THERMAL BLANKETS

Allen C. Botacchi
Regional Extension Agent — Horticulture

Research on thermal blankets has been conducted at Penn State, Rutgers, and other universities for over five years. Researchers have reported fuel consumption reductions of 20-40% when tightly sealed blankets, especially along the edges or on sidewalls were used.

Components of the system include: drive mechanism, support, blanket, and controls.

Figure 1. The simplest thermal blanket—clear polyethylene pulled by hand over wires from eave to eave. Note wires to protect the plastic from the steam main. If this "thermal blanket" is pulled after sunrise, little light is lost.

Other Modifications
Sidewall insulation 5-10
Foundation insulation 3-6
Insulating ventilation fans 1-5
Heating systems
   Automatic fire tube cleaners 6-20
   Turbulators in flues 8-16
   Stack heat recovery unit ?

Maintenance
Structure 3-10
Heating system 10-20

Miscellaneous Factors
Windbreaks 5-10
Greenhouse orientation 5-10

The above table will serve as a guide to determine expected savings. These can be inserted into the formula discussed earlier.

Do not just complain about high energy costs. DO SOMETHING. Do it intelligently and economically.

REFERENCES


System Cost/sq.ft. = years to payback
Energy Cost Saved/sq.ft./yr. = 2 year payback

$2.00 (Curtain System) $1.00 (Ave. Energy Savings)

Example #2

An estimated cost of installed lap seal is $1.00/sq. ft. Calculated energy savings of 15% annually should be realized, or $0.45/sq.ft/yr.

Following the above formula:

\[
\frac{$1.00}{\$0.45} = 2.2 \text{ years payback period}
\]

These are only examples. The best figures are your own. Keep consistent, accurate records and calculate your actual savings.

To be more exact, a grower should add a maintenance, operational, and/or replacement cost to any system used. In the above examples, the thermal curtain may need to be replaced every five years and the lap seal is guaranteed for 10 years. These are additional factors and costs which must be included.

Anticipated energy savings from different conservation methods are found in the following table taken from Badger & Poole (1979)

<table>
<thead>
<tr>
<th>Method</th>
<th>Annual % Saving Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass</td>
<td>0 (Base)</td>
</tr>
<tr>
<td>Major Modifications Continuous</td>
<td></td>
</tr>
<tr>
<td>Double plastic film over glass</td>
<td>40-60</td>
</tr>
<tr>
<td>Glass lap sealants</td>
<td>5-40</td>
</tr>
<tr>
<td>Single plastic film over glass</td>
<td>5-40</td>
</tr>
<tr>
<td>Double layer plastic film</td>
<td>30-40</td>
</tr>
<tr>
<td>Periodic</td>
<td></td>
</tr>
<tr>
<td>Curtains</td>
<td>20-60</td>
</tr>
<tr>
<td>Polystyrene pellets</td>
<td>60-90</td>
</tr>
<tr>
<td>Liquid foam</td>
<td>40-75</td>
</tr>
</tbody>
</table>

DRIVE

The common drive system consists of pulleys and cables. A slip clutch must be installed on the main drive to protect it and the blanket. Commercially available linear induction motor systems (mounted in the support tracks) are also available. Many systems are manually operated.

SUPPORT SYSTEMS

Prior to installing any support system, the greenhouse structure must be evaluated to determine that it can stand the additional loading. Curtains or blankets may be pulled gutter to gutter (suggested manner) or gutter to gutter.
to ridge. Blankets are normally pulled end to end in quonset-type greenhouses.

Supports consist of track, cables, wires or rope. A track system is preferred in a long span, where the load is evenly distributed over the entire structure. Blanket wear will be reduced in cable systems, when the blanket is suspended by small pulleys.

**BLANKETS**

Reflectorized coated plastics should always be placed with the reflective side outward. Research indicates that solid blankets will reduce heat loss 10-30% more than a porous blanket. Porous blanket materials do allow air and water vapor passage. Less expensive materials such as clear or black polyethylene are very effective but do not fold well. Regardless of the blanket material selected, the following factors must be considered: ease of installation, ease of operation, high tear strength, longevity, flame resistance, and economy (reasonable payback period).

![Figure 3. A close-up of the "closet clothes hangers" used to hang the black poly in Figure 2 for ease in pulling.](image)

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**COST PAYBACK OF SYSTEMS FOR ENERGY CONSERVATION**

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Regional Extension Agent — Horticulture

A number of energy conserving techniques and procedures have been covered in this issue. Grower acceptance and adaptation of any of these systems will be determined by range layout, type of houses and the cost payback.

Let us assume that, after weighing the many factors, a grower considers several systems which would work in his range. How does he select the best system, economically speaking? Each grower will have to calculate his "Cost Pay Back Period." Simply stated, how long will it take to recover the cost of the system as a result of the cost of the energy saved?

One note of caution—major greenhouse improvement costs should be paid off in a maximum of six years in today's economy. If the inflation rate and fuel oil or other energy prices continue to rise, the payback period will be significantly reduced.

Now that we have defined cost payback period—how do you use it?

For example, take a hypothetical greenhouse range of 10,000 sq. ft. of glass located in an open unprotected area. Crops are maintained at 60°F at night. Present fuel and electric power consumption costs $3.00/sq.ft./yr.

**Example #1**

An installed thermal curtain costs $2.00/sq. ft. Calculated energy savings of 33% should be realized annually, or $1.00/sq.ft./year.
be provided by installing a 4 to 6" stovepipe from outside the building to near the stove.

9. Where the tank stove supplements an automatic heating system, locate the thermostat at least 15 feet away.

10. Keep stovepipes clean to increase efficiency.

11. A small hot fire will create less creosote problems than a large smoldering one.

All heat should be located below the blankets except for snow clearance lines.

CONTROLS

Operation of the curtain system may be automated with a time clock or photocell. A snow warning device to automatically open the blankets during a snow storm is strongly advised. All automatic systems should also have a manual opening mechanism.

ALTERNATE USES

If the blanket system can be used for day length control and/or shading, the cost can more easily be justified.

PROBLEMS

1. Difficult and expensive to retrofit in purlin post houses or houses which contain many heat lines above the blanket.

Figure 4. An automated thermal blanket in a large greenhouse.
2. Day storage of the blankets will cause some shading and may reduce crop quality.

3. Nonporous blankets collect condensate dripping from the roof. It may also raise the humidity under the blanket.

4. The melting frost from the inside of the glass may cause crop damage.

5. If the curtain is not retracted during a snow storm and damage should occur, insurance may be nullified.

INSTALLATION COSTS

The cost of an internal blanket system ranges in price from $0.30 to $0.85/sq.ft for a manual system to $1.20 to $3.00/sq.ft. for an automated one.

Figure 5. An automated, translucent and permeable thermal blanket that can be used for summer shade and averts the problem of "bages" of water from overhead, drip from condensation or leaks. It may be somewhat less efficient than some other blankets.
One factor that affects the efficiency of the stove is the length of stovepipe used. The pipe should be long enough to radiate as much heat as possible without cooling the gases to the point where creosote builds up. A stovepipe length of 10 to 15 feet is desirable.

IMPORTANT: The pipe should not be placed any closer than 12 inches from any combustable material. Where possible it should be connected to a chimney flue. If it is necessary to place it through a wooden wall, a three foot square hole should be cut in the wall and combustable material removed. This should be covered with 1/4 inch or 3/8 inch asbestos-cement board and a hole for the stovepipe cut in the center of the board. If the chimney is to be placed through a window, remove the sash and replace it with asbestos-cement board or sheet metal. The stovepipe should be securely attached to the outside of the building with stand-off brackets that keep it at least 12 inches from any combustable material. It should extend at least three feet above the highest part of the roof and be covered with a stovepipe cap. A damper and automatic draft control should be used.

To get as much heating value as possible from the wood that is burned, the following rules should be observed.

1. Use dry wood for more heat and less creosote build-up.
2. Wood should lie flat in the fire box.
3. Pack wood in the firebox with narrow spaces between pieces.
4. Keep a layer of ashes in the bottom of the firebox for insulation.
5. Do not pile wood up near the smoke outlet as the gases are drawn up the chimney before they are burned.

PAYBACK PERIOD

Payback period or return on investment is about 2-3 years. One grower, however, felt that the fuel saved in January and February paid for the blanket material.

REFERENCES


Figure 6. A blanket pulled lengthwise in a hoop house which is also used for daylength control of chrysanthemums.


This oil tank wood stove is built using a 275 gallon oval fuel oil tank. These tanks can be purchased new but a used drum is satisfactory. Sometimes a tank that has developed a few small holes and cannot be used to hold liquid can be obtained at almost no cost. Any used tank should be thoroughly drained and then cleaned with a strong detergent and water. Plugs should be put in all pipe openings. Doors and chimney can be cut using a cold chisel and a heavy hammer. Do not use a cutting torch or electric welder. This could cause an explosion of any remaining vapor.

The tank should be mounted on pipe legs with the bottom of the tank being about one foot above the floor. Pads should be welded to the bottom of the legs if the stove will be set on the ground or a wood floor.

The ideal door is a cast iron furnace door with damper. If this cannot be obtained, a chimney cleanout door or just reenforcing the steel cut out of the tank end will do. Edges of the metal should be ground or filed smooth. Fire brick or a three inch layer of sand should be placed in the bottom of the stove to prevent the tank bottom from burning through.

The tank stove should be installed to meet state and local building codes pertaining to heating equipment. In general, the stove should not be placed any closer than three feet from any combustible material. If it is to be placed on a wood or other combustible floor, the floor should be covered with 3/8 inch asbestos-cement board covered with No. 24 U.S. gauge sheet metal. This covering should extend at least six inches beyond all sides of the stove and at least 18 inches out from the front where the fuel supply door is located.