

# Zero-Fouling operation in Condensers Cooled with Hard Well Water in a Dairy Plant



**Industry:** Dairy (food)  
**Application:** Hard Well Water Condenser  
**Product:** Self-cleaning Condenser  
**Location:** USA  
**Year of Installation:** 1988  
**Additional Purchase:** 2023

## Problem Description

A dairy plant in the USA suffered from severe fouling of three condensers used for condensing the vapor of a multi-effect falling film evaporator due to hard well water<sup>1</sup> used for the cooling process. The hard well water that is applied in the condensers has a hardness of 7-8 grain per gallon (gpg<sup>2</sup>) and led to rapid scaling, reducing the cooling capacity significantly in a matter of days.

<sup>1</sup> Hard well water is water that originates from a well and contains a high mineral content, especially calcium and magnesium ions. When hard water is employed as a coolant in a condenser, these minerals can scale on the surfaces, diminishing the efficiency of heat transfer and potentially causing operational issues.

<sup>2</sup> gpg = One grain per gallon (gpg) is equivalent to 17.14 parts per million (ppm). Water hardness can be measured in gpg or ppm, but gpg is the most used measurement.

Various conventional solutions (for example regular cleaning, optimizing process conditions, etc.) had been tried by the customer to prevent this fouling problem, however without success. Plant management decided to replace their fouling

## Condenser System Details

Self-cleaning Condenser

	<b>Parameters</b>			<b>Condenser</b>			
		I	II	III			
	<b>Tube Side</b>	Hard Well Water					
	<b>Shell Side</b>	Vapor					
	<b>Number of Tubes</b>	7	19	19			
	<b>OD/ID Tubes (mm)</b>	51 x 1.5		60.3 x 1.5			
	<b>Length Tubes (m)</b>	6					
	<b>Heat Transfer Area (m<sup>2</sup>)</b>	6	18	21			
<b>Particle Size (mm)</b>	3						

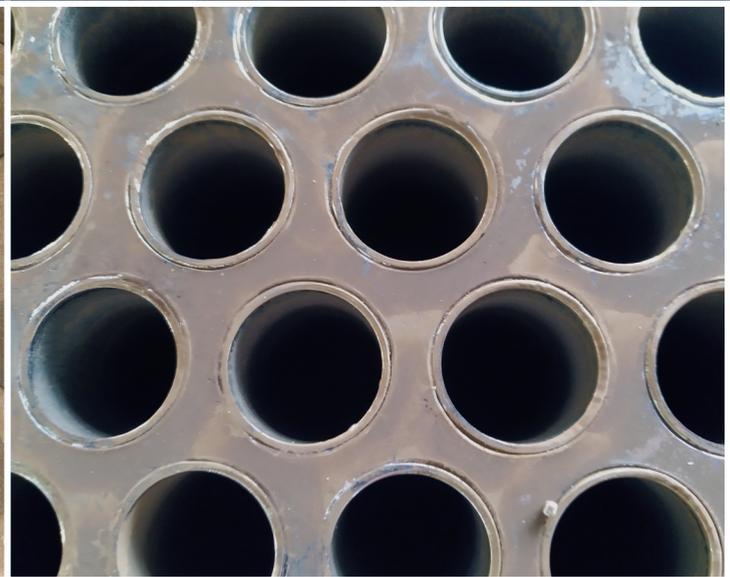
## Results

The Self-cleaning heat exchanger Technology helped the customer to achieve up to zero-fouling operations.

All three exchangers went into operation without any problems and were only opened once to twice a year for inspection. The units operate 85% of the time and are still running (as of 2023 from 1988) to the satisfaction of the customer.



**Conventional**



**Self-cleaning**

The plant expresses that they are satisfied with the performance and operation of the heat exchanger.

Fouling has never been observed, contrary to earlier experiences with conventional exchangers that required a lot of maintenance on a regular basis.

*“Statement made by the plant director inspecting the tubes after 3 years of operation without being subjected during that period to any cleaning procedure: “... how is this possible, ... these tubes look better than new...”*

**The customer has decided to buy 2 more self-cleaning condensers during Q1 2023.**

KLAREN Technology is a competence brand of Taprogge GmbH and the technology can be applied to heaters, coolers, evaporators, crystallizers, reboilers and condensers.



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