Quick Facts

Company
Dare Foods
Ontario, Canada

Industry
Food & Beverage

Challenge
As Dare Food's tubular exchangers and kettles began to fail, they decided to look for more efficient equipment to help avoid excessive costs.

Solution
API provided a simpler design using a SIGMA 7 preheater plate heat exchanger and a SIGMA 26 for the evaporator to reduce residence time. This design not only saved Dare money but also produced a better-quality candy and actually removed an ingredient from the candy label.

Plate Heat Exchanger Heightens Product Quality at Dare Foods

For more than 120 years, family-owned Dare Foods has been producing high-quality snack foods, including cookies, crackers, fine breads and candy. Headquartered in Kitchener, Ontario, Canada, Dare sells its broad range of snack foods to customers throughout North America and in more than 50 countries around the world.

Dare operates six manufacturing plants in Canada and the U.S. In the company's Toronto plant, Dare operated tubular heat exchangers and batch kettles for the cook process of its candy production line.

When the tubular exchangers and kettles to make the candy began to fail, Dare executives hired Confectionery Consultant Walter Vink to assist them in the search for replacement equipment. Dare executives expected to maintain the same process; however, the consultant pointed them to potentially new and more efficient equipment that could help the company avoid excessive costs since the tubular two-stage process Dare had been operating would require a unit redesign and subsequent ASME and CRN certifications to meet legal code requirements.

The consultant actively pursued the possibility of using plate heat exchanger technology for the company's candy-making process. At the time, the technology was not new to the food processing industry, but it was novel for candy cooking lines. The consultant reached out to the Plate & Thermal Systems Group at API Heat Transfer in Buffalo, New York.

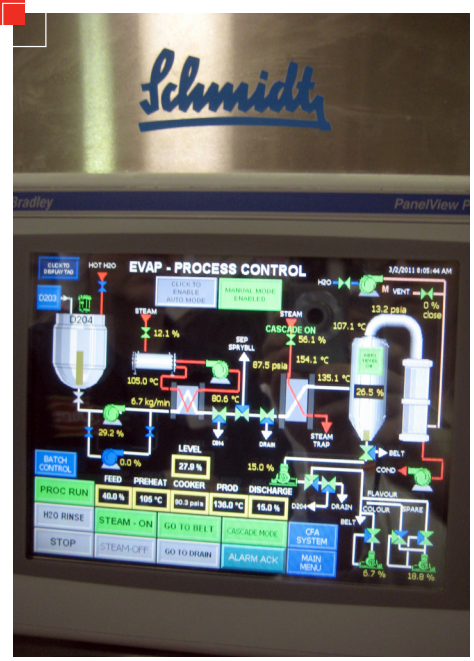
The confectionery consultant had learned about API's success in engineering plate heat exchanger processes for two of the top five candy makers in the world. Plate heat technology is advantageous because it enables a plant to concentrate as needed at a lower approach temperature, which more gently heats the candy and ultimately ensures a

Dare asked API to design a plate heat exchanger system to remove water from a **70%** solid solution to achieve a **98.5%** solid solution, leaving only **1.5%** or less water.

higher-quality product. Traditional tubular systems necessitate a high temperature that can lead to burn on.

The tubular system Dare had been operating required heating beyond the 140°C temperature only to flash down under a vacuum to the state where the sugar was at the right concentration. This process differs from plate heat technology, which uses continuous boiling.

For its hard candy products, such as Scotch Mint, Striped Mint, and Chocolate Mint, a solid solution of 70% is very water-like and easily pumpable but cannot be wrapped in a candy wrapper. Therefore, it is necessary to remove the water through evaporation so it can become more viscous and easily wrapped. The higher temperatures help keep the sugar solution flowing while the water is removed. Once the solution is at the proper concentration, or low level of water, it is cooled and formed into round candy shapes before it is wrapped.



The evaporator is absolutely necessary to reach the proper product condition from its beginning milk-like state. And, it must reach this state quickly enough to avoid turning the white sugar component yellow through heating.

Continuous boiling is easier to control and more consistent than using the flashing method. It also improves product quality since the temperature is actually lower, and there is a more even distribution of concentrate with continuous boiling in the plate.

The more the consultant learned about the plate heat exchanger process used to make high-concentration sugar applications, the more he was intrigued. He asked to see a demonstration of the process, so API sent its pilot equipment to Toronto for the consultant and Dare executives to test its performance. A process engineer from API's Plate & Thermal Systems Group traveled to Toronto as well to show the group how to operate the equipment. He said it was important for them to see the difference in product quality between flashing and continuous cooking.

The process engineer had to convince Dare that they did not need the vacuum to flash, and they could even drop the temperature lower. The executives listened but didn't believe it until testing was completed and the results proved the point.

The Dare team reacted very positively to the pilot test, acknowledging the benefits they saw with the plate heat exchanger. They agreed that the process produced a more consistent and higher-quality candy and decided to move ahead with the project.

The new plate heat exchanger system fit into the same footprint as the old tubular system and even allowed for an improvement as API designed an elevated platform.

Designing the System for Dare Foods

Dare asked API Heat Transfer to design a plate heat exchanger system to remove water from a 70% solid solution to achieve 98.5% solid solution, leaving only 1.5% or less water. In a solution that is mostly sugar and very little water, the sugar molecule tends to bind itself to the water molecule and requires more energy to release the water. This phenomenon is called boiling point elevation and for 98.5% solids, the heat needed to release the water is 140°C at atmospheric conditions. The equipment can reach this with steam as a source of energy at 148°C, which allows Dare to use their existing steam source at 50 psig, easily supplied by the facility's boiler.

API designed and built the system for Dare in API's Buffalo facility. To meet the prescribed duty requirements from the customer, API used a Sigma 7 preheater plate heat exchanger and a Sigma 26 for the evaporator. Preheating the incoming sugar solution allows the size of the evaporator to be reduced and ensures a good distribution. The preheated solution enters at the boiling temperature, and the boiling action starts rapidly, helping to accelerate the sugar solution through the heat transfer channels. This process reduces residence time, further contributing to higher-quality candy

API's plate heat exchangers are CRN- and ASME-certified. Its simpler design compared to the two-step tubular system saved Dare from having to redesign their system and apply for certification. It also saved the company money.

As a part of the design, Dare requested three-way divert valves to protect the equipment during a power outage. API engineered the equipment to include several of these valves that will open during a power outage. When the valves open up, all the sugar drops to floor, thereby protecting the equipment.

Dare also had a special positive displacement pump that they felt was imperative to reuse from their old system. API worked to build this pump into the new system. Thus, API pre-assembled as much

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equipment as it could at its Buffalo facility and then shipped it to Dare's Toronto manufacturing plant. Dare had an install contractor on site, and API supplied oversight in the form of an engineer who traveled to the plant to supervise re-erection as well as conduct training with their operators.

The instrumentation on the computer-controlled system is easy to understand and clearly communicates to the operators what is happening with the equipment throughout the process. Operators can view the operation on a computer and make adjustments and manipulations far easier than they could on the previous equipment.

The new plate heat exchanger system fit into the same footprint as the old tubular system and even allowed for an improvement as API designed an elevated platform, enabling operators to walk around the equipment. This makes the equipment easier to maintain and service.

Better Color, Taste and Viscosity

After the system was installed and Dare executives saw the candy coming off of the belt, one of them remarked, "That's a winner!" They added that the candy was even better quality than what was produced during the pilot.

In addition to producing better quality candy, the reduced operating temperature of the plate system led to several other benefits. The candy has a better consistency, lower color formation, and notably, Dare no longer needs to add the whitening agent titanium dioxide to the candy. The fact that they could remove this ingredient from the candy label is a huge advantage.

Product output is more consistent as well. For example, during the production of Dare's Chocolate Mint candy, a chocolate mixture must be introduced and "wrapped" into the center of a hot, viscous, taffy-like sugar stream. Dare's former system did not produce a uniform concentrate stream, which resulted in a large number of "blowouts" at the final wrapping stage. Not only did this cause a mess that required frequent stoppages and cleanup, but it also resulted in a large amount of waste. Dare's new system produces a uniform viscosity that has significantly increased its Chocolate Mint candy yield and decreased losses during production.

In the end, the decision to divert from traditional candy-making techniques and employ alternative, contemporary equipment proved to be an asset in both product quality and overall plant production. The new system helped the plant increase yield, lower costs, and simplify process operations.