The Walk Passive Solar Food Dryer

Over the years we've tried about every solar dryer design imaginable. The only common factor in all those attempts was their very limited usefulness here in the humid upper Midwest. None of them worked reliably using only passive solar energy. Some designs relied on a crutch, either a fan during the day or electric backup heat at night. Most of them mimicked electric dryers with multiple screens, one above the other, which means that the warm air must rise through several layers of moist produce. Some didn't work at all if not tracked to face the sun directly throughout the day. It was with this background that the "idea light" came on in Larisa's head.

The Hot Tin Roof Experiments

One day (in 1985) we needed to dry a bunch of greens and the current solar dryer was full (a couple of handfuls was its full capacity). We had an old window screen lying around and a corrugated metal roof built over our old mobile home. Using a ladder, Larisa placed the screen on the roof then put the greens on it. She wanted to warm the food while keeping the sunlight out so she covered it with a piece of black cloth. Then, to keep everything from blowing away or being bothered by flies, she covered it with the storm window that had been stored with the screen.

Later that afternoon we thought we'd check on the experiment. The greens in the old dryer were still quite limp so Larisa crawled up the ladder to take a look at the stuff on the roof. Much to her surprise, the roof-top greens were crispy dry! It looked like we had finally stumbled on something that worked.

Basic Design Principles

We found through experimenting that the primary components for this idea were:

- glazing (glass or greenhouse plastics)
- black surface (fabric or metal)
- screen to hold food
- airspace under food screens
- reflective surface tilted toward the sun

The sun shines through the clear glazing onto the black surface, causing it to heat up. This heat is radiated from the black surface and onto the food screen below it. The shiny, sloped metal roofing that everything rests upon reflects heat back up toward the food. Also, its corrugations provide an airspace under the screen for moisture-laden air to circulate up the slope and out of the dryer by natural convection. The food is not exposed to sunlight and retains its color. This combination of design factors also met the design criteria of what we thought would be the ideal dryer:

- utilizes passive solar energy
- has no moving or electrical failure-prone parts
- no sun tracking is required
- the food is not exposed to sunlight
- enough tray space for large batches
- moderate temperatures to dry quickly
- easy to use and clean
- absolutely must work reliably
- partially dry food stays in dryer overnight
- stable in windy locations
- critter and bug-proof, for the most part

Building the Radiant Solar Dryer

Using the basic principles and design criteria established from our experiments, we built a 4'x12', waist-high "shed". The metal roofing on this shed has corrugations that run north to south. The roof angle is approximately 12°-15° and slopes towards the south. This gives enough elevation so the warm air will rise but not so much that the food will slide downhill. The storage space underneath can be used to stack firewood or store garden accessories.

Our dryer, with nearly 48 square feet of tray space, can preserve enough food for a large family or a group of smaller families.

A good "starter" size dryer is 4' by 4' with four 2' x 2' trays. You can make more modules of this size later if you need to add capacity. The 4 foot size from top to bottom allows food to be reached from either side yet is wide enough to achieve sufficient hot air flow. On a fully sunny day, at noon, with nothing in the dryer, the temperature can easily reach 155° F. in the upper tray. When a full load of wet sweet corn kernels goes in, the same spot may only reach about 120° F., which is great for really wet food. The lower tray will have correspondingly lower temperatures. If the top to bottom dimension is larger than 4 feet, there is potential for cooking or scorching food, particularly when the ambient air temperature is already sweltering.

Glazed Heat Collector Cover

The function of the glazing is to create more infrared energy (heat) from the sunlight that passes through. It is also the weather-proof cover for the dryer.

The glazing we first used was Kalwall™ 40 mil fiberglass reinforced polyester greenhouse glazing. It holds up better than glass in hail storms and weighs much less, but the surface deteriorates over the years, becoming more clouded and less translucent. We now prefer polycarbonate or Lexan™ corrugated greenhouse glazing (not the "twin-wall", insulated type, but the single layer kind). This material costs about as much as Kalwall™ but looks to have a much longer lifespan and is even tougher against hail. The corrugations do not significantly affect the performance of the collector so the ends of the ribbed channels can remain open, but you may decide to close them in with the product's matching sealing strips to keep out bugs and dirt.

Recycled glass will also work, however it can be quite heavy and there is more risk for breakage, but if it's what you have, it's worth considering. Steer clear from using old windows that may have lead paint on the frames. Recycled glass shower or bath doors with metal frames can be put to good use. You may have to adjust the rest of the design to accommodate the size of your materials.

One material to stay away from is acrylic glazing. Although much cheaper initially, the heat causes it to become very brittle, requiring replacement in a few years.

The wooden framework has the glazing fastened to the top side and the heat radiator material attached to the bottom side. The cover framework can be

constructed from 2"x2" mitered cedar or other untreated, but rot-resistant wood.

Heat Radiator

Instead of the black cloth used in the original experiments we now use a layer of aluminum, painted with barbecue (BBQ) black paint (a high temperature tolerant, flat black paint) on both sides, stapled to the underside of the cover framework. Sheet steel (28 gauge or lighter – not galvanized so paint will adhere) or used "printer plates" will also work, but aluminum flashing is the most easy to find, available in 2-foot widths. The black metal heat collector is more convenient to use, less messy, more efficient, and probably less expensive in the long run than black cloth which can fade or shed fiber particles over time.

The top of the metal is painted black to absorb the sun's heat and the bottom is also painted to radiate that heat onto the food. The collector must be black on both sides to transfer the heat through toward the food.

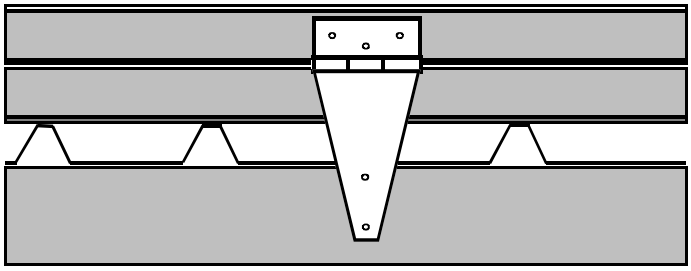
We prefer using a brush-on form of BBQ black paint versus spray cans. Two coats will give good coverage. BBQ paint usually contains carbon black, clay, and some type of polymer or resin that turns into a carbon-rich film when you put the empty dryer out in the sun. Its solvent usually isn't low-VOC so it's essential to allow several days in the sun for the paint to off-gas before use.

Food Trays/Screens

The food trays are 2 foot square screens made from mitered cedar 2"x2"s with a 3" deck screw in each corner. The lower inside edge of the frame is cut away (1/8" deep dado cut) so that the screen is recessed and does not extend out to the frame's edge. This eliminates the possibility of screen edges snagging clothes when you lean against the dryer. We weren't able to find 2"x2"s, so we ripped 2"x4"s in half. As you cut each piece, lay out the miter cuts for the next piece starting from the last cut. With the overlaps in these angled cuts, there will be a bit of scrap leftover from an 8' board which is good in case there's "checking" or a crack at one end.

The screen is stainless steel which, although costly, is easy to clean, provides a non-toxic surface for the food, and should last a lifetime. The screen that we used was 12 mesh, .018", type 304. Our friends used 10 mesh, .023" which is a little more open and works just as well. The mesh size refers to the number of wires per inch, the other measurement is the size of the individual wires, and the type is the alloy content. Anything approximating window screen will work. For many years, we referred folks to a couple of industrial manufacturers of screen or suggested they check with local metal shops to find screen. We finally decided to buy 4'x100' rolls of the screen and offer it for sale on our website since locating affordable screen was usually the stumbling block that kept folks from building the dryer. You can purchase directly from the factory if you have a group that can share a roll of the screen – check the internet for sources with the best price.

A bead of hi-temperature food-grade silicone caulk keeps food particles from getting stuck between the wood frame and the screen. Any 100% silicone caulk is usually listed as food grade (in extremely tiny print), since



Cover: Glazed Heat Collector/Radiator
Food Trays: Framed Screens
Base: Airspace & Reflector

the only thing in it other than the silicone is acetic acid, which gives off a vinegar smell as it drys.

Our original experiments used fiberglass window screen, but we have since discovered that it is coated with polyvinyl chloride that is stabilized with several substances, one of which may be lead. **Please, do not place food in direct contact with any material that is not absolutely food safe.** (For other alternatives to stainless steel, see our book "Feeding Ourselves".)

Base Framework – Airspace & Reflector

The base framework has a reflective metal surface attached to its top. The metal should either be galvanized steel, plain aluminum, or painted white to reflect the infrared heat up toward the food trays. If you use corrugated roofing for this purpose, it will provide the necessary airspace under the food trays. The ribs on the corrugation need to run in a north/south orientation. Metal without ribs may be used, but you'll need to provide wood strips for the screens to rest on, creating an air channel.

Legs and Other Hardware

The cover framework is attached to the dryer base with T-strap hinges and a hasp latch. Right-angle brackets are fastened to the south edge of the roofing to keep the trays of food from sliding off the downhill side.

The legs are metal fence posts driven into the ground and attached to the side of the base with U-bolts. This option will not rot and can stand up to strong winds.

Wood Sealants

The under-framework of the base is all treated wood and needs no other sealants (ACQ treated lumber is more environmentally safe than the older formulas).

All of the cedar is coated with a homemade sealant: melt 1 pound of paraffin, remove from heat and vigorously stir in 3 quarts boiled linseed oil and 1 cup of gum spirits turpentine. When cool it looks like crystallized honey. Apply liberally with a brush. (This is also great for window sills or exterior trim where you want water repelled.) Re-coat in subsequent years when needed. An alternative wood sealer can be made by mixing 20 parts of boiled linseed oil to 1 part of beeswax (this is mix can be used on bee hives instead of paint). An even more green option is beeswax applied melted to the wood, before the screen is attached, then "ironed" into the wood with an old iron (just like hot-waxing skis).

Excerpted from "Feeding Ourselves – The Four-Season Pantry from Plant to Plate" by Larisa Walk & Bob Dahse.
Available from www.GeoPathfinder.com.