SOLAR ENERGY FOR TREE SEED WORK

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Early in 1976, the Tennessee Valley Authority's Forest and Wildlife Resources Branch in Norris, Tenn., felt the need for a facility for drying limited amounts of pine cones and other tree seed for research and demonstration use. Because only moderate heat is needed for seed drying and processing, TVA saw the potential of combining practical application and demonstration of solar heat with satisfaction of needs for tree seed drying.

The solar-heated facility that was designed as a result was completed in time for use during the winter of 1976-77—a period of record cold—and proved to be effective both as a demonstration of an application of solar heating and for seed drying and processing. This paper describes the facility, its use, and modifications that have been incorporated.

Figure 1. – *Exterior view -south and east sides of solar-heated forest tree seed processing facility showing construction and collector details.*

Construction Details

The building is constructed on a 4-in. thick, 20 X 20 ft. concrete slab. Structural framing is conventional 2 X 4 in. studding, with the exception of the south-facing wall, where 2 X 6 in. framing was used. The exterior surface is 4/4 finished yellow-poplar board and batten (fig.1). Interior walls are of 1/4 in. plywood. Doors are sandwich construction of 2 X 4 in. framing covered with 1/4 in. plywood, enclosing styrene foam "beadboard" (R = 4.16).

The structure is divided into two rooms separated by insulated sliding doors to permit independent temperature regimes. The solar collector room (fig. 2) is 20 feet long by 9 feet 8 inches wide and faces due south. This room is insulated with 1 inch "beadboard" outside the wall studs plus 3 ½ -in. Dow-Corning fiberglass batting between wall studs. The collector is angled at 53° from horizontal in order to make efficient use of late fall-early winter sun and has a surface area of approximately 270 square feet. Glazing material is a single layer of fiberglass, Kalwall Corporation "Sunlite," premium grade, .040 inches thick. Vents at the top and bottom of the room are used to prevent overheating during seed drying and also to provide ventilation in summer. Two 14-inch fans, connected to an attic fan thermostat, provide air circulation for drying cones and cooling in summer.

The workroom is 20 x 10 ft., 8 in., and is insulated with 2 in. of beadboard (1 in. inside and 1 in. outside wall studs. (The wall between the solar room and workroom contains 3-½ in. of fiberglass between studs. Two

2,000-watt electric resistance heaters are available for use if three or more consecutive sunless, humid days cause drying problems.

The estimated construction cost of the building was slightly less than $3,000 (1976).

Discussion

Approximately 100 bu. of Virginia pine and 20 bu. of yellow-poplar cones were processed in the building during the fall/winter of 1976-77. Temperature was monitored every 15 minutes at six locations by a multichannel recorder connected to thermistors. Thermistors were located in the solar room on the concrete slab (which was the only source of stored heat), 1 ½ ft. and 1 ft. above floor level. Two thermistors were on the floor and 4 ft. above floor level in the workroom. Outside temperature is monitored on the north side of the building approximately 7 ½ ft. above ground level.

We found that inside night temperatures remained 12° to 14° F above outside temperatures without auxiliary heat. On sunny days in December and January, temperatures 10 ft. above floor level averaged 20° to 25° higher (120° to 125° F) than temperatures 1 ½ ft. above the floor (95° to 105° F). The attic fans were used to force the heated air toward floor level and circulate it. Even on cloudy days, some temperature rise was experienced.

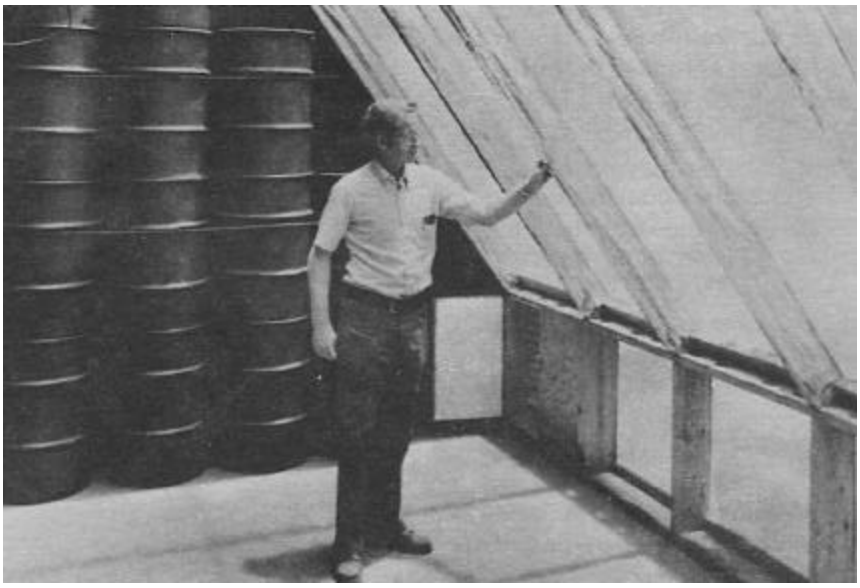

Figure 2. – *Interior of solar drying room – note barrels of water added to provide heat storage.*

Heat was stored and reradiated by the floor slab, as shown by the temperature 1 ½ ft. above floor level exceeding that at 10 ft. during early morning hours by 2° to 5° F. The concrete slab, painted flat black, was the only heat storage provided in the 1976-77 winter period. Additional storage, consisting of 28 steel drums each filled with 30 gallons of water (fig. 2), has since been added and is expected to level out the day/night temperature fluctuations.

Relative humidity on sunny days during the winter ranged from 10 to 20 percent, and even after 4 to 5 days of cloudy or rainy weather never exceeded 35 to 40 percent.

Operation

Cones to be processed are placed in wire-bottomed racks which can be stacked 8 or 10 high. Several racks are placed on a dolly and wheeled into the solar room. When there is adequate sun, cones remain in the solar room day and night. When no sun is expected or rain weather prevails for 2- to 3-day periods, cones are wheeled into the workroom where temperature and humidity can be maintained at a more favorable level for drying. Once cones have opened sufficiently they are moved to the workroom for seed extraction in a tumbling machine. Drying time is estimated to be less than 1 week during sunny weather.