

- 30 -

CLAIMS

1. A method of concentrating a process fluid, including a carrier fluid, including:
 - 5 (a) maintaining a process fluid at a predetermined temperature value/range;
 - (b) evaporating the carrier fluid from the process fluid to produce a concentrated process fluid;
 - (c) monitoring at least one process variable of steps
 - 10 (a) or (b) to detect fouling formed in either step (a) or (b); and
 - (d) initiating a cleaning protocol if the process variable deviates from a predetermined value/range to reduce the fouling formed.
- 15 2. The method according to claim 1, wherein step (a) includes feeding a process fluid into a heat exchanger to maintain the process fluid at a predetermined temperature value/range.
- 20 3. The method according to either claim 1 or 2, wherein step (b) includes feeding the process fluid from a heat exchanger to an evaporator.
- 25 4. The method according to any one of the preceding claims, wherein step (b) includes heating the carrier fluid without using an external heating source.
- 30 5. The method according to any one of the preceding claims, wherein step (b) includes direct contact of the process fluid with a mass transfer medium.

- 31 -

6. The method according to claim 5, including a step of humidifying the mass transfer medium prior to contacting the process fluid.
- 5 7. The method according to any one of the preceding claims, wherein step (b) includes spraying the process fluid onto an evaporation fill material and directing an air stream through the evaporation fill material in the opposite direction.
- 10 8. The method according to any one of the preceding claims, wherein step (c) includes monitoring pressure difference across a heat exchanger.
- 15 9. The method according to any one of the preceding claims, wherein step (c) includes monitoring fluid flow rates through an evaporator.
- 20 10. The method according to any one of the preceding claims, wherein step (d) includes initiating the cleaning protocol if the pressure or flow rate deviates from a predetermined value/range to reduce fouling in a heat exchanger or evaporator.
- 25 11. The method according to any one of the preceding claims, including recycling part of an effluent mass transfer medium from an evaporator.
- 30 12. The method according to any one of the preceding claims, including directing part of an effluent mass transfer medium into a drift chamber to remove entrained process fluid prior to returning the mass transfer medium to the evaporator.

- 32 -

13. The method according to any one of the preceding claims, wherein the cleaning protocol includes circulating an anti-fouling solution through one or more process equipment used in the method.

5

14. The method according to any one of the preceding claims, wherein the cleaning protocol includes subjecting fluid conduits of a heat exchanger or evaporator to ultrasonication.

10

15. A method of producing a sugar concentrate from sugar cane, including:

(a) obtaining a sugar-containing extract from sugar cane;

15

(b) maintaining the extract at a predetermined temperature value/range;

(c) clarifying the extract in the absence of added lime;

20

(d) evaporating water from the extract to form a sugar concentrate;

(e) monitoring a process variable of step (b) or (d) to detect fouling formed in either step (b) or (d); and

25

(f) initiating a cleaning protocol if the process variable deviates from a predetermined value/range to reduce the fouling formed.

16. The method according to claim 15, wherein step (a) includes crushing sugar cane to obtain the sugar-containing extract.

30

17. The method according to either claim 15 or 16, wherein the extract is maintained at a maximum temperature of 20-40°C.

- 33 -

18. An apparatus for concentrating a process fluid,
including a carrier fluid, comprising:

a heat exchanger to maintain the process fluid at a
predetermined temperature value/range;

5 an evaporator in fluid communication with the heat
exchanger to receive the process fluid and evaporate the
carrier fluid from the process fluid to produce a
concentrate;

at least one sensor for monitoring a process variable
10 across the heat exchanger or the evaporator to detect
fouling of the heat exchanger or the evaporator;

a cleaning system to reduce fouling in the apparatus;
and

a controller configured to receive signals from the
15 sensor or a manual user input to initiate the cleaning
system if the process variable deviates from a
predetermined value/range.

19. The apparatus according to claim 18, including one or
20 more pressure sensors to monitor pressure difference
across the heat exchanger.

20. The apparatus according to either claim 18 or 19,
including a flow rate sensor to monitor a mass transfer
25 medium or process fluid flow rate through the
evaporator.

21. The apparatus according to any one of claims 18 to
20, including a drift chamber to receive at least part
30 of a mass transfer medium from the evaporator to remove
entrained process fluid to form a cleaned mass transfer
medium stream which is returned to the evaporator.

- 34 -

22. The apparatus according to any one of claims 18 to 21, wherein the evaporator includes a bubble plate to facilitate humidification of a mass transfer medium prior to contacting the process fluid.

5

23. The apparatus according to any one of claims 18 to 22, including an ultrasonicator to clean the heat exchanger and/or evaporator.