

Sweet success for new secondary solution

There has been concern over potential toxicity and corrosion problems associated with some heat transfer fluids used in refrigeration applications.

Alternative, more natural products may be safer, but technical problems have tended to restrict their use.

A new alternative, based on a by-product of the sugar industry, shows promise as a safe, efficient alternative in secondary cooling systems. It is based on a betaine (trimethyl glycine)/water mix, the active ingredient being produced during the processing of sugar beet. It is claimed to be completely non-toxic and non-harmful to the environment.

Betaine is well known in the pharmaceutical, cosmetic, food and medical industries. The solution has good heat transfer abilities, is not harmful to materials used in systems and has natural corrosion protection properties.

Development

A four year development programme was undertaken to optimise the characteristics of the fluid for use in heat hvacr transfer applications. The result, according to the researchers, is a proven non-toxic, non-harmful, non-corrosive fluid with good thermodynamic properties that can be used in many applications.

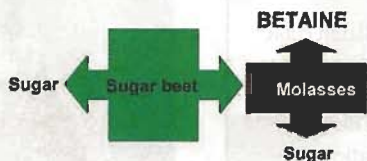
The optimised fluid has been patented and is now being commercialised under the name Thermera.

The most important technical characteristics of a heat-transfer fluid are freeze protection, thermal and microbiological stability, physical properties which ensure good heat transfer, and low induced corrosion.

The main environmental characteristics of a heat transfer fluid are that it has a low environmental impact, that it is non-toxic, safe

Major benefits are claimed for a new, natural heat transfer fluid, derived from sugar beet.

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to use, and easy to dispose of or recycle, and that the total costs over the product's life cycle are competitive. The importance of low toxicity has grown in recent years, due to tighter legislation and the rise of liability issues.

Chemically, betaine is a quaternary ammonium compound with three methyl groups attached to the nitrogen atom of a glycine molecule.

Performance

Technical performance was evaluated by measuring several different physical properties of betaine-water solutions and by conducting field tests in actual HVACR systems. Most measurements were done in (or for) the Fortum Technology Center, Porvoo, Finland.

With Thermera, the equipment burst protection reaches well beyond the freezing and congealing points of the fluid, say the researchers. No permanent physical changes could be induced in piping or other heat transfer

The heat capacity of betaine-water solutions was found to be in the same range as that of traditional fluids, although slightly lower than glycols'.

Typically, viscosity values rise when temperature drops and therefore forced

circulation of the fluid becomes more energy consuming and heat transfer less efficient.

Ethylene glycol and betaine fluids have similar properties in this regard, whereas propylene glycol fluids have higher viscosity.

Insight

All these properties provide an insight into the fluid's performance in heat transfer systems. However, it is worth noting that the importance of each property can vary significantly from application to application. The operating temperature range and flow characteristics in the particular system have to be taken into account.

Overall, the heat transfer efficiency of Thermera has been observed in field-tests to top that of most commonly used ethylene glycol based fluids.

Another fluid characteristic that needs to be taken into consideration when selecting a heat transfer fluid, is the solubility of the fluid in water. Glycols, for example, are not soluble in water, they are only mixable. As a result, glycol based fluids are never homogenous.

As a secondary result, evaporating effects need to be considered: with glycols the glycol evaporates from the water, lowering the freezing protection capabilities. In contrast, with Thermera, a true water solution, the water evaporates, increasing the freezing protection capabilities.

Thermera is non flammable and betaine has food approval in Japan and Korea and dietary supplement status by FDA in the US.

Corrosion rates for various materials with betaine based solutions have been measured. The results show that corrosion rate even without any corrosion inhibitors added is below levels accepted by equipment manufacturers in the HVAC industry (for copper for example, a corrosion rate up to 2.0 µm p.a is most commonly accepted). Corrosion speed for pure water is higher.

They conclude that life cycle costs for Thermera are "competitive with conventional glycol products if the costs of ownership are taken in consideration, and the installation properly designed for use with Thermera."

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