Minimizing Energy Use for Produce Cooling
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EQUIPMENT LOAD:

A fruit or vegetable cooler is totally different than a restaurant or convenience store cooler. In a restaurant or convenience store, the cooler has a constant load, the product already arrives pre-cooled, and packaged, and the cooler humidity is designed to be as low as possible to keep the product and packaging dry.

In a fruit and vegetable cooler the product arrives at varying temperatures anywhere from 50º - 90ºF and has to be cooled as quickly as possible to retain its moisture and quality. The quicker the product is cooled the longer the shelf life. Also humidity is kept as high as possible so we don't get product shrinkage or break down.

Fruit and vegetable coolers are designed to store specific products. If we have 5,000 pounds of apples and 5,000 pounds of sweet corn we may have the same cubic volume and possibly even weight, but sweet corn generates 10 times more heat than apples so the refrigeration system must be sized accordingly.

INSULATION LOAD:

In a fruit or vegetable cooler the majority of our cooling load is the product, pulling field heat out. The cooler wall load is usually about 25% of the total load.

Adding excessive insulation may be a waste of money because it doesn't change the size of the refrigeration equipment. The amount of insulation will hit a point of diminishing returns. Using more than you need will cost more than the energy it saves. The insulation load must be calculated for the specific requirements. A closed cell foam insulation like urethane is best as it does not absorb moisture to reduce its insulating properties.

INFILTRATION LOAD:

Outside air entering the cooler is the biggest load factor that a person can change: it must have a good vapor barrier, the cooler should be tight and well-sealed. The cooler door is a big factor in refrigerant load. The size of the door, tightly sealing door gaskets, and strip curtains on the door openings greatly affect refrigerant load, as does the number of door openings per hour.

PURCHASE BTU'S NOT HORSE POWER:

Depending on compressor size and manufacturer there is a lot of variance between BTU's and Horse Power. You could have 3 different compressors of the same H.P. and they may vary by 25% difference in capacity.

DEFROST: Air, Electric, Hot Gas

Air defrost turns the compressor off with a time clock while the evaporator fans run, good for maybe 38ºF and higher temps. Electric defrost has heater elements in the coil to melt frost, and hot gas defrost is a reverse cycle refrigeration system that uses hot refrigerant gas to melt the frost.

TO OPERATE BELOW 38ºF:

Electric defrost has the least expensive up front cost but is the most expensive to operate. Hot gas defrost systems are about 20 – 30% more expensive than electric defrost but they are the most energy efficient defrost system to operate. NYSERDA has given Customer Rebates to cover cost difference of these systems.

MULTIPLE REFRIGERATION SYSTEMS:

Having 2 smaller systems in a cooler compared to 1 larger system is more energy efficient. For example we could have 2 – 7-1/2 H.P. systems and start them separately, cutting out starting load by 50% of the larger 15 H.P. system. Also when the cooler reaches temp, one smaller compressor can handle the load instead of short cycling and starting and stopping a large compressor. This also provides the benefit of redundancy in case of a breakdown.

CONTROLS:

Use only digital thermostats. They are much more accurate and you can set the differential between on and off. There are several companies in the marketplace that offer control packages to save energy by eliminating defrosts. They work well on normal walkin coolers where the load remains constant. In fruit and vegetable coolers the load can change daily. This confuses these energy saving packages and may result in nuisance ice ups and actually cost more to operate.

OUTDOOR COOLING:

We use computer systems to cool with outside air, modulating the amount of cold air that can enter the storage to maintain temperature. They can also be tied into refrigeration systems. When it's warm outside the refrigeration runs and when it's cool outside we cool with outside air automatically within .1ºF. This is the most energy efficient system there is. Arctic installed a cabbage storage where we turn 70 H.P. of refrigeration off and use 6 H.P. to cool with outside air. This system is used on potato, cabbage, onions, and carrots, as well other crops.