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RENEWABLE NATURAL RESOURCES

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SOLAR HEATED FIREWOOD DRYER

Dry firewood can be an important source of energy for home heating in the 1980's. But the key is dry firewood. This paper presents a method for the homeowner for drying firewood efficiently by using a solar heated dryer.

Why Dry Firewood?

Many people know from experience that green wood smokes and smolders with only a little heat emitted rather than burning rapidly and cleanly with good heat liberation. Technically, when burning green wood, which can be 50% water by weight (or more), some of the heat from combustion must be used to evaporate (or boil) the water in the wood. This means that since some of the heat is used for evaporating water there is less heat available for heating the home. To be more specific, consider the heat from green oak compared with the heat from the same volume of wood that has been dried:

Increase In Available Heat Through Drying
Compared to Green Firewood

Partially Air Dried	5%
Fully Air Dried	10%
Solar Dried	13%

Partially Dried is less than 1 summer month of drying (40% moisture content, oven dry basis). Fully Air Dried is 3 summer months of air drying (20% moisture). Solar Dried is 6 to 8 weeks of drying (7% moisture).

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In addition to liberating more useful heat, dry wood also keeps the stove, flues, and chimney hotter and this in turn means that creosote in the flue gasses is not as likely to contact a surface that is cold enough to result in condensation of the creosote. If the creosote condenses, it looks like tar and can run out through cracks. But more serious, creosote is highly flammable, and, if allowed to build-up in flues or chimney, it can present a serious fire hazard.

Dry wood is also lighter in weight; 50% lighter or more.

Dry wood, because it supplies more heat than green wood, also means that substantially less wood is needed per year for heating, thereby conserving our forest resource and saving money.

[Obtaining firewood from our forests is beneficial to these lands when done properly. Firewood harvest thins out overstocked stands and provides a method of eliminating crooked, diseased trees that have little commercial value. Frequently, state forestry officials can provide guidance for forest land and wood lot owners to assure a beneficial firewood harvest program.]

Why Solar Dry?

As mentioned in the previous paragraphs, solar dried lumber has less moisture and more heat than green, partly air dried, or fully air dried wood. Additionally, solar dried wood can be obtained year round. This means that firewood can be cut in mid-fall and be ready for burning by Christmas.

Solar dried wood, because it supplies more heat, also means that up to 13% less wood (compared to green) is needed per year for heating. This is a savings of $40 per year or more. The solar dryer shown here (Figs. 1, 2, and 3) will dry one cord in 6 to 8 weeks and costs less than $60. The dryer will easily pay for itself in two years. (In addition the dryer can possibly be used for starting hardy plants in the spring.)

Solar Drying

The sun provides approximately 1000 Btu's of energy per square foot per average day--a little less in the winter; a little more in the summer. The key to effective solar energy utilization is to convert solar energy to useful heat at a fairly low cost. Further, any solar process must be able to tolerate several days (or longer) of low solar energy input.

This solar dryer uses a passive "greenhouse" design where the firewood is inside the collector itself. Solar energy comes through the clear plastic on the south-facing, 45° sloped roof. It is incident on the black plastic on the floor and the black painted screen. The energy is absorbed and converted to heat. This heat warms the surrounding air, which rises to the top of the dryer. As it rises it pulls air from the rear through, drying the wood. This air is in turn heated, rises, and pulls more air through the firewood, and so on. This internal circulation assures good drying.

The dryer is designed and firewood is loaded into the dryer with a 4" gap at the rear wall and a 4" gap at the top to assist this circulation pattern. The sloped plywood roof and its white color also assist.

The north wall could be plastic to cut expenses, but we believe plywood will provide more rigidity and permanance.

The dryer is loaded by lifting the front clear plastic up and over the top.

For optimum drying, the firewood should be split, as bark is an excellent vapor barrier.

Once the firewood is dry, in 4 to 8 weeks, it can be left in the dryer or stored in a dry location away from the house.

Firewood and the dryer should be checked periodically to avoid insect infestation and to avoid bringing insects into the home.

Estimating Performance

The 45° sloped roof has an effective area of approximately 85 sq. ft. We assume that an average day has 1000 Btu's/sq. ft. of solar energy incident on this roof. We assume, further, that ½ of this energy is used in the dryer and ½ is lost through ventilation, leaks, and conduction. (Although we might improve this efficiency with insulation and tighter construction, it would not be cost effective.) Therefore, we have (85 sq. ft. x 1000 Btu/sq. ft./day x ½) or 42,500 Btu's/day available. Finally, a cord of green oak contains 1900 lbs. of water which will require 1,900,000 Btu's of energy to evaporate it.

Our dryer will provide 1,900,000 Btu's in just less than 45 days, on the average. (1,900,000 Btu's ÷ 42,500 Btu's/day = 45 days.)

Improving Dryer Performance

The dryer should be located in a sunny area (not blocked by shadows) facing southward, although it is not critical to face the dryer exactly true-south.

The dryer shown here was designed to minimize cost, sacrificing performance a little to keep costs down. The dryer can be improved a) by providing more incoming solar energy, b) by increasing the collector's size, and c) by reducing dryer losses and improving its efficiency. Careful study is needed to assure that any improvements made will be cost effective.

A. Increasing solar energy

The incident solar energy can be increased by designing the roof angle to more closely match the sun's angle. The rule is: for optimum performance year round, the roof angle should equal the latitude. (To clarify this, in Florida, the roof would be at 30°--fairly flat. As we go further North, the roof would become more vertical.) For better performance in the winter months, the roof angle should be at the latitude plus 10°. (In Virginia this would be

(37° + 10°) = 47°. For ease of construction, we used a 45° angle.) For optimum summer performance, the angle would be the latitude minus 10°. When adjusting the angle, remember it is the square footage at that angle that is important, too.

A second way to increase energy is to use reflectors around the outside of the collector to reflect additional energy into the dryer. Mirrors would be best, but aluminum foil or white painted panels are fairly good and less expensive.

B. Increasing collector size

The collector size can be increased by making all the components larger than shown. However, if the collector is doubled and twice as much wood is put in the dryer, the performance will be unchanged. Therefore, if dry wood is needed in a hurry, decreasing the volume of wood in the dryer will result in faster drying.

C. Reducing losses

Heat energy is lost from the dryer in several ways: ventilation with the outside (but ventilation also exhausts moisture so we must have some ventilation) and heat conduction through the walls, floor, and roof (we can insulate the walls and floor and use two layers of glass or other more expensive roof covering to reduce these losses). There are also radiation losses, but these are usually small.

Questions?

If you have additional questions, feel free to contact your Extension Office or the Virginia Division of Forestry District Offices. If you build a dryer, we would be anxious to hear from you so that we can estimate the effectiveness of this program.

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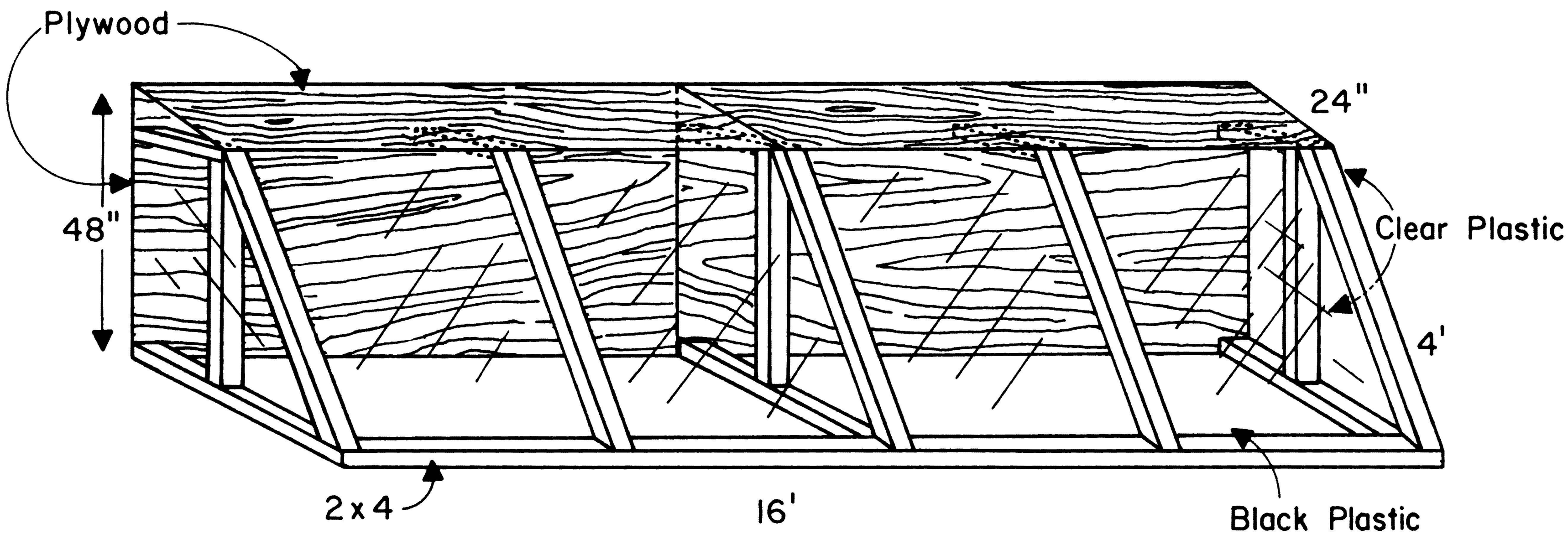
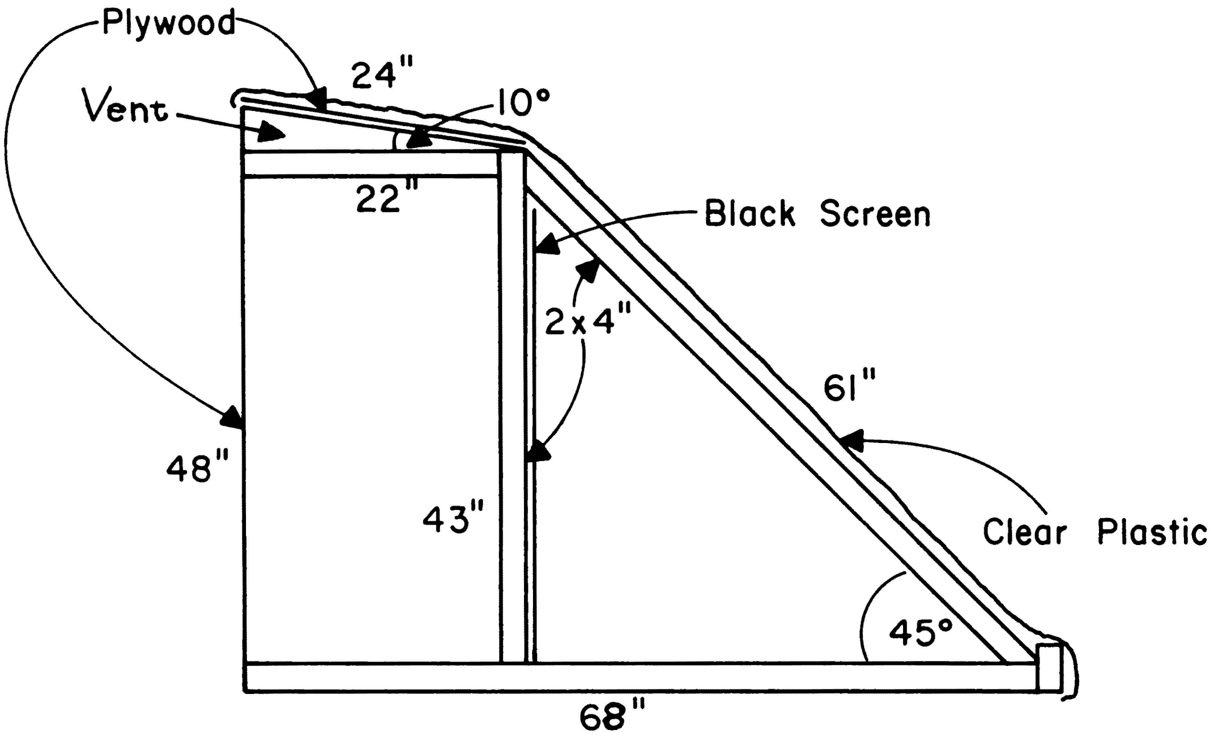


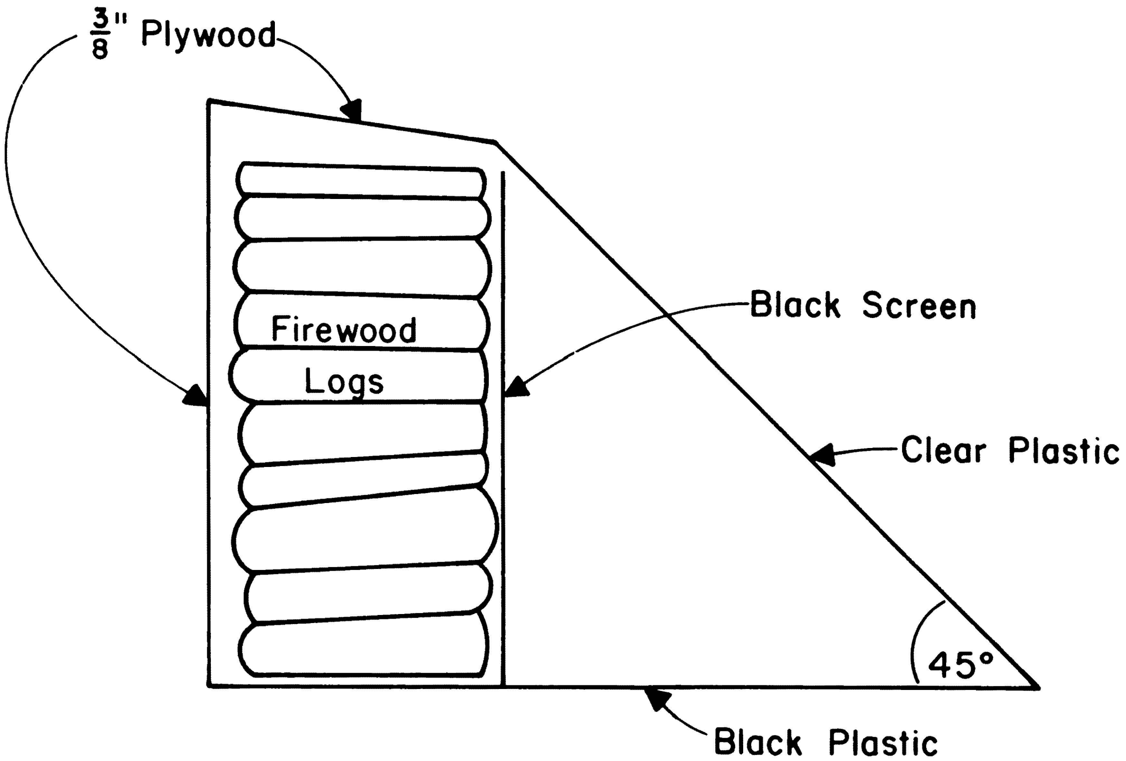
FRONT VIEW

List of Materials
(1 cord size)

QUANTITY		EST. COST
10	2x4x8' studs	$14.49
1 lb.	16 penny common nails	.34
3/4 lb.	roofing nails	.32
3 pcs.	3/8" C-D-Ext. plywood	20.85
1 qt.	white paint, latex exterior	2.00
1 qt.	black paint, latex	2.76
16 ft.	48" window screen	12.30
6 ft.	16' black polyethylene plastic sheet	1.20
16 ft.	16' clear polyethylene plastic sheet	2.99
	TOTAL	$57.25



SIDE VIEW



CROSS SECTION