases. In the above table the value of Douglas fir is 100 percent, the standard to which we compare the others. The reason for this is that Douglas fir is widely distributed over the state and you are more likely to be familiar with it as a fuel than with many of the other species. The relative fuel values given are based on the air-dry weight of the wood. The pitch content is not considered. Therefore, pitchy wood of any species would have a higher relative fuel value than the table shows. The value for ponderosa pine with a high pitch content would be about 130.

We could obtain another relative fuel value by comparing wood to coal. In available heat, a cord of Douglas fir is the equivalent of 0.8 ton of coal. The coal equivalent of the other species can be approximated by multiplying their relative fuel values by 0.8.

[1]From cubic-foot weights established by the Forest Products Laboratory. Cord weights assume 80 cubic feet of wood to the cord.

Other Fuel Uses for Wood

So far we have been talking about wood cut specifically for fuel in home heating units. Large quantities of wood that has been changed in form by some manufacturing process are also used for fuel. Most of this is in the form of sawdust and hogged fuel used by mills and other industrial plants for heat and power. Manufactured wood briquettes are available for home heating in sizes adaptable to stoves and stoker furnaces. Ton for ton, briquettes have two-thirds the heating value of good coal. They are very clean and easy to handle. Also, a manufactured attachment is sold that can be used to convert a coal or wood furnace into a sawdust burner. Wood fuel in the form of briquettes or sawdust is frequently a good choice.

Fuelwood for Outdoor Fires

Here are a few hints about fuels for your camp or picnic fires that may be useful. In wet weather, finding fuel that will burn is a problem. Let's start with that. Wood from standing dead trees and upright stumps will be the driest and the easiest to start. A pitchy stump is a real find when everything outside is wet. The lower dead branches of living trees and the lichens that often grow on them are good. In spots sheltered by heavy foliage or by windfalls, you may find needles and cones dry enough to start a fire. Of course when the weather is dry, you will still find these materials good for starting fires.

Woods that pop and throw sparks are usually a nuisance in the campfire. Almost any wood will pop when it burns if it is not dry, but some woods are known for being spark throwers even when they are dry. Our species that have the spark-throwing habit are larch, spruce, hemlock, redcedar, grand fir, box elder, and maple.

When you want coals for a cooking fire, try to find hardwood fuel. Chokecherry, mountain maple, curlleaf mahogany and other shrubs you can often find in size and quantities suitable for a good cooking fire. Aspen and cottonwood make rather good coals. Of the conifers, you will find Douglas fir and larch about the best.

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D. R. THEOPHILUS, Director

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