**A message for the Chemical Industry,**
**Pulp and Paper Industry and other Operators of evaporators and/or reboilers.**

# The Retrofitting of Fouling Heat Exchangers into a Self–Cleaning Configuration

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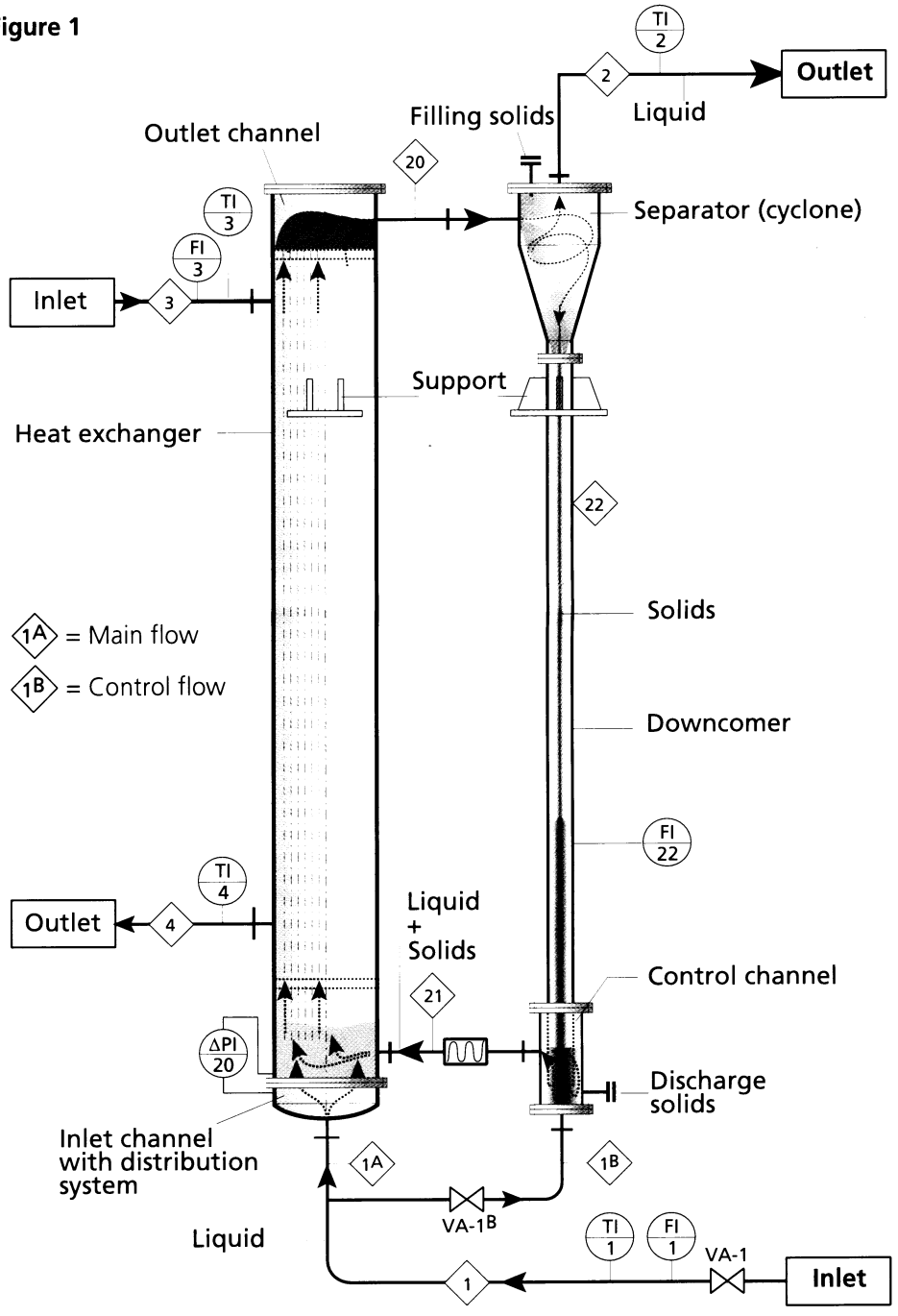
## Premise

Many heat exchangers, evaporators and reboilers that are in severely fouling services can now be retrofitted into a self-cleaning heat exchanger.

## Principle

New self-cleaning heat exchange technology has been developed by Klarex Technology that can be applied in most vertically oriented shell and tube exchangers. The fouling prone fluid, stream 1 in Figure 1, that flows upward inside the tubes, is charged with solid particles that are swept upward with the fluid producing a scouring action on the walls of the tubes as they travel. A unique distribution system in the inlet channel provides a uniform distribution of liquid and particles into all the tubes. From the outlet channel the particles are carried into the separator where they disengage from the liquid and are returned through the external downcomer into the control channel and from there through the connecting line between control channel and inlet channel into the inlet channel. The flow of particles is activated by the control liquid flow, which is a fraction of the total liquid flow supplied to the exchanger. By changing the control liquid flow, the intensity of the cleaning action can be varied. If desired, the cleaning action can also be applied intermittently.

**Figure 1**

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# Examples

**Figure 2A**

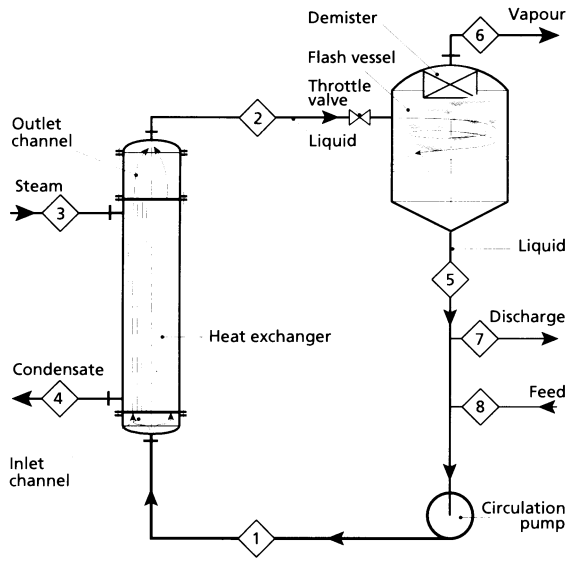



Figure 2A: An existing traditional forced circulation evaporator without boiling in the tubes.

**Figure 2B**

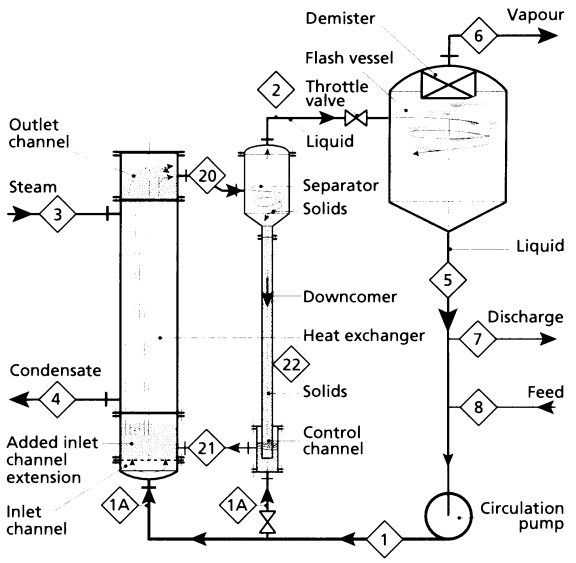



Figure 2B: Traditional forced circulation evaporator retrofitted into a self–cleaning configuration.

**Case 1:**

**Figure 3A**

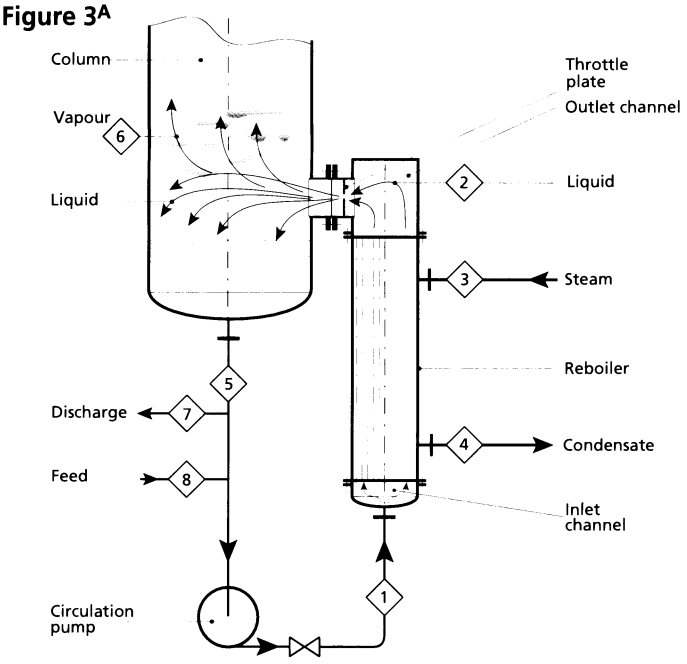
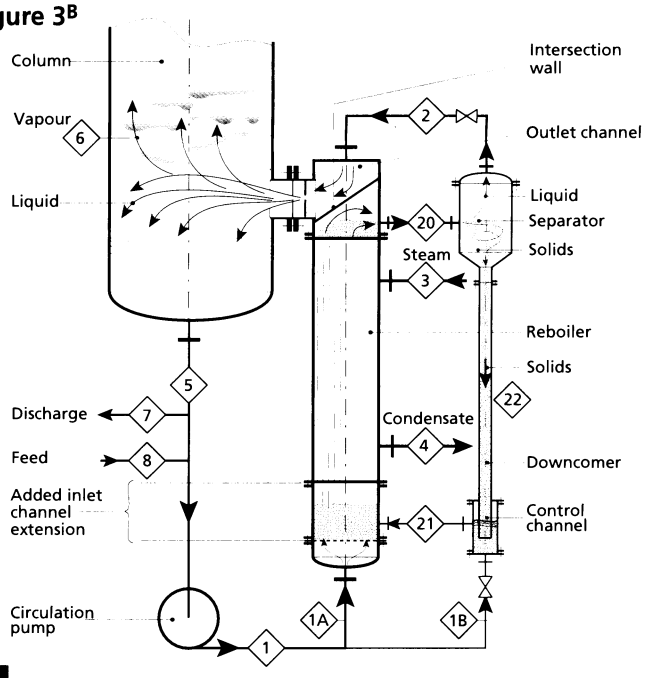



**Figure 3B**




**Case 2:**

Figure 3A:
A large chemical plant operates a reboiler with forced circulation. Boiling in the tubes caused fouling of the exchanger. Boiling in the tubes was suppressed by installing a throttle–plate in the reboiler outlet and increasing the liquid velocity by also putting the spare pump into operation. This did not improve the rate of fouling.

Figure 3B:
After retrofitting to a self–cleaning configuration, the existing outlet channel is divided into two parts. The liquid flow and the cleaning particles are transported from the lower part of the outlet channel into the separator where the particles are removed from the liquid and flow through the downcomer into the control channel and from there to the inlet channel. The liquid leaves the separator at the top and returns to the upper part of the outlet channel where it passes the throttle–plate before flashing into the column.

# Examples (continued)

**Figure 4A**

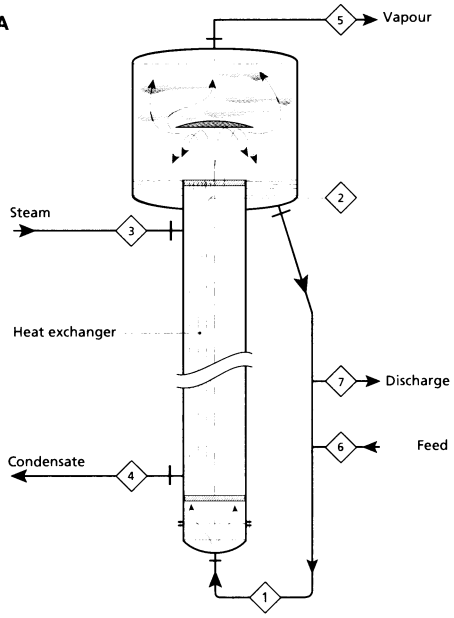
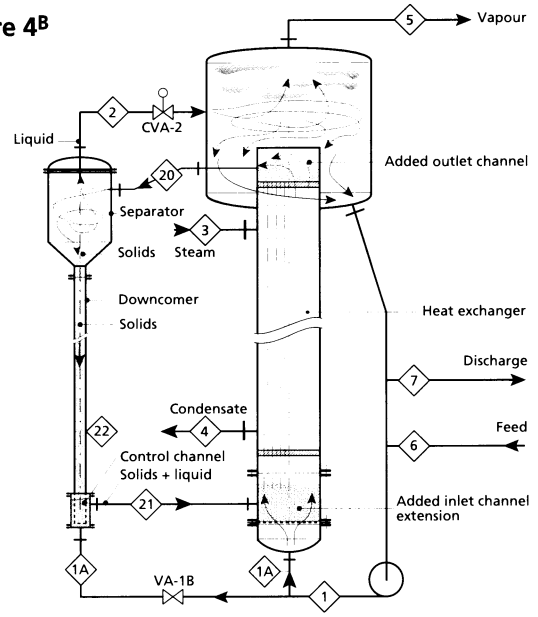



**Figure 4B**




**Case 3:**

Figure 4A:
The long-tube vertical evaporator with boiling in the tubes uses either natural circulation or forced circulation.

Figure 4B:
The upper tube-plate is capped with an outlet channel and instead of an evaporator with boiling in the tubes and a vapor-head on top of the tubes, this evaporator operates with forced circulation, without boiling in the tubes, while the vapor-head is used as a flash chamber.

**Figure 5A**

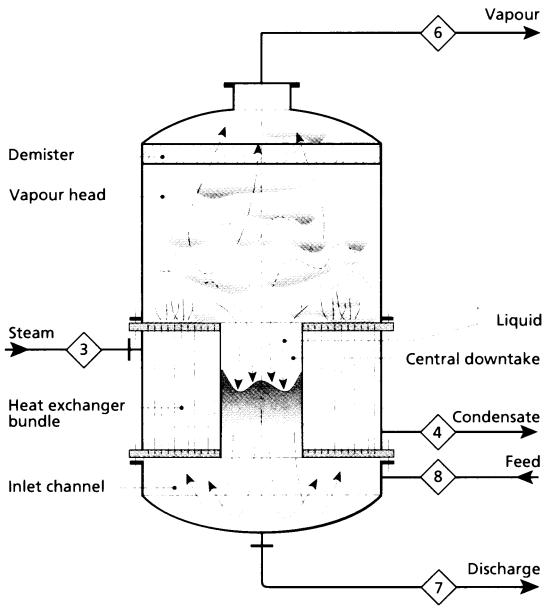
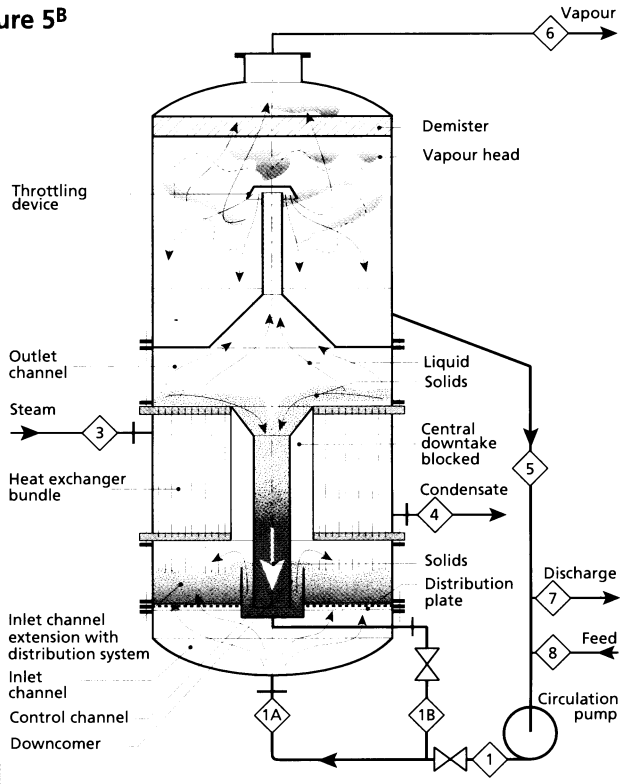



**Figure 5B**




**Case 4:**

Figure 5A: The short-tube vertical evaporator with central downtake: is usually designed for natural circulation.

Figure 5B: Retrofitted into a very compact self-cleaning design, the central downtake is used to accommodate the downcomer and control channel, while the inlet channel extension with distribution system and outlet channel are flanged between parts of the original evaporator. In this configuration the evaporator operates with forced circulation and the vapor-head is used as flash vessel.

# Test heat exchanger

A small test heat exchanger may be operated in parallel with the existing fouling heat exchanger.

A single-tube heat exchanger equipped with external circulation of the cleaning particles can prove the viability of the self-cleaning technology. Figure 6 illustrates a test on a black liquor from bagasse evaporator.

**KLAREX TECHNOLOGY can provide the following:**

*The basic test exchanger and specifications of the various measuring instruments.

*An instruction manual for the operation of the test heat exchanger.

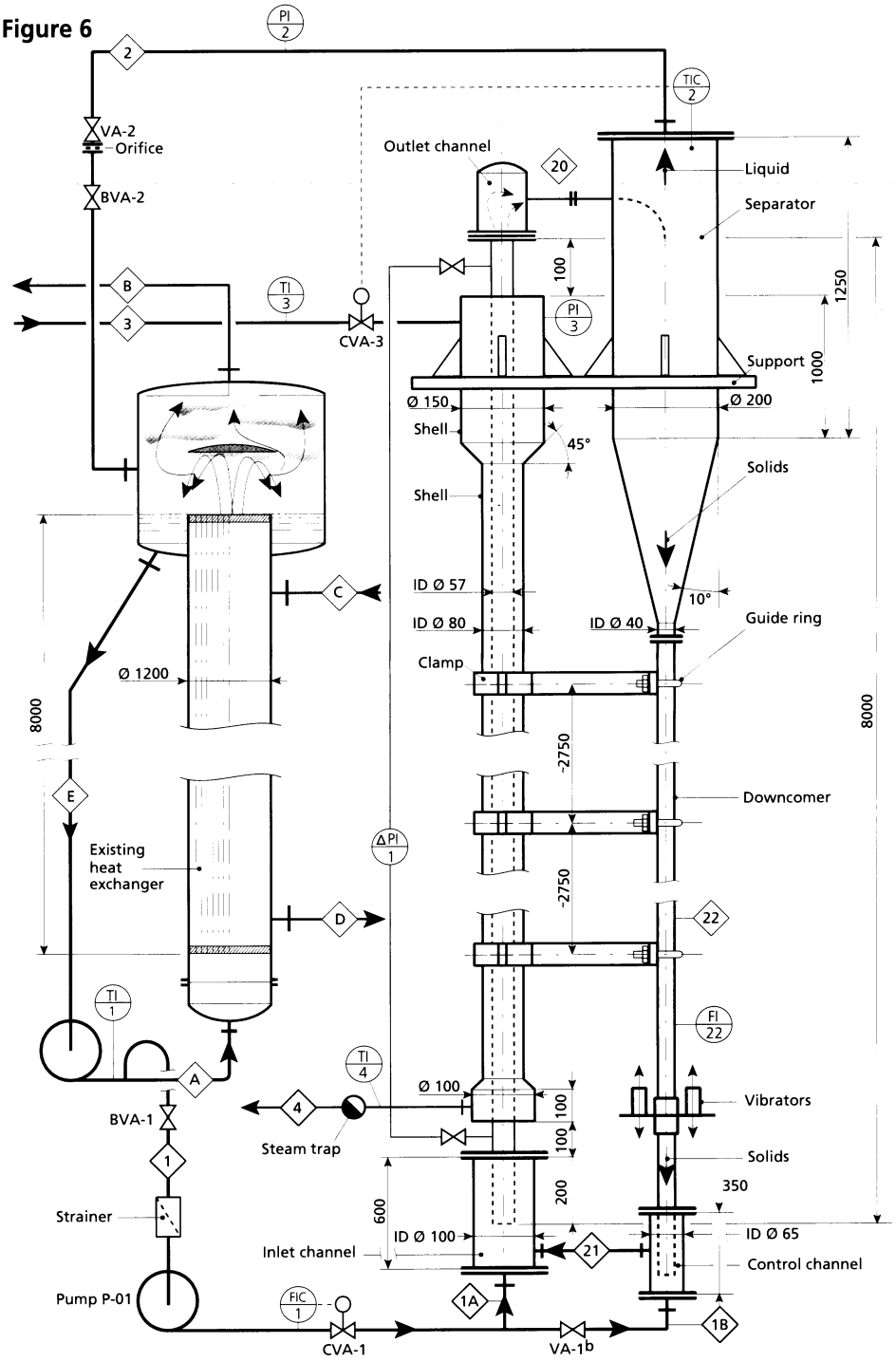
*Supply of and/or advise on data logging equipment, including a computer program for the calculation and read-out of relevant information (such as overall heat transfer coefficients as a function of time) on a personal computer.

## SUMMARY

Conventional heat exchangers suitable for retrofit into a self–cleaning concept have been reviewed. Many more than have been described in this brief publication are possible. In case of questions, whether of a general or a more specific kind, please do not hesitate to contact us.

Please send your inquiries about this self-cleaning technology for either retrofitting or for new installations to our authorized representative in North America:

**Figure 6**

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