Self-cleaning fluidized bed heat exchangers; proven solution for up to zero fouling operation

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Sustainability I Energy Efficiency I Innovation

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Fouling

Major problem in heat transfer

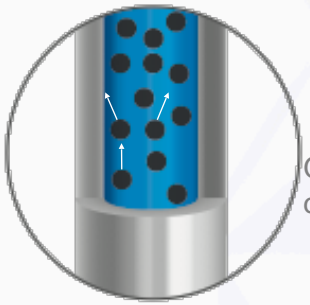
- Loss of energy
- Production loss or reduced operation capacity
- Oversizing and / or redundancy of equipment
- Higher maintenance costs
- Hazardous waste streams from cleaning
- Adjusted Process Conditions

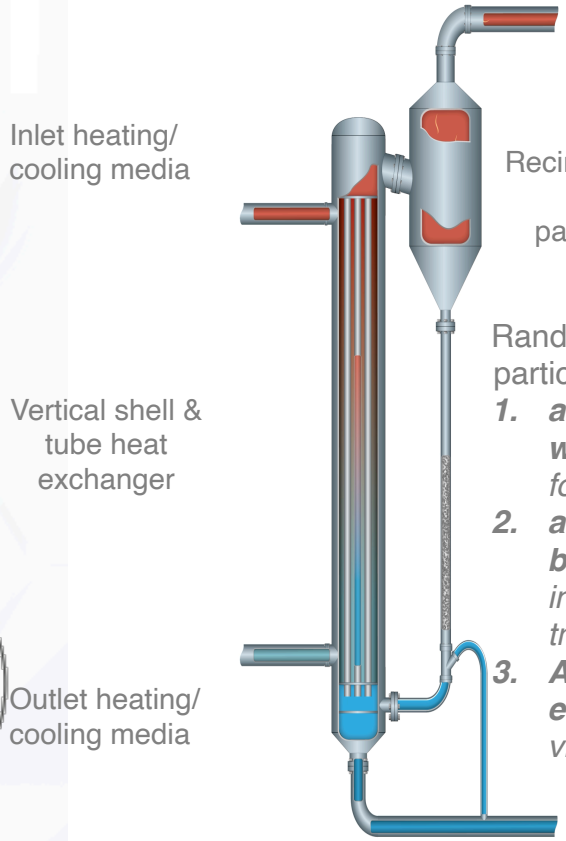
Principle Self-cleaning technology

The self-cleaning fluidized bed heat exchanger technology can solve the issue of fouling

A clean tube wall if:
Rate of removal > Rate of deposition

Scouring action





Random movement of particles gives:

1. ***an impact with tube wall**, removing the fouling layer*
2. ***a break-up of the boundary layer**, increasing heat transfer*
3. ***A shear thinning effect**, reducing the viscosity*

Cleaning Particles

- Material:
  - Chopped Metal Wire

  or
  - Ceramic
- Sizes:
  - 1.5 - 4 mm
- Volume fraction
  - 3 – 15%

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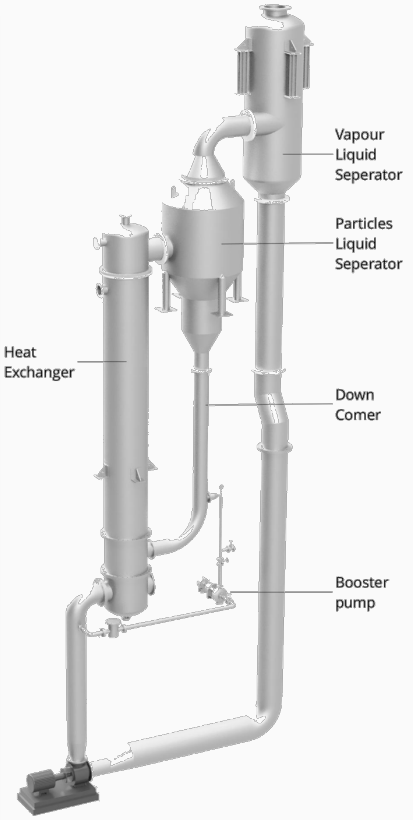
Applications
Self-cleaning technology




- Heat exchangers susceptible to crystallization, polymerization or particulate fouling
- Forced circulation reboilers in the chemical industry
- Heat exchangers for white-water and black-liquor in the pulp industry
- Heat exchangers in thermal desalination of brackish water and seawater
- Preheaters for crude oil in refineries
- Bio-based processes, oleo-chemicals
- Heat exchangers for geothermal brines
- Heat exchangers for high density and viscous slurries in the mining industry (indirect heating)
- Direct seawater coolers for large industrial installations and offshore platforms
- Evaporators/Crystallizers for wastewater treatment like concentration of produced water, Vinasse, or stillage and black-liquor
- Ice Slurry Generator for HVAC systems

Case: Revamp of a forced circulation evaporator for effluent of dyes producer

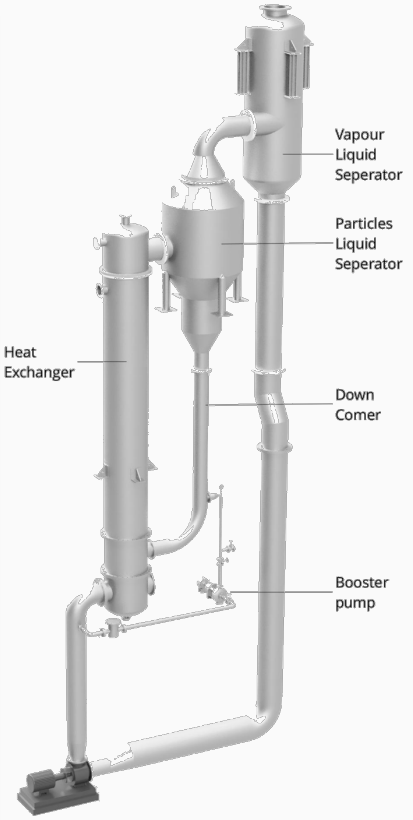
Application	4-effect evaporator plant for wastewater from dye manufacturer. Plant was cleaned every 2 weeks
Country	India
Effluent	Composition varies but one of crystallizing species is $CaSO_4$. Liquid contains large quantity of COD
Project 2018	Revamp of the 1st effect into self-cleaning configuration



Case cont'd: Revamp of a forced circulation evaporator for effluent of dyes producer

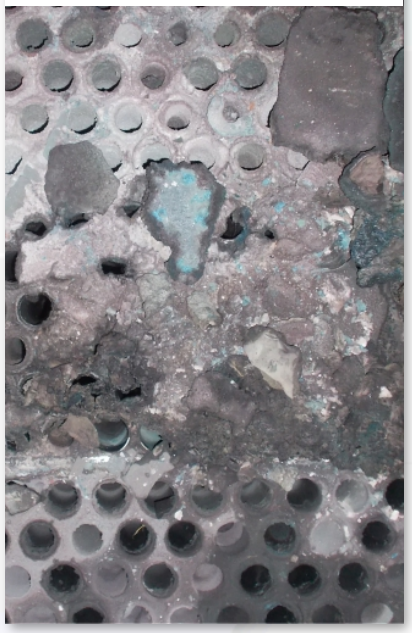
Heat exchanger specifications

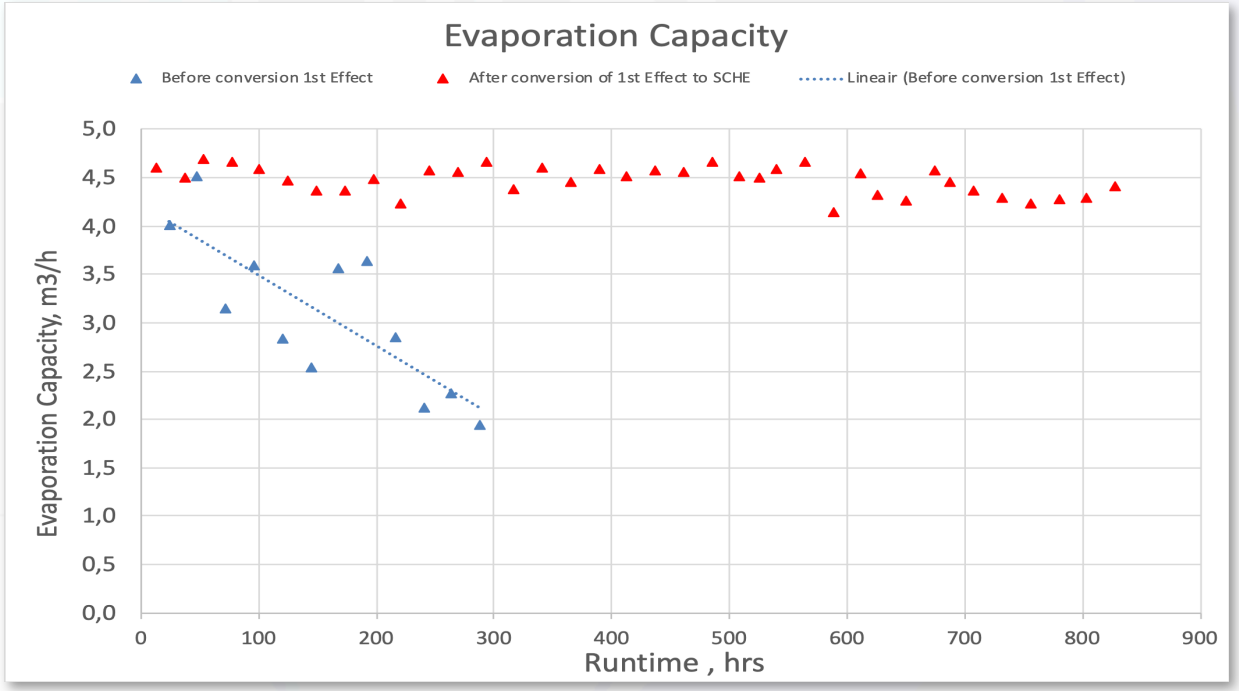
Number of tubes	373
Length Tubes	6000 mm
Flow	900 m^3/h
OD Tubes	38.1 mm
Recirc. Temp.	100 °C
ID Tubes	34.9 mm
Particle Type	Stainless Steel
Particle Size	1.9 mm



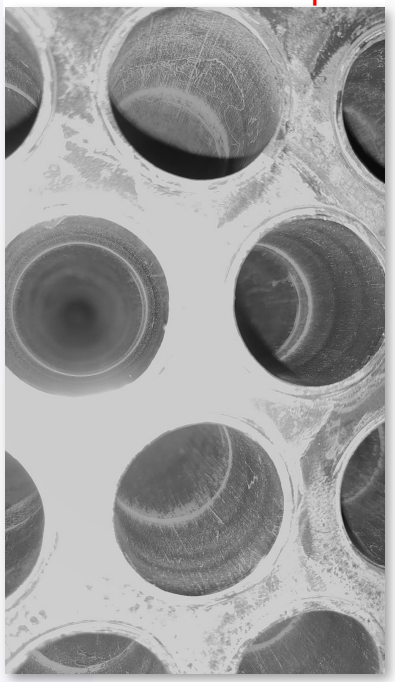
Result of the revamp of a forced circulation evaporator for effluent of dyes producer

Before the revamp





After the revamp



- **Before the revamp**, the evaporation capacity of the total plant reduces with 50% within 300 hours of operation
- **After the revamp**, the evaporation capacity of the total plant was kept at 100% thus improving plant production and reducing maintenance cost

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Example: Sodium Sulphate Recovery

Industry	:	Agrochemicals
Location	:	Asia
Application	:	Sodium Sulphate Recovery
Installation type	:	Revamp 1st Effect Evaporator
Equipment	:	Multiple Effect Evaporator (MEE with TVR)
Built in years	:	2021
Capacity	:	flow 850 m^3/h
Medium	:	Effluent with Na_2SO_4; Concentration from 12 to 30 wt. %
Result:	:	Total plant output increased with 10-15%; steam economy increased with 5-10%

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Example: Heat Recovery Sunflower Oil

Industry	: Edible Oil
Location	: Europe
Application	: Oil – Oil Heat Recovery
Installation type	: New Built
Equipment	: 1 Heat Exchanger (14 m) with double-shell arrangement
Built in years	: 2021
Capacity	: 30000 kg/h
Medium	: Sunflower Oil

Top Bundle
- 2 m tube length
- Heating by steam
- Start-up function
- Support if $T < T_{set}$

Bottom Bundle
- 2 x 6 m tube length
- Oil – Oil
- Heat recovery part

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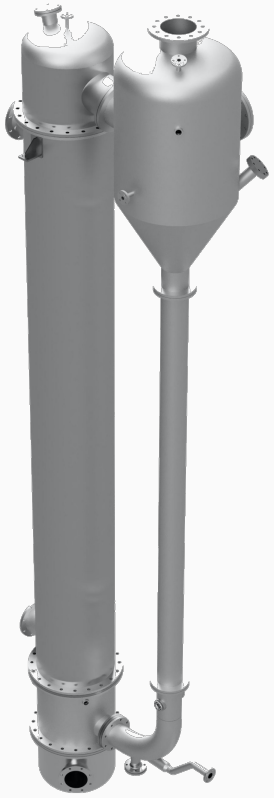
Example: District Heating

Industry	: District Heating
Location	: Europe
Application	: Heat Recovery from River Water
Installation type	: New Built
Equipment	: 2 Heat Exchangers (725 kW each)
Built in years	: To be installed in Q2-2023
Capacity	: 254 m^3/h (each)
Medium	: River Water



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