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Suzie the Sustainable Scorcher

Andrew Beacham  
*Colby College*

Spencer Martin  
*Colby College*

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Storage and Distribution

Radiant heating uses a series of tubes to distribute heated water throughout the main hut and cabins. However, the boiler isn’t always running, so the system needs some kind of battery to even out the huts heat availability. Water has a very high heat capacity, and this property is incorporated into the 800 gallon water tank battery. The storage tank is super well insulated, so it resists changes in temperature and therefore makes for great thermal energy storage. Pipes are connected from this tank to the hot water system, as well as the heat exchangers which provide heat to the radiant floor heating system.

Radiant floor heating is more effective than forced air induction or typical baseboards, as a result of the thermal mass of the floor, and the surface area of the heating. It effectively turns the entire floor into one large baseboard, evenly heating the room, with air flowing upwards as it is warmed. The closed loop system begins when the cooled water is heated by the water-battery, and then pumped to whichever zone is calling for heat at the time. The warm water is looped through the floor, transferring its heat to the surrounding flooring, and therefore the above room. The cooled water now returns to the battery, which restarts the cycle. The water-battery can be re-heated independently of the huts being heated.

Who’s Suzie?

Suzie is the heart of the Flagstaff Hut Heating System. It is a biomass boiler that is over 80% efficient. It is rated up to 171,000 BTU, or about 180,000 kilojoules. It supplies the hot water system as well as a thermal storage tank. Annually, Suzie consumes 20 cords, or 2500 cubic feet, of dry wood. This wood is first gasified, meaning the combustible gases are extracted before burning. The combustion chamber introduces compressed air, and the flame that is produced heats to temperatures well above 1700 degrees Fahrenheit. This process produces syngas, which is a combination of Hydrogen and Carbon Monoxide gas. These products are then “cleanly” burned at a high efficiency to heat the 48 gallons of water which are used for heat transfer, which flows to the thermal storage tank.

The average weight of a cord of wood to be 2 tons, 40 tons of wood are used every season ($4,000). Since 1 ton of wood has a heat content of 15,620,000 BTU, 624,800,000 BTU are used annually at the hut. That is the equivalence of using over 4,500 gallons of oil per year. ($12,560). Using wood or biomass is net carbon neutral. Pounds of CO₂ emitted.

Alternative Systems

There’s no such thing as a free lunch, right? But what if instead of being free, it just had no additional costs. All of the payment, in the form of energy loss, is going to occur either way. This is the case for the solar heating system, and the payment comes from the glass holes in the wall. Windows, of course, are much less insulating than walls with several different layers of insulating compounds. The R-Value of the ceiling was 32. This means that the ceiling is very well insulated and minimizes heat loss. Windows, however, are not this well insulated. They had an estimated R-Value of 11. So the heat is coming into the large room and warming the slab floor, which therefore continues to warm the room even after the sun goes down.

Flagstaff has a propane backup heater, which could lead to some questions? Why would this be needed if Suzie is so great? The issue is that Suzie is too good. Running at capacity of 171,000 BTU, the boiler is very efficient. However, in the summer, throwing in a log or two at a time isn’t a good way to heat the water of the shelter. Below peak efficiency, it doesn’t make sense to run the full boiler. It is much more efficient to run a smaller propane boiler to heat the small amounts of water the huts use during warm months.