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## **STEAM BLANCHING VS WATER BLANCHING: COST, EFFICIENCY, AND PRODUCT QUALITY**

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## Summary

In this white paper, we will examine water blanching and steam blanching. We will compare differences in energy consumption, water use, wastewater effluent, capital and operational costs, product yields, and product quality characteristics such as taste, texture, color, and nutritional value.

The goal of this paper is to help food processors understand the important differences between steam and water blanching so they can select the most effective technology for their applications.

Blanching can achieve a range of objectives, depending on the application. For many fruits and vegetables as well as seafoods that are frozen, canned, or dehydrated, blanching inactivates enzymes and reduces microbial loads to improve food safety and increase shelf life. For potatoes that become French fries, blanching also leaches sugars to improve product texture and color. For some meat and poultry products as well as bagels and potato products that are ready-to-eat, blanching cooks the product. For nuts, blanching can facilitate peeling or kill microbes such as salmonella, depending on the temperature and duration of the blanching operation.

Within each of these applications, a food processor has a variety of water blanching and steam blanching technologies to choose from.

## Blanching Equipment

Both immersion and deluge water blanching, whether achieved with a rotary, auger, double draper, or belt-conveying system, have one thing in common: product is exposed directly to food-grade water that typically ranges in temperature from 158°F to 212°F (70°C to 100°C).

With steam blanching, product is exposed directly to food-grade steam that is typically 212°F (100°C) as it is conveyed within a chamber. Some steam blanchers use convection technology that forces the steam through the bed of product to increase the heat transfer efficiency. Other steam blanchers present the product in a single layer to achieve individual quick blanching (IQB).

To minimize the product's exposure to heat, some steam blanchers follow the heat penetration stage with a holding stage that allows the core temperature of the product to rise without the addition of more steam.



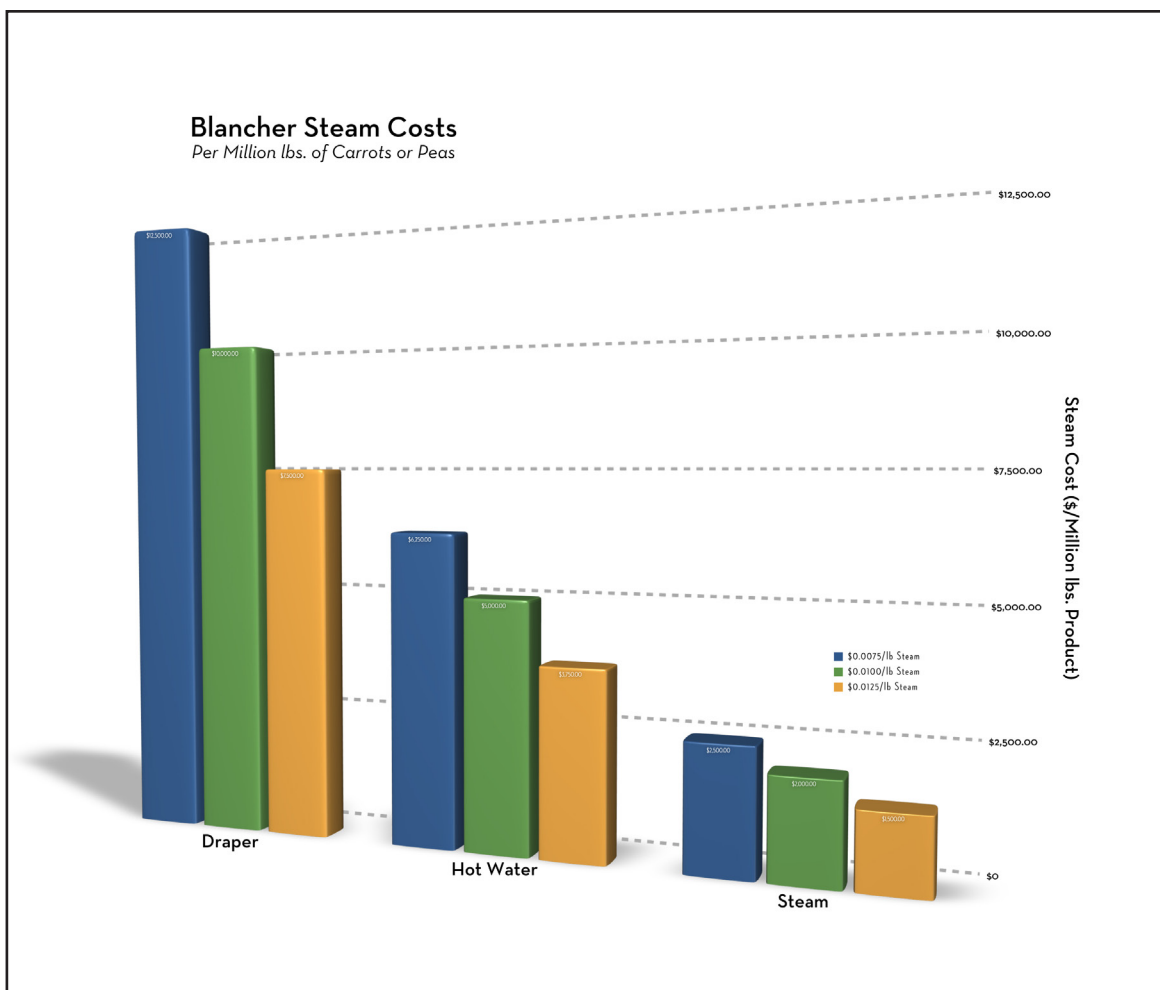
*ABCO Heat/Hold Blancher*

## Energy Consumption

Most water blanchers and steam blanchers require steam that is produced by a boiler. With water blanching, the steam heats the water and the product. With steam blanching, the steam is applied directly to the product. Because the boiler is one of the most expensive pieces of equipment to operate in a food processing plant, given the high cost of energy, steam consumption has a direct and significant affect on energy costs.

Compared to the most modern water blanchers, steam blanchers use approximately half the steam. Compared to older water blanchers, steam blanchers can often reduce steam use by as much as 80 percent. The energy costs associated with the blanching operation mirrors this reduction.

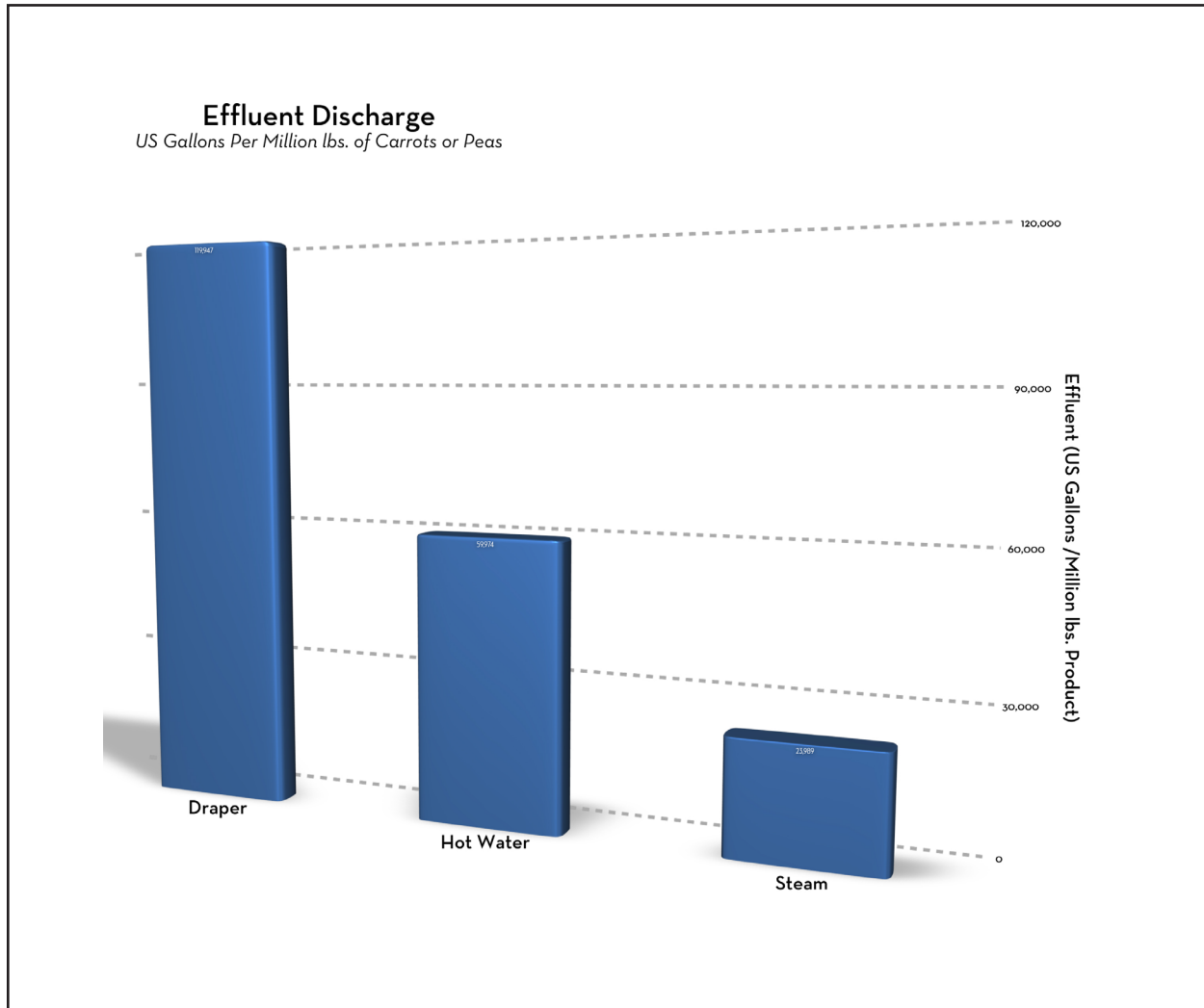
If it costs \$0.01 (U.S.) in energy to produce 1 lb. (454 grams) of steam, which is a close approximation of today's cost, a food processor will spend \$5000 to \$10,000 in energy to blanch one million lbs. (454 metric tons) of carrots or peas with a water blanching system. By comparison, it will cost only \$1000 to \$2000 in energy to steam blanch the same volume of product.<sup>1</sup> As energy costs rise, the savings achieved with steam blanching becomes even greater.



Cost comparison of draper, hot water, and steam use in blanching carrots or peas.

## Water Use and Wastewater Effluent

Like energy costs, water use and wastewater effluent are directly correlated to the volume of steam used. Steam blanchers require half the steam of water blanchers, therefore, half the volume of water is needed for the operation and half the volume of wastewater is discharged.



*Effluent discharge comparison chart for draper, hot water, and steam use in blanching.*

The quality of wastewater differs too. BOD (biological oxygen demand) loads and COD (chemical oxygen demand) levels, which reflect the content of soluble solids in the wastewater caused by leaching, differ greatly from one blanching application to another based on differences in the technology used as well as differences in the compositions of the products. For example, cut products leach faster through the cut sections compared to whole products where the membrane acts as a barrier.<sup>2</sup>

Regarding differences produced by the technology, the BOD concentration can be higher in a steam blancher's wastewater, but the dramatic reduction in the volume of wastewater results in a significantly lower overall BOD level released from a steam blancher compared to a water

blancher. Since it costs less to treat high-strength, low-volume waste than a large-volume, diluted waste<sup>3</sup>, steam blanching is the preferred technology from a wastewater perspective. Steam blanchers are increasingly replacing water blanchers in food processing plants that wish to reduce BOD and hydraulic waste loads.<sup>2</sup>

## Product Quality

During blanching, a product's flavor, color, texture, and nutritional value are altered. Some of these changes are beneficial, like when the enzymes that produce off-flavor development are inactivated. However, the loss of nutritional value associated with blanching is always detrimental. The task then, is to fine-tune the blanching operation, given the specific product and application, to maximize the positive changes while minimizing the negative changes.

Food scientists have studied the effects of steam blanching versus water blanching and consumer focus groups have augmented this data with sensory analysis.



The degradation of nutritional value occurs because water leaches out vitamins and minerals, and heat degrades nutrients. Although this loss differs from product to product, in general, steam blanching achieves greater nutrient retention than water blanching. One study found that steam blanching showed a significant improvement in ascorbic acid (vitamin C) retention over water blanching for both peas and broccoli. However, for cut green beans, there was a less significant difference because the ascorbic acid is found primarily in the seeds, which are protected from leaching by the pod.<sup>4</sup>



Because steam blanching minimizes the leaching of soluble solids, which leaves more natural sugars in products, it improves flavor retention and color retention to produce a final product with superior flavor, texture, and color.

One interesting study conducted by Agriculture and Agri-Food Canada compared the effects of water versus steam blanching on the sensory quality of mashed potatoes. In the study, 96 consumers rated their perceptions of products' appearance, flavor, and texture. Results showed the group preferred the steam blanched mashed potatoes over the water blanched samples for appearance, flavor, and texture. Many of the consumers commented that the water blanched mashed potatoes were grayer, more bland, and had a gluey, gummy, or pasty texture<sup>5</sup>

## Product Yields

As nutrients and flavors are lost when sugars are leached from product during blanching, yield is also lost. A study on kernel corn showed that blanching with steam retained 8 to 10 percent

more soluble solids – primarily sugars – when compared with water blanching.<sup>6</sup> Yield increases of up to 5 percent for steam blanched products over water blanched products are possible, depending on the product and the application.



*Key Technology's Turbo-Flo® Blancher for use in blanching, cooking, and pasteurizing.*

## **Conclusions**

Compared to water blanching, steam blanching often cuts energy costs in half while reducing the costs to obtain water and handle wastewater. Additionally, by reducing steam consumption, steam blanchers minimize the capital costs and operational costs associated with the boiler. These lower operational costs quickly offset the higher capital costs associated with steam blanchers.

Steam blanchers often cost 20 percent more than water blanchers at the time of purchase. Based on energy cost savings alone, steam blanchers almost always achieve payback within one to three seasons. The additional cost savings associated with procuring water, treating wastewater, operating the boiler, and maintaining or increasing product yields accelerate the payback of a steam blancher. Improving the quality of product further supports the benefits of water blanching over steam blanching.

With the trend toward higher energy costs, higher water costs, greater restrictions on the quality of wastewater, and increasing consumer demand for more nutrient-rich products, the market conditions are increasingly favoring the use of steam blanching over water blanching.

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