DIY BEER/SODA CAN SOLAR HEATER

dgeorge@heritage-consultants.com

This document describes the materials needed and the process involved in building a Beer/Soda Can Solar Heater for your home or workshop. The heating unit shown to the left measures 26 inches in width by 82 inches in length, and it contains 135 recycled aluminum cans stacked in 9 rows of 15 cans each. The unit works in a fashion similar to a traditional chimney. That is, air is drawn into the unit through a 3 inch intake hole on the bottom of the unit, it travels through the aluminum cans where it is heated by solar radiation, and it is expelled at the exhaust hole at the top and into your home or workshop area. When a small fan is added to the intake the heated air can be blown into any space at a constant rate. Tests of the unit described herein have been conducted with an ambient air temperature at the intake port of 45 degree Fahrenheit. The resulting heated air at the output has reached temperatures as high as 185 degrees Fahrenheit, or a gain of 140 degrees! In sunny to partly sunny weather the unit the will work all day. Currently, there is no means by which the heat generated by this unit can be stored, so a traditional heating system will be required at night. The remainder of this document presents step by step, illustrated directions on how to build the unit.

MATERIALS USED:

With the exception of the aluminum cans, all of the materials used to build the unit shown above were purchased from a Lowes home improvement store. They include:

- 135 aluminum beer/soda cans of the same size, shape, and diameter
- 2 metal building stud caps measuring 10 feet in length (the ones without the holes in them)
- 4 tubes of silicone (service temp of –60 to 400 degrees Fahrenheit)
- 3 cans of Rustoleum high heat paint for gas grilles.
- 1 roll of foil backed bubble type insulation measuring 15 inches by 15 feet in length
- 1 roll of Shurtape DC-181 tape for Class I ducting
- 1 package of #10x3/4 inch hex head self tapping metal screws
- 1 piece of plywood or similar material measuring 26 x 82 inches in width
- 2 pieces of 1 x 4 in pine measuring 26 inches in length each
- 1 sheet of clear polycarbonate corrugated roofing material measuring 26 inches x 8 feet in length
- 1 piece of 8 foot long wavy mounting strip for corrugated roofing
- 2 plastic 4 inch to 3 inch plumbing reducers for the intake and exhaust ports

TOOLS USED:

The following is a list of tools used during construction of the solar heater shown above. They include:

- 1-1/2 inch hole saw
- 2-1/8 inch hole saw
- Cordless drill with 1/8 inch drill bit
- Tin snips or comparable
- Calking gun
- Circular saw
- Heavy gloves
- Jig saw with a wood blade
- Bottlebrush
- Permanent marker

STEP ONE: COLLECTING THE CANS

Collect 135 aluminum cans (more or less depending upon how large you plan to build your unit) and, without any alteration, let them soak overnight in soapy water. This will remove the worst of the residue left in the cans and will reduce any unpleasant smells while you are working on your unit. I collected my cans the old fashioned way, by walking several miles each day and picking them up. You could also, of course, collect the cans from family members and friends.

STEP TWO: PREPARING THE CANS

Figure 1

Once your cans have been removed from the soaking and have dried, remove the pop top tabs by bending back and forth until the tabs fall off. Since that is the extent of the modification to the top of the can, it is a good idea to make sure when you bend the tab forward that you push the flap in the opening of the can to as far open as possible. This will keep it from impeding airflow.

Once you have removed the tabs, insert your 1-1/2 inch hole saw into your cordless drill (see Figure 1). Then put on your gloves. Turn the cans so that the bottom is up. Secure the can in one hand on a rigid surface. Drill out the bottom of the can with the hole saw. This is a bit tricky and takes some getting used to. The drill should be applied lightly to the can and your grip on the can should be neither too firm nor too loose. If you try to do this too fast or hold the can too firmly, the result will be that the can gets crushed.

STEP THREE: CLEANING THE CANS

After you have drilled the cans out, soak them again in hot soapy water. You could let them sit overnight, but an hour or two will do. Be careful putting them in to water that you do not touch the cut edges. They are sharp and will slice you easily. When rinsing the cans, I used a bottlebrush to quickly scrub the inside of each can. Once rinsed, place you cans in a well-ventilated area and let them dry overnight.

Step Four: Initial Assembly of the Frame & Backing

After you have cut and washed your cans, and while they are drying, you can begin to assemble your unit's frame and backing. I used metal stud caps for the frame and 3/8 plywood for the backing, but that could be changed to accommodate whatever materials you have at hand. Just remember it needs to be rigid but not weigh a ton. The completed unit shown above weighs approximately 30 lbs.

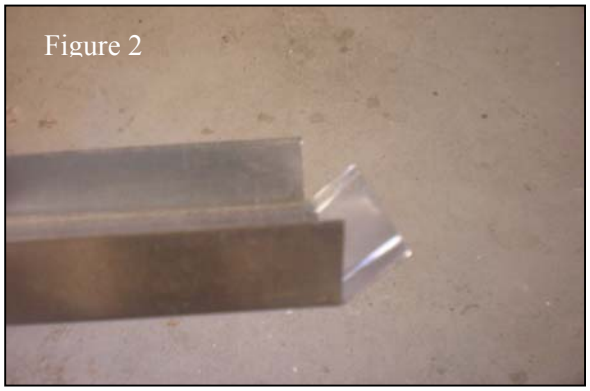
Figure 2

Using the tin snips, cut the metal studs for the sides of the unit. Make them 84 inches long. Then, from each end, remove 1 inch squares from each of the sides of the stud, leaving the face intact. Then, fold the resultant flap into the stud cavity, creating a box at the each end of the studs like the one shown in the picture to the left (see Figure 2).

Once you have finished the sides of the frame, cut two 26 inch long pieces from the remainder of the metal studs. These will be the end caps of your frame.


Figure 3

Once you have cut the metal portions of the frame, cut your plywood backing to measure 25-3/4 x 81-3/4 inches, so that it will fit easily into the assembled frame. Next, begin assembling the frame by attaching the two end pieces to one of the side sections (do not complete the frame at this point). To assemble the corner joints, slip the metal end piece into one of the side sections, then drill three 1/8 pilot holes. Next attach the two pieces together using the #10x3/4 self-tapping screws as seen in Figure 3. Once you have three sides of the metal frame completed, slide the backing material in and secure it to the frame with the self-tapping screws. As discussed above, the frame should NOT be completed at this point. Instead it should consist of a three-sided box with plywood backing.

Step Five: Insulating the Frame & Backing

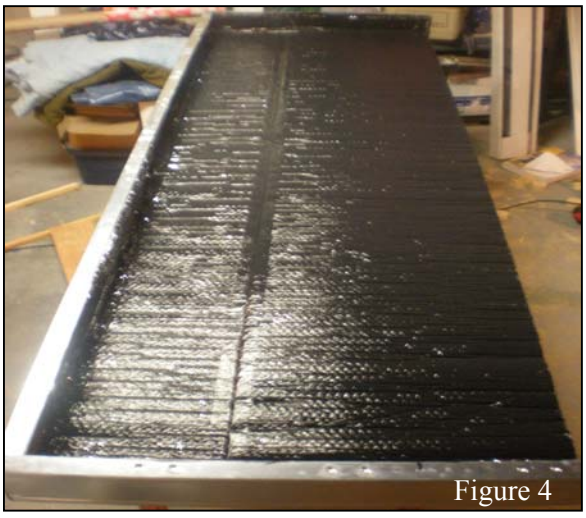
Figure 4

Once the initial assembly of the frame is completed, begin the process of insulating it. This involves rolling out the foil backed bubble insulation into two strips measuring 82 inches long each. Place the insulation into the frame and onto the backing board. Let it overlap in the middle and tape the joint using the Shurtape. Also, cut 4 inch wide strips to fit within the sides of the frame. Seal the joints between the sides and back with the Shurtape.

Next, paint the insulation with the high heat black paint for gas grilles (see Figure 4). This promotes the capture of the sun's heat. Again, the frame should not be completed yet. It should remain as a three-sided box at this point.

STEP SIX: ASSEMBLING THE "MANIFOLD"


Figure 5


Figure 6

While the paint is drying on the frame, begin to assemble the heating manifold for your unit. This involves siliconing all of the cans together. Run an ample bead of silicone around the top of a can and then place the next can on top of that, and so on and so on until you have a "tube" of 15 cans high (see Figure 5).

In order to make the tubes straight and well adhered together, I placed them in a jig that held them upright. This can be any long run that has a 90-degree bend into which the cans are placed. Put some sort of weight on top of each tube of cans to provide downward force while they dried (see Figure 5). Bricks were used here. Let your tubes dry overnight before removing from the jig.

After you have made all nine of the tubes, it is time to drill the nine holes in each of the two 1x4 inch boards. These boards are called the top and bottom "headers," and they separate the manifold from the cold air entry point and the hot air exhaust hole.

The holes in the headers into which the tubes are inserted are cut using the 2-1/8 inch hole saw and the cordless drill. In order to get the holes spaced properly, take nine loose cans and line them up along the boards. Then trace the outline of the cans. Then, make a mark at the center point of each circle. Using the hole saw, cut out each circle. If you have it a file available, lightly file the edges of each circular opening.

To assemble the manifold, lay your tubes of cans on the floor parallel to each other. Then, place an ample amount of silicone on the top and bottom of each tube. Then firmly press the headers in place on the top and bottom of the tubes. To hold them in place, I left the assembled manifold on the floor, pushed it against a basement wall, and then placed a heavy object against the other end. Let the manifold dry overnight before you move it. The completed manifold is shown in Figure 6.

Step Seven: Paint & Install the "Manifold" & Complete the Frame

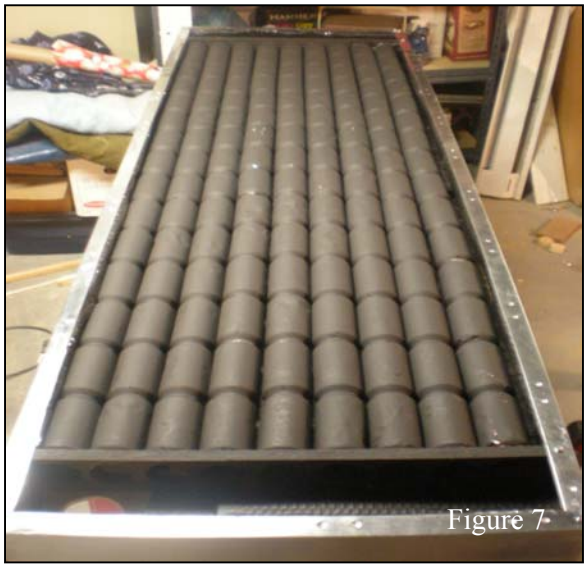
Figure 7

After the manifold has dried overnight, paint it completely with no less than two coats of the high heat black paint. Just be sure to do this in a well-ventilated area, as the paint smells quite a bit. I painted my manifold outside in 35 degree Fahrenheit temperature and it dried just fine in a few hours.

Once the manifold is dry, slip it into your three-sided frame. Then, scribe a line along the headers. Remove the manifold, and cut out that part of the insulation onto which the headers would sit. If you do not, the manifold will not fit into the side rails. Also, at this point, it is a good time to cut the intake and exhaust holes. I placed my intake at the bottom left below the header and my exhaust at the top right above the header (see Figure 7). To make accurate sized holes, used the smaller side of the plumbing adapter to trace a circle. Cut the holes for your intake and exhaust adapters using a jigsaw.

Once you have cut the insulation in the areas where the headers will rest and out the entry and exits holes, slip the manifold back into the frame. At this point, you can finally install the fourth side of the frame! Secure the fourth side of the frame at the corners using the machine screws. However, do not secure the manifold to the side rails yet. This will be done once the cover is installed.

Step eight: Installing the Cover and Sealing the Unit

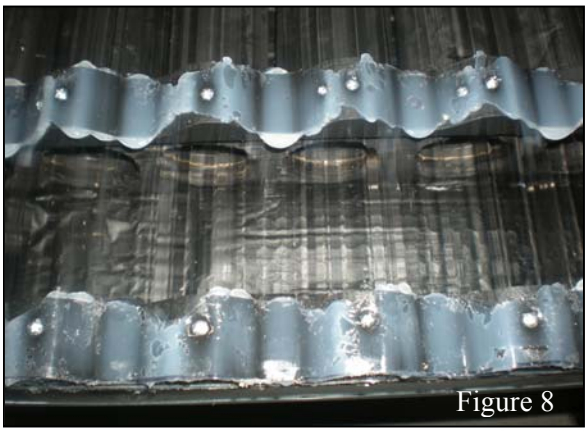
Figure 8

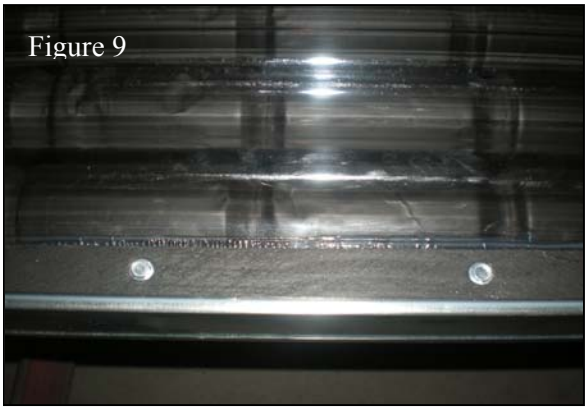
Figure 9

Once the manifold is seated within the frame and the frame is secured at all four corners with the self tapping screws, it is time to put the polycarbonate top on and seal up the unit. First, cut the polycarbonate sheet to 82 inches in length. Next, cut 24 inch long pieces from the wavy corrugated roofing support piece. The pieces are shorter than the width of the unit on purpose. This will make sense later. Paint the support pieces with the black paint. Once the paint has dried, center the supports so 1 inch is exposed on either end, and silicone them in placed, with one on each end of the frame, as well as one on top of each header (a couple wood screws in each will hold them in place while you put the top on).

Now to put the polycarbonate top on and seal it up. Before you go ahead a silicone the supports and get ready to put the top on, it is very important to make sure that the "waves" in the supports all line up the same way so that when the top is applied the ridges all fall into the valleys correctly and in a linear fashion. It is also crucial to put the top on so that the wavy portions of the long edges face up. These edges

will be your attaching points for the polycarbonate sheet to the frame. As seen in Figure 9, I cut strips of wood measuring 1/4 inch thick by 82 inches long. I used these strips as a bolting surface on the sides of the frame.


Figure 10

Once you are confident, everything fits together well, run thick beads of silicone along all four edges of the frame, as well as on the wavy supports on the headers. Then place your polycarbonate sheet in place. Place a self-tapping screw on each of the ridges at the ends of the unit, as well as long the length of the headers. Next, place the thin wooden strips on top of the long sides of the polycarbonate sheet and secure them down every 6 inches or so using the self-tapping screws. Remember to drill pilot holes or the wood will split. Next go around every seam and gap and fill it with silicone so that the unit is completely sealed from the elements. Finally, turn the unit over and silicone your intake and exhaust adapters in place (see Figure 10). Finally, let it dry overnight.

SUMMARY:

The unit shown here was built in stages over the course of just about two weeks. As mentioned above, it is remarkably efficient and can produce exhaust temperatures upwards of 185 degrees Fahrenheit, so long as it is exposed to the sun on a more or less constant basis. This unit could undoubtedly be built of other materials (e.g., wood for the frame and glass for the top), and could be made smaller or larger depending upon your desired application. I chose the materials listed above because they were easy to get and I think they will survive the elements for a long period of time. The total cost of the unit above was right around $100.00.

LINKS:

For information related to solar heating units or to the material used to build the one shown here, you can visit the following websites:

www.builditsolar.com

www.youtube.com (type in beer can solar heater for a keyword)

www.cansolair.com (excellent example of large scale units)

www.shurtape.com

www.rustoleum.com

www.gesilicones.com