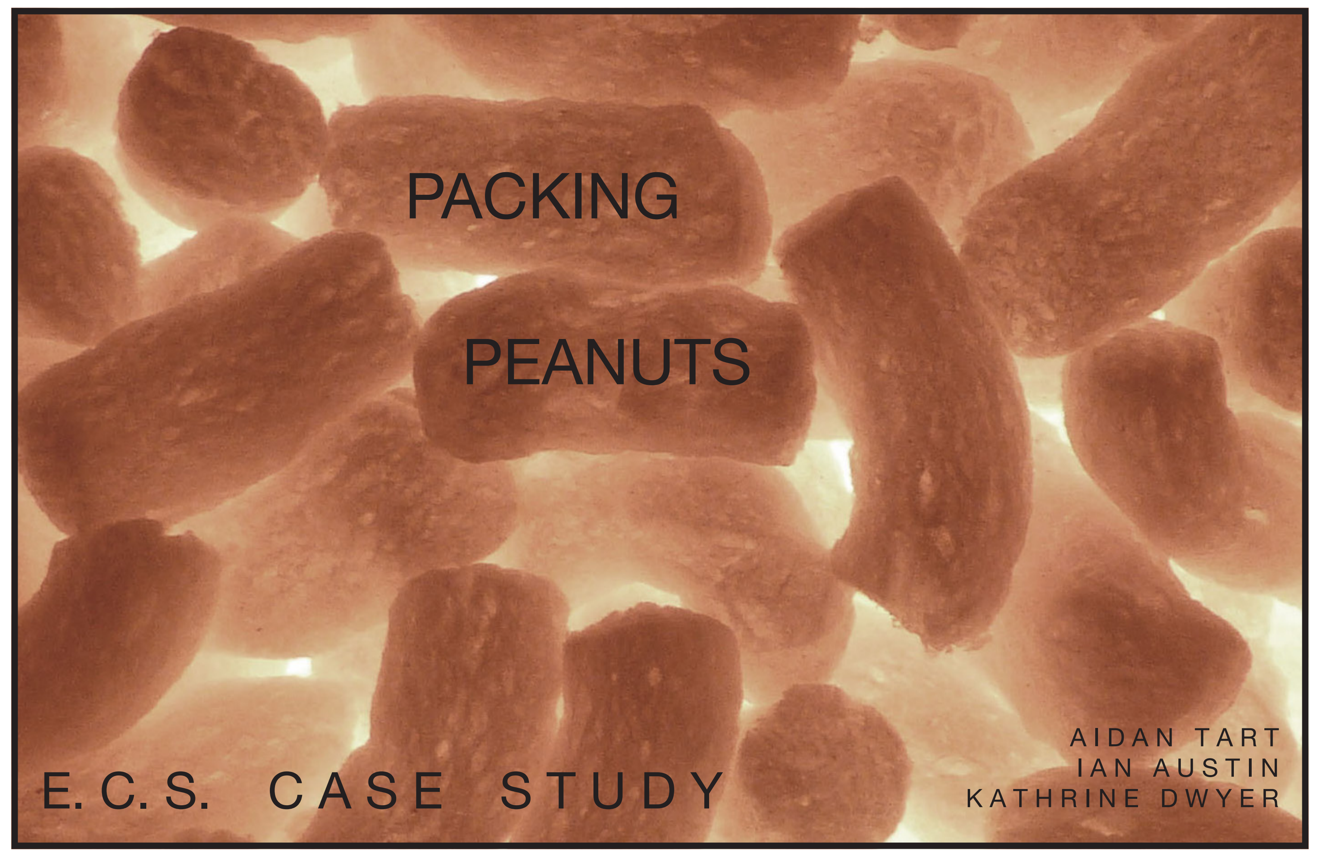


F A C T S A B O U T P O L Y S T Y R E N E

- Takes over 140 years to Biodegrade
- Degrades into Harmful Carcinogens
- Manufactured from petroleum
- Not economical to recycle
- May pose health risks

+ Excellent Insulator- Due to it's insulative values, it can return up to 200 x the amount of energy required to produce it.
+ Easy to mold into many shapes.
+ Can be used under foundations to prevent freezing and thawing

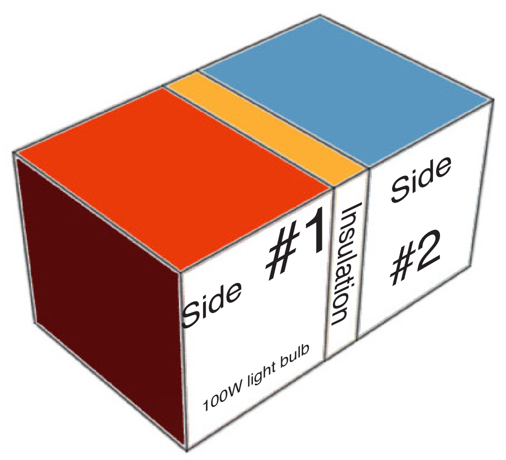
A B S T R A C T

In our consumer society, the ultimate and most lasting product is, without a doubt, the landfill. We produce massive amounts of materials and products which have a functional lifespan of a month or a year and then discard them as waste to decompose for hundreds or thousands of years. Our goal is to discover which materials can be reused so that such destructive cycles can be slowed or even reversed. Responding also to the inefficiency of buildings, we have honed in on Styrofoam. We believe that this material, which is otherwise thrown away, can be used to add insulative value to double pane windows. During the night, or whenever views are not desired, broken down Styrofoam would fill the gap between the panes of glass to add extra insulation. We plan to test our theory by using a hotbox to determine the R-values of window sections with and without the Styrofoam filler. If we are successful, then will have discovered a positive use for a destructive product.

H Y P O T H E S I S

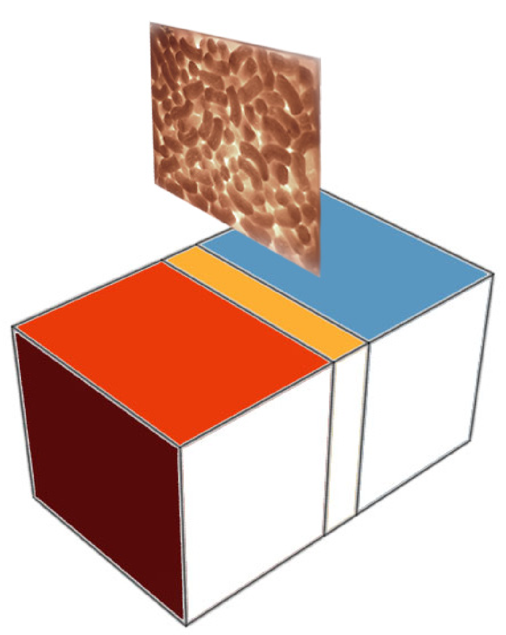
When the 3" gap between the panes of a 1' by 1' double pane window is filled with recycled packing peanuts (expanded polystyrene), that windows resistance to heat flow will increase by more than 8 h ft^2 F/ Btu.

M E T H O D O L O G Y



Materials:

+ One sheet of plywood.
+ Two ¼" dowels to construct the heat box without the use of nails because of their ability to serve as thermal bridges.
+ Two pieces of 10" x 12" glass.
+ Enough rigid insulation to completely cover the interior of the heat box.
+ One 250 watt heat light.
+ One extension cord.
+ Enough recycled Styrofoam to fill the 3" gap between the two sheets of glass
+ 3 HOBOS to collect data from within both chambers of the heat box as well as monitor the outside control temperature.



Testing Process:

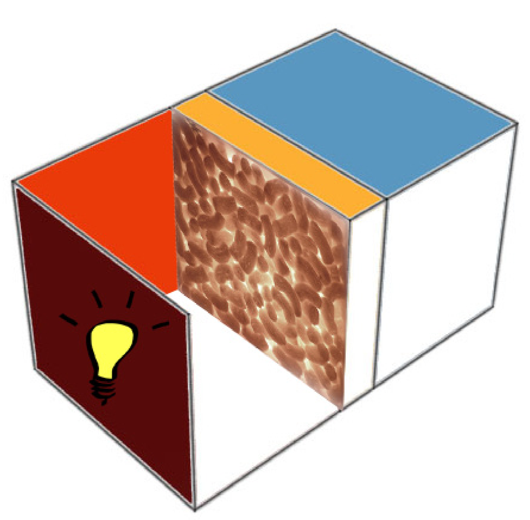
+ Place HOBOS in both chambers of the heat box, and a third HOBO in the same room but away from the heat box to keep a control record of the surrounding temperature.
+ Turn the devices on to begin collecting data.
+ Turn the heat lamp on.
+ Secure the lid of the heat box as quickly and securely as possible
+ Collect data for 10 minutes with the heat lamp on
+ Turn the heat lamp off
+ Collect data for an additional 15 minutes as the heat box cools

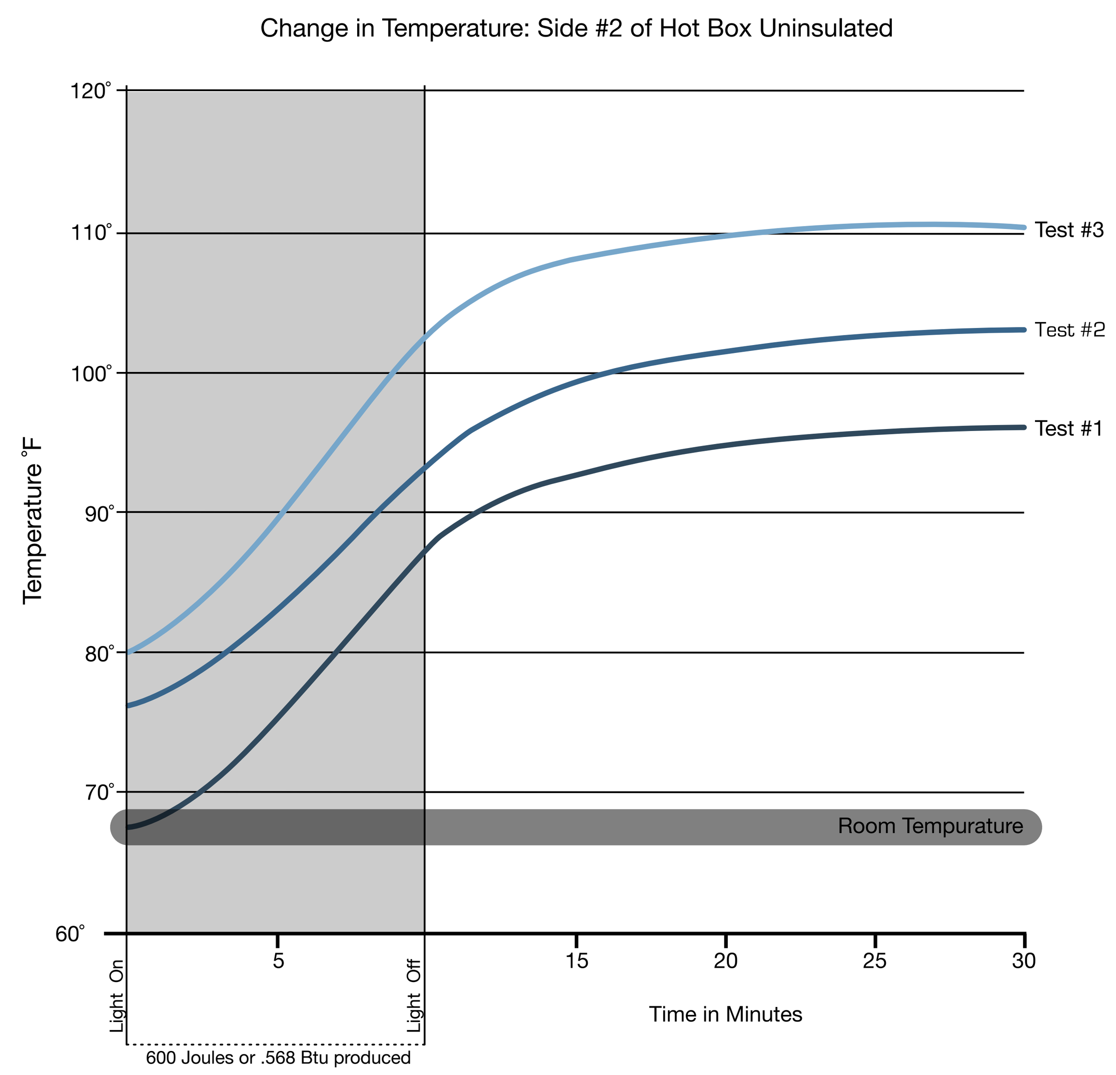
+ Account for some potential error in the data between the time the heat lamp is turned on and the lid is securely fastened because of massive infiltration

+ Repeat the testing process 3 times with varying control temperatures to gather multiple sessions of data that can be used to rule out fluke test results, and also use this data to find strong averages of measurements. This is the control data that will be used to compare to the data gathered from testing the glass with the Styrofoam in place.

+ Compact the recycled Styrofoam into the 3" space between the panes of glass.

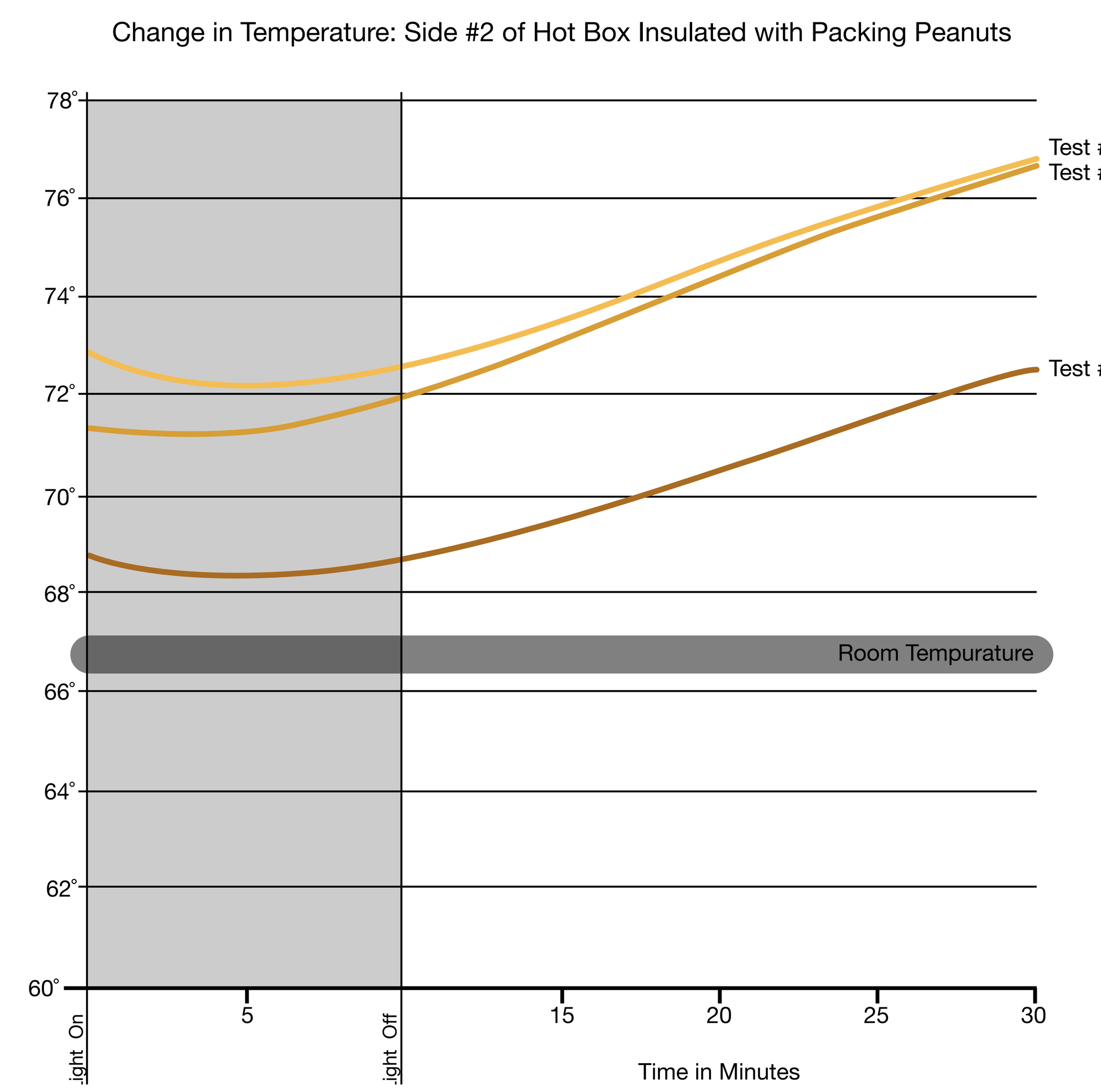
+ Repeat the testing process 5 times under the same conditions as the first times, now with the Styrofoam in place, in order to gather the data that is most important to this case study. Once all testing sessions are complete, the changes in temperature within the heat box when the "window" is empty and when it is filled with recycled Styrofoam can be compared and a conclusion as to whether or not the Styrofoam made an impact, or how great an impact, can be drawn.





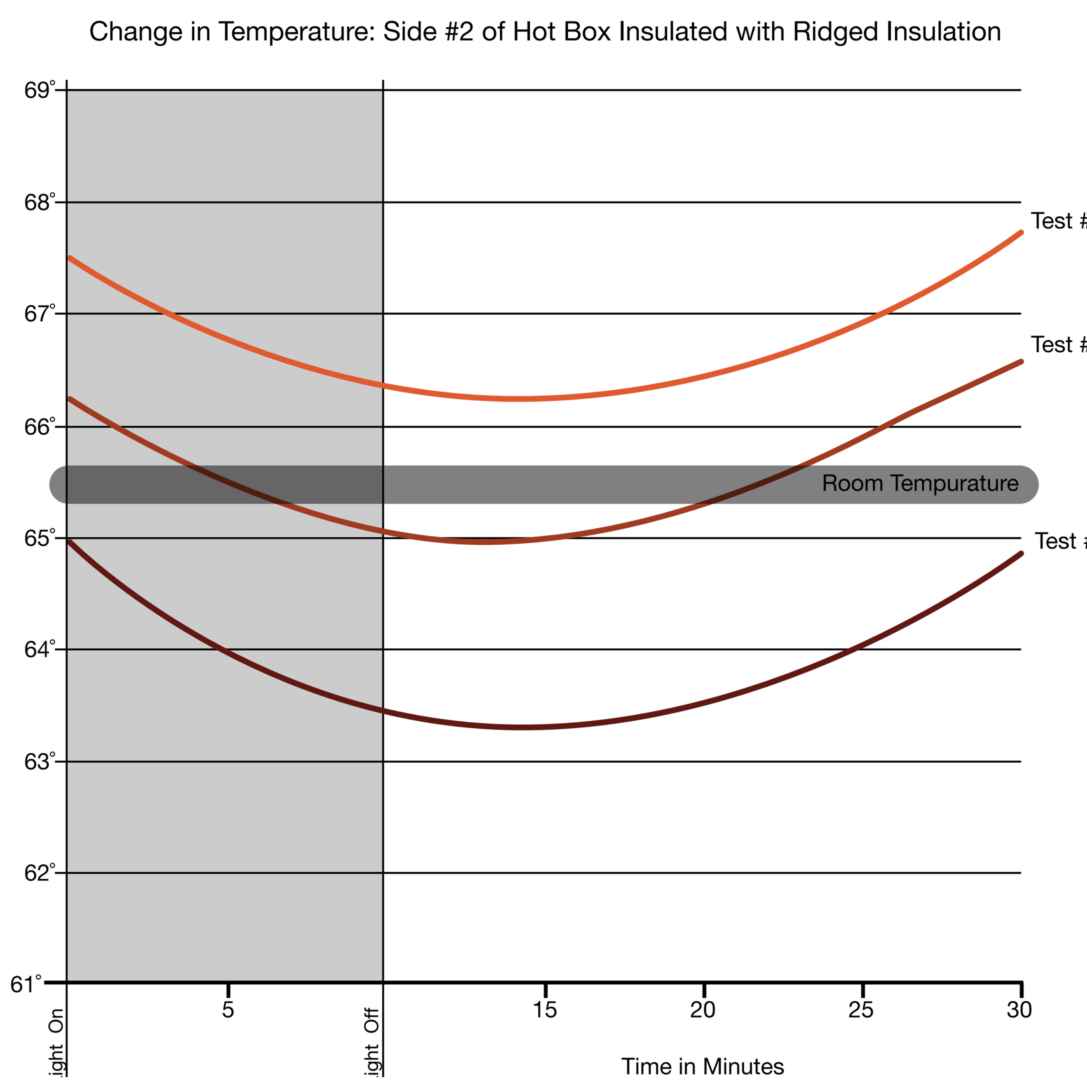
Analysis:

In these first tests the hot box was run with no insulation. These three tests show that with no insulation, there is a dramatic increase in temperature on the side opposite the lamp (side #2), with little to no lag time. Without insulation, the glass, airspace, and air films have a combined R-value of 4.4. One factor that may be amplifying the increase in temperature is the light absorbed by the insulation of the side opposite the lamp. Some of the light must be absorbed and radiated out as heat.



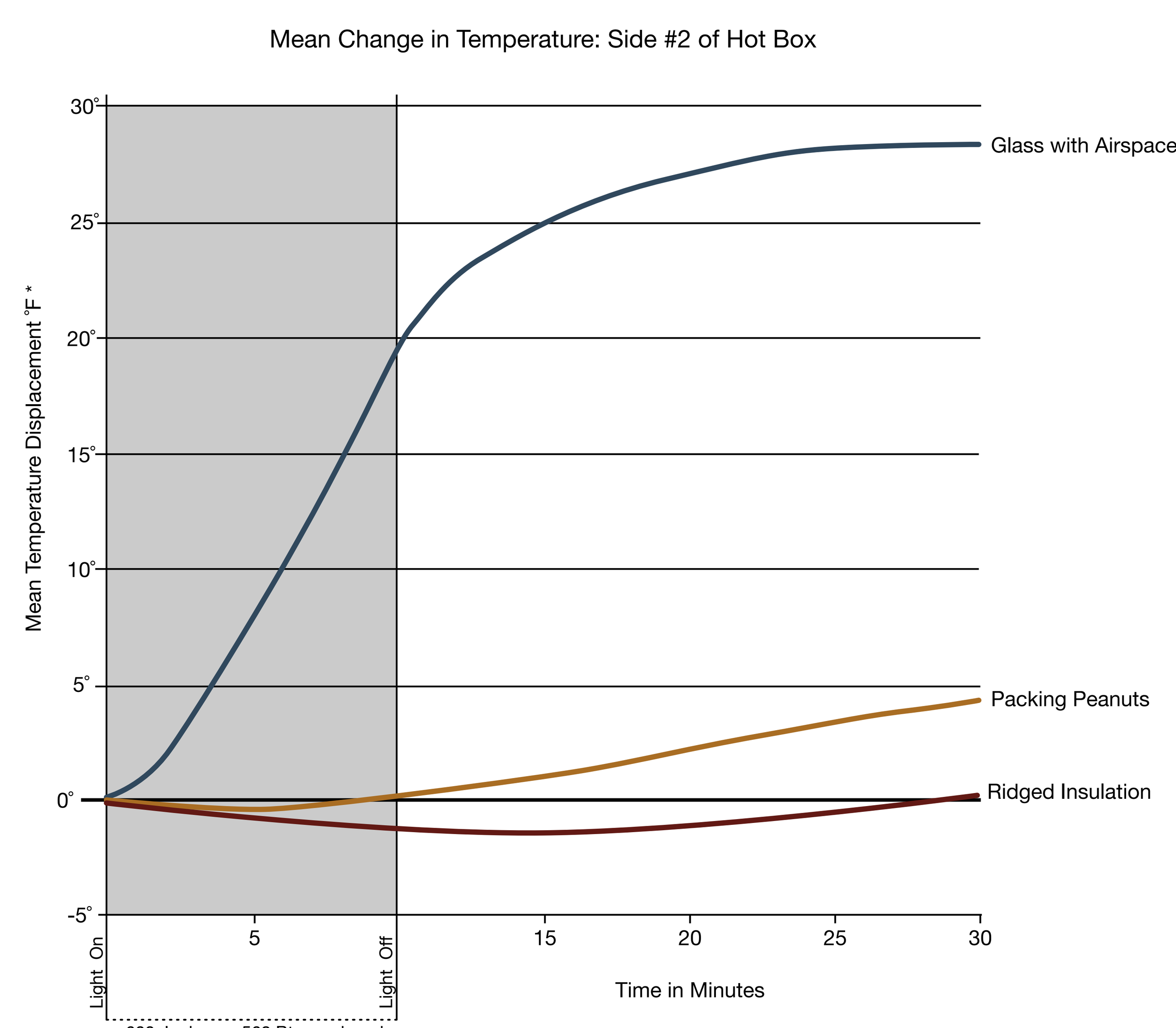
Analysis:

Filling the 3" gap between the glass panes of the hot box with packing peanuts reduced heat loss dramatically. Without the peanuts the change in temperature was around 28° F. With them, the change in temperature was reduced to just 5° F. Also, there appeared an apparent lag in heat flow. Side #2 lost heat until after about 5 minutes it reached equilibrium, then started to gain heat. Because side #2 resisted the heat flowing into, side #1 heat up much more quickly than it did without the peanuts.



Analysis:

The packing peanuts seemed to work very effectively, but they were no match for the 2 sheets of ridged insulation (R-7.8 total. With the ridged insulation, the temperature only rose 1.8° F on average within the 30 minutes of testing. The time lag was about 3 times that of the packing peanuts, taking around 15 minutes for side #2 of the hotbox to reach equilibrium.



Analysis:

This chart makes the average heat flow visible by showing change in temperature as a function of time. Without insulation, side#2 heats up steadily while the light is on, but heat gain immediately decelerates when the light is turned off. When the airspace is filled with packing peanuts however, the temperature hardly increases while the light is on, and heat gain slowly accelerates after the light is turned off. This lagging effect is even more dramatically illustrated by the ridged insulation.

Conclusion:

Our insulated double paned window performed very well compared to a standard double paned window. We did not, however, manage to prove our hypothesis correct. The goal R-value for our window system was R-8, better than the rigid insulation that was used as a comparative test. Unfortunately, the system fell just shy of the goal, achieving about an R-7 rating. This is still a significant improvement from a standard window system, and is also a very conceivable system.