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Temperature Sensitive Chocolate Kitchens Use
DOWFROST™ Heat Transfer Fluids From Dow

MIDLAND, MICH—(January 26, 2009)— Candy bars, milk shakes, cookies, flavored coffee—even cereal and medicine! Chocolate is a key ingredient in many foods. In fact, it ranks as the favorite flavor of most Americans. And yet, few of us know the role of chemistry for making this popular treat.

Foods companies all over the country are using thousands of gallons of DOWFROST™ Heat Transfer Fluid from The Dow Chemical Company to manage heating and cooling during the incredibly heat and cold sensitive chocolate manufacturing process. Dow has decades of experience working with food manufacturers all over the world to help them keep their products cool. There is a lot more to managing heat and cold for chocolatiers than keeping the stuff from melting in your hands. Using an inhibited glycol heat transfer fluid in food manufacturing offers many advantages for manufacturers everywhere.

The major applications for inhibited glycol heat transfer fluids in the food industry fall into two broad categories: chilling/freezing of food and beverage products. Alternative heat transfer technologies all have serious drawbacks in these applications. In place of water, uninhibited glycols, alcohol or other methods, inhibited glycols like DOWFROST™ are much better suited.

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The following characteristics explain the preference inhibited glycols offer food manufacturers:

- The acute oral toxicity of propylene glycol is very low, similar to glycerin. Ethylene glycol is moderately toxic.
- Glycols provide good heat transfer ability and freeze protection with low volatility.
- Properly formulated with inhibitors, glycol fluids combat costly corrosion in heat transfer systems.
- Glycols are practically odorless and colorless, although they are sometimes dyed for easy detection of systems leaks.
- Glycol/water solutions (up to 80% glycol) are not considered flammable; they have no flash points when tested under the TAG closed loop cup method.

DOWFROST™ fluids have an effective temperature range of -50 F degrees up to 250 degrees F. DOWFROST™ is not recommended for use as a food additive but the low toxicity makes it very safe for use around food manufacturing, like chocolate.

Making Chocolate

From the plantation, where the beans are grown, to the factory where it is finally finished, chocolate making is dependent on strict temperature management. If chocolate gets too hot or too cold, its appearance and texture can change. The change in appearance is the result of the size of the crystals in the chocolate. Uncontrolled crystallization of cocoa butter typically results in crystals of varying size, some or all large enough to be clearly seen with the naked eye. This causes the surface of the chocolate to appear mottled and matte, and causes the chocolate to crumble rather than snap when broken. The uniform sheen and crisp bite of properly processed chocolate are the result of consistently small cocoa butter crystals produced by the tempering process.

The fats in cocoa butter can crystallize in six different forms (polymorphous crystallization). The primary purpose of tempering is to assure that only the best form is present. The six different crystal forms have different properties.

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Crystal	Melting temp.	Notes
I	17 °C (63 °F)	Soft, crumbly, melts too easily.
II	21 °C (70 °F)	Soft, crumbly, melts too easily.
III	26 °C (78 °F)	Firm, poor snap, melts too easily.
IV	28 °C (82 °F)	Firm, good snap, melts too easily.
V	34 °C (94 °F)	Glossy, firm, best snap, melts near body temperature (37 °C).
VI	36 °C (97 °F)	Hard, takes weeks to form.

Making chocolate considered "good" is about forming as many type V crystals as possible. This provides the best appearance and texture and creates the most stable crystals so the texture and appearance will not degrade over time. To accomplish this, the temperature is carefully manipulated during the crystallization.

Managing Heat & Cold

Generally, the chocolate is first heated to 45 °C (115 °F) to melt all six forms of crystals. Next, the chocolate is cooled to about 27 °C (80 °F), which will allow crystal types IV and V to form. At this temperature, the chocolate is agitated to create many small crystal "seeds" which will serve as nuclei to create small crystals in the chocolate. The chocolate is then heated to about 31 °C (88 °F) to eliminate any type IV crystals, leaving just type V. After this point, any excessive heating of the chocolate will destroy the temper and this process will have to be repeated. However, there are other methods of chocolate tempering used. The most common variant is introducing already tempered, solid "seed" chocolate. The temper of chocolate can be measured with a chocolate

temper meter to ensure accuracy and consistency. A sample cup is filled with the chocolate and placed in the unit which then displays or prints the results.

Two classic ways of manually tempering chocolate are:

- Working the molten chocolate on a heat-absorbing surface, such as a stone slab, until thickening indicates the presence of sufficient crystal "seeds"; the chocolate is then gently warmed to working temperature.
- Stirring solid chocolate into molten chocolate to "inoculate" the liquid chocolate with crystals (this method uses the already formed crystal of the solid chocolate to "seed" the molten chocolate).

Chocolate tempering machines (or *temperers*) with computer controls can be used for producing consistently tempered chocolate, particularly for large volume applications.

Storage

Molten chocolate and a piece of a chocolate bar; contrasts in temperature.

Chocolate is very sensitive to temperature and humidity. Ideal storage temperatures are between 15 and 17 °C (59 to 63 °F), with a relative humidity of less than 50%. Chocolate is generally stored away from other foods as it can absorb different aromas. Ideally, chocolates are packed or wrapped, and placed in proper storage with the correct humidity and temperature. Additionally chocolate is frequently stored in a dark place or protected from light by wrapping paper. Various types of "blooming" effects can occur if chocolate is stored or served improperly. If refrigerated or frozen without containment, chocolate can absorb enough moisture to cause a whitish

discoloration, the result of fat or sugar crystals rising to the surface. Moving chocolate from one temperature extreme to another, such as from a refrigerator on a hot day can result in an oily texture. Although visually unappealing, chocolate suffering from bloom is perfectly safe for consumption.

Regulatory Status

DOWFROST™ is covered and approved for use in food manufacturing by the United States Department of Agriculture (USDA), Food and Drug Administration (FDA) and the United States Department of Agriculture (USDA). Inhibited glycol fluids have successfully demonstrated their ability to upgrade process efficiency, extend equipment life and improve overall economy while contributing to greater system cleanliness and safety.

About Dow

With annual sales of $54 billion and 46,000 employees worldwide, Dow is a diversified chemical company that combines the power of science and technology with the “Human Element ” to constantly improve what is essential to human progress. The Company delivers a broad range of products and services to customers in around 160 countries, connecting chemistry and innovation with the principles of sustainability to help provide everything from fresh water, food and pharmaceuticals to paints, packaging and personal care products. References to “Dow” or the “Company” mean The Dow Chemical Company and its consolidated subsidiaries unless otherwise expressly noted.

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