

Forced circulation evaporator with self-cleaning heat exchanger for a distillery plant

Client : Shochu Distillery

Location: Japan

Year of installation: 1997

Prior Projects

The project in Japan is comparable to an application for an alcohol producer in the Netherlands. For this Japanese distillery company the self-cleaning heat exchanger was applied to concentrate Vinasse. The aim for this project was to go to a concentration level of 70% (dry material). This later appeared not to be required because the company could also use a less concentrated product as feed for livestock.

Background

Many alcohol plants in Japan are located on the coast. In the alcohol plants in Japan both rice and wheat are fermented and from this liquor the alcohol is distilled. Normal procedure was to dispose this Vinasse or Stillage fluid as a waste stream into the sea. During the period prior to installation it was foreseen that this disposal would be forbidden by new legislation. Therefore the client started to investigate how the waste stream could be concentrated by evaporation. In this the self-cleaning fluidized bed technology was selected to heat the waste stream. Conventional heat exchangers were never considered because the severely fouling liquid would cause a blockage in just a few hours. The concentrated waste stream would be used as feed for livestock.

It was expected that after successful operation more plants would be equipped with this technology. With the declining Japanese economy the more stringent legislation has been postponed.



Process Description

The forced circulation evaporator with the self-cleaning heat exchanger H-101 is shown in the screen dump of the plant automation system. The evaporator, runs at a reduced pressure of 22 kPa in the flash chamber EV-101.

The heat exchanger is heated using condensing steam at a pressure of 29 kPa with a saturation 612 temperature of 68°C. The latent heat present in the vapor generated in the flash chamber is re-used by the use of a steam ejector where higher pressure steam is used as motive steam to increase pressure and temperature as to give a driving force for evaporation. The vessel S-101 as indicated on the figure is the separator to collect the particles from the fouling liquid.

Key-parameters of the SCHE

Type	External recirculation
Heat transfer surface	85 m ²
Particles	2.5 mm cut metal wire
Temperature tube side	Approx. 63 °C (outlet)
Recirculation Flow	185 m ³ /h
Tubes	97 with length of 6 m & Diameter 34 x 1.2 mm
Heat transfer coefficient	800 kcal/h m ² °C -> 930 W/m ² k
Treatment Capacity	30 ton/day (feed)
Evaporator	Rate 900 kg/h
Concentration	Up to 30% solids

Operational experiences

After more than two years of operation the self-cleaning heat exchanger has proven to be a success and the plant is still in production. Material loss appeared on the distribution plates but not on the heat exchanger tubes.

With respect to the material loss of the applied particles it was found that the average weight loss is less than 3% per year. In the engineering phase care was taken to measure the actual viscosity of the liquid under a fluidized condition. Background is that in previous projects it was found that the fluidized bed strongly reduces the apparent viscosity of a viscous fluid.

For the case in Japan a viscosity was given by the customer of 200 cP. A sample of the liquid was tested in a fluidized bed and it was found out that the viscosity of the liquid experienced by the fluidized bed was less than 10 cP. The self-cleaning fluidized bed heat exchanger for this application was designed for this low value of viscosity and operation of this installation turned out to be successful.



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