

# Revamp of the 1<sup>st</sup> effect of a 4-effect evaporator train into a self-cleaning configuration

Severe fouling by crystallization  
of a variety of sulfate salts



**Industry:** Dyes Producer  
**Application:** Effluent Treatment  
**Location:** India  
**Year of installation:** 2018

## KLAREN Self-cleaning Heat Exchanger Technology

The KLAREN-System, a self-cleaning fluidized bed heat exchanger, provides an 'on-line' and 'in-line' continuous cleaning method to solve fouling of shell and tube heat exchangers up to zero-fouling operation. The KLAREN-System uses cleaning particles that are carried and fluidized by the upward flow of the fouling liquid in the tubes and are evenly distributed over all tubes. The upward flow directly implies that the heat exchanger will be vertical.

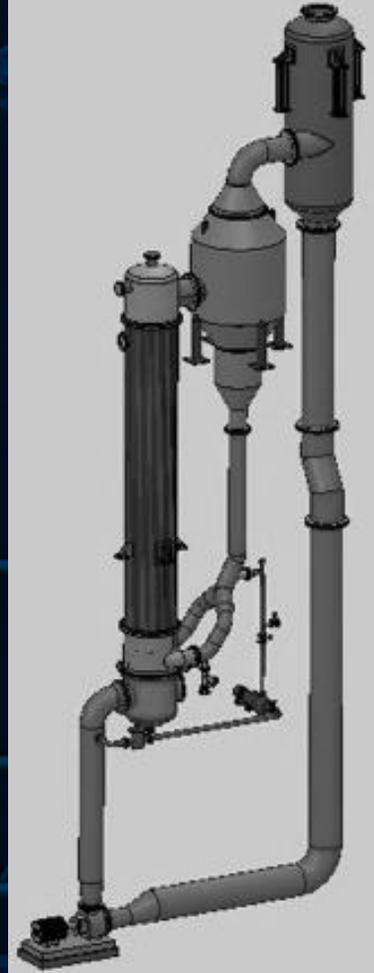
The cleaning particles made of ceramic or cut metal wire and with diameters varying from 2 to 4 mm create a scouring effect on the tube wall surface and remove the developing fouling layer at an early stage of formation. After passing through the heat exchanger, the cleaning particles are disengaged from the liquid in a special designed separator and are returned to the inlet channel through an external down-comer and the cycle is repeated.

At the end of 2017, Klaren International together with a local partner was given the order for a revamp of an evaporator into a self-cleaning configuration. The revamp was completed early 2018 after which the plant was taken into operation.

## The Project

The evaporator being revamped was the 1<sup>st</sup> effect of a 4-effect evaporator train to treat wastewater from a plant that produces dyes for textile. This 1<sup>st</sup> effect experienced severe fouling by crystallization of a variety of sulfate salts. Effect 2 to 4 experienced some fouling but to a lesser extent. Due to fouling, within only 20 days of operation, the plant regularly lost more than 50% of its treatment capacity (see graphic below).

For the revamp into the self-cleaning configuration, the heat exchanger was equipped with an inlet channel to feed the particles into the heat exchanger and distribute them over all tubes. In between the heat exchanger outlet and the entrance of the flash vessel a particle separator was installed to collect the particles and transport them via a central down-comer back to the inlet. In the revamp the existing heat exchanger bundle could be re-used.

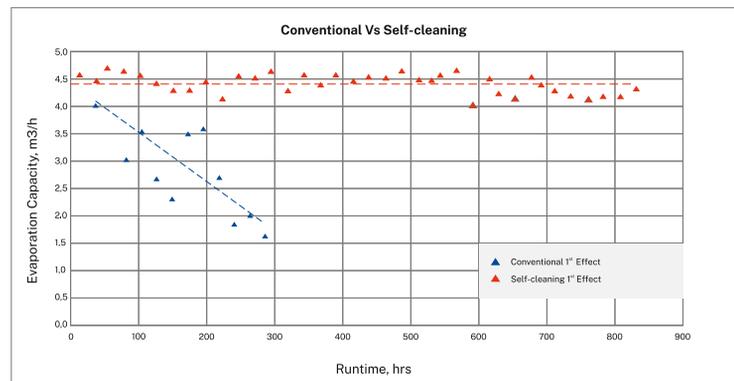


### Heat exchanger specifications

Number of tubes	373
OD Tubes	38.1 mm
ID Tubes	34.9 mm
Length Tubes	6090 mm
Flow	900 m <sup>3</sup> /h
Recirculation Temperature	100°C
Particle Type	Ceramics
Particle Size	3 mm

### Results

After taking the plant back into operation, the evaporation capacity kept constant as is shown in the graph, which results in increased production, lower downtime and reduced maintenance cost.



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