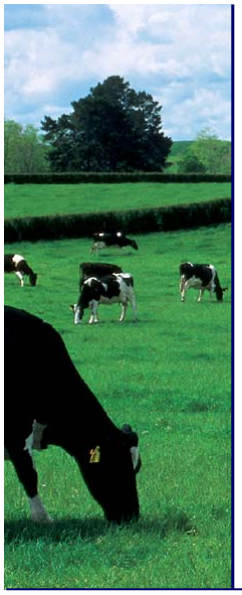
Sustainable Cleaning

IDF World Dairy Summit

Melbourne,

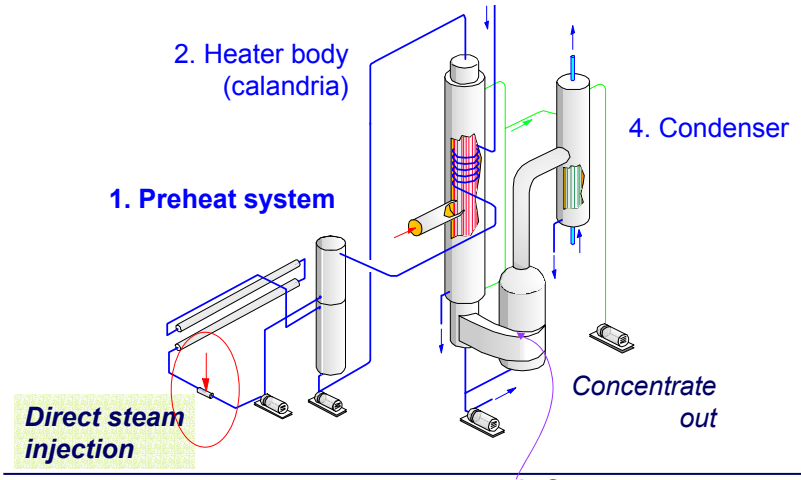
23-25 November 2004



The use of a Heat Flux Sensor for In-line Monitoring of Fouling and Cleaning of Non-heated Surfaces

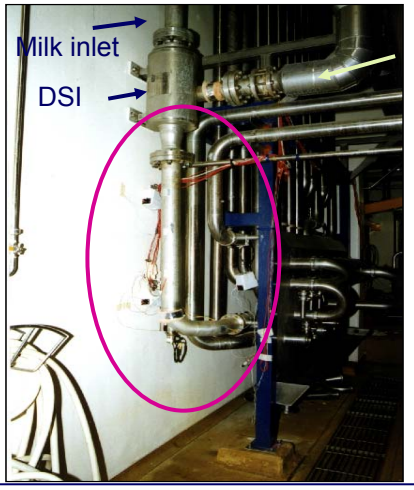
Tuan Truong

Evaporator preheat system



Fonterra

Direct-steam-injection heater (DSI)

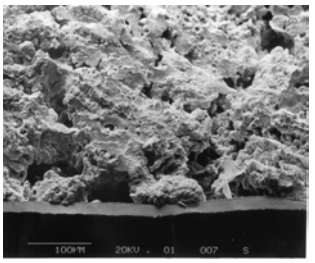


Fonterra

Fouling deposits in areas downstream of DSI heater (non-heated surfaces)

20 mm

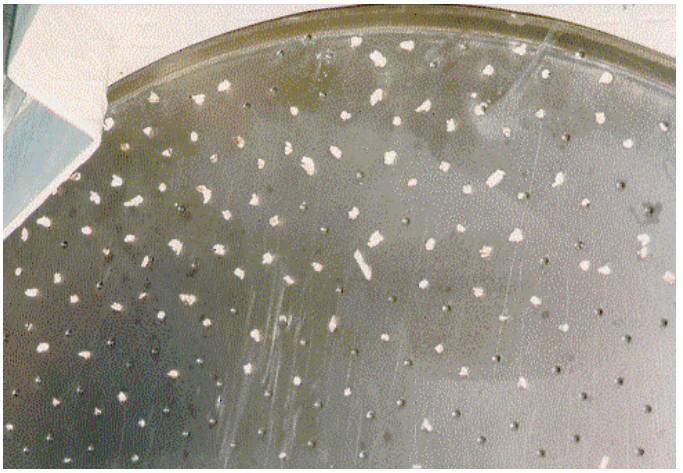
2 mm



0.1 mm

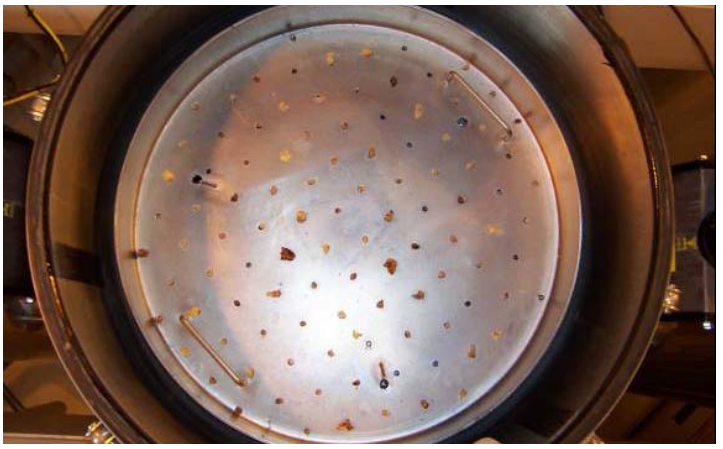
Fonterra

Consequence: Blocked evaporator distributor plate



Fonterra

Consequence: Blocked evaporator distributor plate



Fonterra

Consequence: fouling in evaporator tubes

Fonterra

Consequence: fouling in evaporator tubes

Costs of fouling

- Increase in capital outlay - $8m per plant
- Loss of production time - 5 to 10 %
- Loss of product - 100T per powder plant per year
- Product downgraded due to contamination
- Increase in cleaning cost
- Increase in waste treatment cost
- Reduction in environment benefits

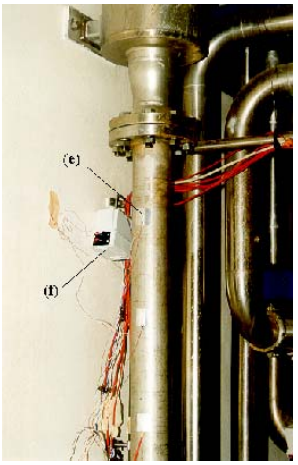
⇒ A system to measure directly the extent of fouling and cleaning effectiveness is needed.

Monitoring of fouling and cleaning: Heat Flux Sensor

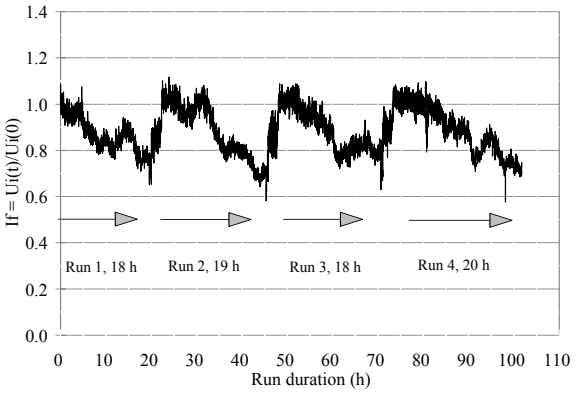
- Small size (10 mm x 20 mm)
- Low cost (NZ$300 each)
- Robust
- No disturbance to routine operation
- Calculated from measured heat flux:
  - Internal local heat transfer coefficient, U_i
  - Normalised internal heat transfer coefficient, $I_f = U_i(t) / U_i(0)$

- Reference: T.Truong *et al.* (2002), *Trans. IChemE*, Vol 80, Part C, pp 260 - 269.

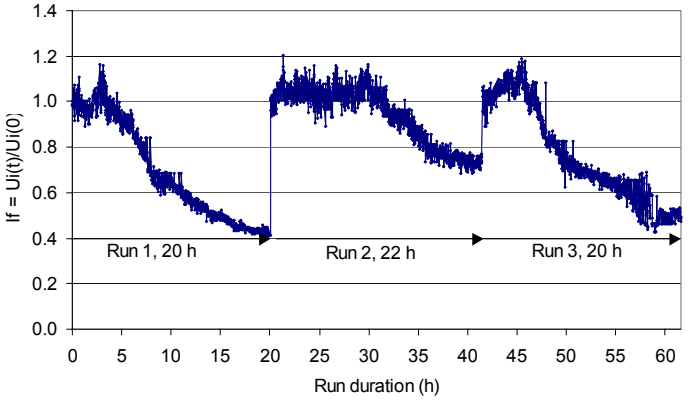
Attachment of Sensors



Monitoring of fouling and cleaning – case study 1



Monitoring of fouling and cleaning – case study 2



Closing remarks

- A robust, un-obstructive and low cost system
- Detects the growth and the extent of fouling layer during processing.
- Provides a good indication of the time at which plant cleaning is necessary and the effectiveness of the CIP system used.