ALTERNATIVE REFRIGERATION STRATEGIES FOR RURAL ALASKA

Walt Kallenberg, P.E.
Energy Sea Company
3705 Arctic Blvd. (PMB 127)
Anchorage, Alaska 99502
T 907-229-7831
E walt@energysea.com
W http://www.energysea.com/

Summary

Operation and maintenance costs present a special challenge for refrigeration systems in rural Alaska. Electric energy costs associated with conventional refrigeration systems utilizing mechanical compression cycles can make operation of community cold storage and process freezing systems cost prohibitive. Alternative refrigeration technology and system configuration strategies requiring less electrical energy are available for applications in rural Alaska.

Absorption Refrigeration (“Ice by Fire”)

Absorption refrigeration cycles utilize molecular forces and thermal energy to compress the refrigerant gas rather than mechanical compression. The refrigerant gas is mixed with an absorbent liquid to allow molecular forces to create a solution composed of refrigerant and absorbent liquid. This solution is pumped to a high pressure with much less electrical energy than mechanical compression of the refrigerant gas. The solution is then heated to
break the molecular bonds between the refrigerant gas and absorbent liquid, releasing the refrigerant gas at the higher pressure. The hot refrigerant gas is then condensed into a liquid and then expands to provide refrigeration in much the same process as the conventional mechanical compression refrigeration cycle.

The absorption refrigeration advantage lies with the ability to use thermal energy rather than electrical energy to create high pressure refrigerant gas required in the refrigeration process. Thermal energy can be derived more efficiently from fuel sources than electrical energy. In the case of rural Alaskan communities, the source of thermal energy can be the heat exhausted from the community electric power plant. Advanced absorption refrigeration technology is available that can utilize even low grade heat sources such as electric generator engine jacket water at temperatures of 80 degrees C. (180 degrees F.).

Absorption technology is currently being demonstrated in an absorption refrigeration system that produces ice utilizing waste heat from the electric power plant in Kotzebue Alaska. This absorption system was designed and constructed by Energy Concepts Company with the support of the Alaska Energy Authority and Kotzebue Electric Association in 1992. This absorption refrigeration system has successfully produced ice for community fishing operations every summer since.

**Eutectic Cold Cell Storage**

Refrigeration systems are often required to service high demand loads for short time periods in batch freezing processes. These high demand loads determine the size of the refrigeration equipment. Eutectic cold cells can be used to store refrigeration capacity for use during periods of high demand. Eutectic cold cells contain solutions with freeze points below -25 degrees C. (-13 degrees F.). Refrigeration capacity is stored in the cold cell as a eutectic “ice”, and can be used in the refrigeration process when required. This technology allows the refrigeration equipment to be reduced in size and operated over longer periods of time to take advantage of continuous thermal energy sources such as
waste heat rejected from a community power plant. The combination of absorption refrigeration and eutectic cold cell storage technology can provide more practical solutions for refrigeration systems in rural Alaska. The hybrid absorption eutectic refrigeration system can take advantage of smaller waste heat streams, relying on the eutectic cold cell storage system to meet short term periods of high demand. Eutectic cold storage systems are manufactured by Dole Refrigerating Company and are currently in use in numerous refrigeration system applications.

**Maintenance Monitoring Networks**

Maintenance monitoring of operating refrigeration systems is required to insure success of a community cold storage facility. Maintenance personnel costs are a significant consideration in the economic feasibility of any community project. Advances in control technology and communication systems make it possible to monitor refrigeration system operations in separate communities from a single location. A network monitoring system shared by several communities can reduce maintenance and operations costs and improve system reliability. Maintenance monitoring networks are in place in many applications in Alaska.