WHAT IS CLAIMED IS:

1. A heat transfer system for sourcing a variable load, comprising:

a heat exchanger that defines a first fluid path and a second fluid path;

a first variable control pump for providing variable flow of a first circulation medium through the first fluid path of the heat exchanger;

at least one controller configured for:

controlling the first variable control pump to control the first circulation medium through the heat exchanger in order to source the variable load,

determining, based on real-time operation when sourcing the variable load, that the heat exchanger requires maintenance due to fouling of the heat exchanger, and

in response to said determining, controlling the first variable control pump, to a first flow amount of the first circulation medium in order to flush the fouling of the heat exchanger.

2. The heat transfer system as claimed in claim 1, wherein the controlling the first variable control pump to the first flow amount in order to flush the fouling of the heat exchanger is performed during real-time sourcing of the variable load.

3. The heat transfer system as claimed in claim 1, further comprising a second variable control pump for providing variable flow of a second circulation medium through the second fluid path of the heat exchanger.

4. The heat transfer system as claimed in claim 3, wherein the first fluid path is between the heat exchanger and the variable load, and the second fluid path is between a temperature source and the heat exchanger.

5. The heat transfer system as claimed in claim 3, wherein the first fluid path is between a temperature source and the heat exchanger, and the second fluid path is between the heat exchanger and the variable load.

6. The heat transfer system as claimed in claim 3, wherein the at least one controller is configured for, in response to said determining, controlling the second variable control pump to a second flow amount of the second circulation medium in order to flush the fouling of the heat exchanger.

7. The heat transfer system as claimed in claim 6, wherein the first flow amount or the second flow amount is a maximum flow setting.

8. The heat transfer system as claimed in claim 6, wherein the controlling the first variable control pump to the first flow amount and the controlling the second variable control pump to the second flow amount are performed at the same time.

9. The heat transfer system as claimed in claim 6, wherein the controlling the first variable control pump to the first flow amount and the controlling the second variable control pump to the second flow amount are performed in a sequence at different times.

10. The heat transfer system as claimed in claim 1, further comprising a heat transfer module that includes the heat exchanger and at least one further heat exchanger in parallel with the heat exchanger and each other, wherein the first fluid path and the second fluid path are further defined by the at least one further heat exchanger.

11. The heat transfer system as claimed in claim 10, further comprising a respective valve for each heat exchanger that is controllable by the at least one controller, wherein, when flushing the fouling of each heat exchanger, one or more of the respective valves are controlled to be closed and less than all of the heat exchangers are flushed at a time.

12. The heat transfer system as claimed in claim 10, further comprising:

a first pressure sensor configured to detect pressure measurement of input to the first fluid path of the heat transfer module;

a second pressure sensor configured to detect pressure measurement of input to the second fluid path of the heat transfer module;

a first pressure differential sensor across the input to output of the first fluid path of the heat transfer module;

a second pressure differential sensor across the input to output of the second fluid path of the heat transfer module;

a first temperature sensor configured to detect temperature measurement of the input of the first fluid path of the heat transfer module;

a second temperature sensor configured to detect temperature measurement of the output of the first fluid path of the heat transfer module;

a third temperature sensor configured to detect temperature measurement of the input of the second fluid path of the heat transfer module;

a fourth temperature sensor configured to detect temperature measurement of the output of the second fluid path of the heat transfer module;

a respective temperature sensor to detect temperature measurement of output of each fluid path of each heat exchanger of the heat transfer module;

wherein the at least one controller is configured to receive data indicative of measurement from the pressure sensors, the pressure differential sensors, and the temperature sensors, for said determining that the heat exchanger requires maintenance due to fouling of the heat exchanger.

13. The heat transfer system as claimed in claim 12, further comprising:

a first flow sensor configured to detect first flow measurement of first flow through heat transfer module that includes the first fluid path and a corresponding first fluid path of the at least one further heat exchanger;

a second flow sensor configured to detect second flow measurement of second flow through the heat transfer module that includes the second fluid path of and a corresponding second fluid path of the at least one further heat exchanger;

wherein the at least one controller is configured to:

receive data indicative of the flow measurement from the first flow sensor and the second flow sensor,

calculate a respective heat load (Q) of the first flow through the heat transfer module and the second flow through the heat transfer module from: the first flow measurement, the second flow measurement, the respective temperature measure from the first temperature sensor, the respective temperature measure from the third temperature sensor, and the respective temperature measurement from the respective temperature sensor of the output of each heat exchanger from the respective temperature sensor, and

calculate a comparison between the heat load (Q) of the first flow and the heat load (Q) of the second flow, for said determining that the heat exchanger requires maintenance due to fouling of the heat exchanger.

14. The heat transfer system as claimed in claim 1, further comprising:

at least one pressure sensor or temperature sensor configured to detect measurement at the heat exchanger,

wherein the at least one controller is configured to determine a clean coefficient value of the heat exchanger when in a clean state;

wherein said determining that the heat exchanger requires maintenance due to fouling of the heat exchanger, further includes:

calculating, from measurement of the at least one pressure sensor or temperature sensor during the real-time operation when sourcing the variable load, an actual coefficient value of the heat exchanger; and

calculating a comparison between the actual coefficient value of the heat exchanger and the clean coefficient value of the heat exchanger.

15. The heat transfer system as claimed in claim 14, wherein the at least one controller is

configured to determine a clean heat transfer coefficient (U) of the heat exchanger when in a clean state;

wherein said determining that the heat exchanger requires maintenance due to fouling of the heat exchanger, further includes:

calculating, from measurement of the at least one pressure sensor or temperature sensor during the real-time operation when sourcing the variable load, an actual heat transfer coefficient (U) of the heat exchanger; and

calculating a second comparison between the actual heat transfer coefficient (U) of the heat exchanger and the clean heat transfer coefficient (U) of the heat exchanger.

16. The heat transfer system as claimed in claim 15, wherein the calculating the second comparison is calculating a fouling factor (FF) based on the actual heat transfer coefficient (U) of the heat exchanger and the clean heat transfer coefficient (U) of the heat exchanger.

17. The heat transfer system as claimed in claim 16, wherein the calculating of the fouling factor (FF) is calculated as:

FF = 1 / Udirt – 1 / Uclean,

where:

Uclean is the clean heat transfer coefficient (U),

Udirt is the actual heat transfer coefficient (U).

18. The heat transfer system as claimed in claim 14, wherein the at least one controller is configured to determine a clean pressure differential value across the first fluid path of the heat exchanger when in a clean state;

wherein said determining, based on real-time operation when sourcing the variable load, that the heat exchanger requires maintenance due to fouling of the heat exchanger further includes:

calculating, from measurement of ~~the at least one~~ two of the pressure sensors during the real-time operation when sourcing the variable load, an actual pressure differential value across the first fluid path of the heat exchanger;

calculating a third comparison between the actual pressure differential value of the heat exchanger and the clean pressure differential value of the heat exchanger.

19. The heat transfer system as claimed in claim 14, wherein the at least one controller is configured to determine a clean temperature differential value across the first fluid path of the heat exchanger when in a clean state;

wherein said determining that the heat exchanger requires maintenance due to fouling of the heat exchanger further includes:

calculating, from measurement of two of the temperature sensors during the real-time operation when sourcing the variable load, an actual temperature differential value of the first fluid path of the heat exchanger; and

calculating a fourth comparison between the actual temperature differential value of the heat exchanger and the temperature differential value of the heat exchanger.

20. The heat transfer system as claimed in claim 14, wherein the clean coefficient value of the heat exchanger when in the clean state is previously determined by testing prior to shipping or installation of the heat exchanger and is stored to a memory, wherein the determining by the at least one controller of the clean coefficient value of the heat exchanger when in the clean state is performed by accessing the clean coefficient value from the memory.

21. The heat transfer system as claimed in claim 1, further comprising at least one sensor configured to detect measurement indicative of the heat exchanger; wherein the at least one controller is configured to determine a clean coefficient value of the heat exchanger when in a clean state; wherein said determining that the heat exchanger requires maintenance due to fouling of the heat exchanger further includes:

predicting, based on previous measurement of the at least one sensor during the real-time operation when sourcing the variable load, an actual coefficient value of the heat exchanger; and

calculating a comparison between the predicted actual coefficient value of the heat exchanger and the clean coefficient value of the heat exchanger.

22. The heat transfer system as claimed in claim 1, wherein said determining that the heat exchanger requires maintenance due to fouling of the heat exchanger further includes:

determining that the variable load is being sourced by the heat exchanger continuously at a maximum specified part load for a specified period of time.

23. The heat transfer system as claimed in claim 22, wherein said maximum specified part load is 90% of full load of the variable load and said specified period of time is at least on or about 7 days.

24. The heat transfer system as claimed in claim 1, wherein the at least one controller is configured to determine flushing of the fouling of the heat exchanger was successful or unsuccessful by:

determining a clean coefficient value of the heat exchanger when in a clean state,

calculating, from the measurement the real-time operation when sourcing the variable load, an actual coefficient value of the heat exchanger, and

calculating a comparison between the actual coefficient value of the heat exchanger and the clean coefficient value of the heat exchanger,

wherein, based on the calculating the comparison, the at least one controller is configured to output a notification in relation to the flushing of the fouling of the heat exchanger being successful or unsuccessful.

25. The heat transfer system as claimed in claim 1, wherein the first flow amount is: a maximum flow setting of the first variable control pump; or a maximum duty flow of the

variable load; or a maximum flow capacity of the heat exchanger.

26. The heat transfer system as claimed in claim 1, wherein the first flow amount comprises a back flow of the first variable control pump.

27. The heat transfer system as claimed in claim 1, wherein the heat exchanger is a plate and frame counter current heat exchanger that includes a plurality of brazed plates for causing turbulence when facilitating heat transfer between the first fluid path and the second fluid path.

28. The heat transfer system as claimed in claim 1, wherein the heat exchanger is a shell and tube heat exchange or a gasketed plate heat exchanger.

29. The heat transfer system as claimed in claim 1, wherein the at least one controller is integrated with the heat exchanger.

30. A method for sourcing a variable load using a heat transfer system, the heat transfer system including a heat exchanger that defines a first fluid path and a second fluid path, the heat transfer system including a first variable control pump for providing variable flow of a first circulation medium through the first fluid path of the heat exchanger, the method being performed by at least one controller and comprising:

controlling the first variable control pump to control the first circulation medium through the heat exchanger in order to source the variable load,

determining, based on real-time operation when sourcing the variable load, that the heat exchanger requires maintenance due to fouling of the heat exchanger, and

in response to said determining, controlling the first variable control pump, to a first flow amount of the first circulation medium in order to flush the fouling of the heat exchanger.

31. A non-transitory computer readable medium having instructions stored thereon executable by at least one controller for performing the method as claimed in claim 30.

~~32. A heat transfer module, comprising:~~

~~a sealed casing that defines a first port, a second port, a third port, and a fourth port;~~

~~a plurality of parallel heat exchangers within the sealed casing that collectively define a first fluid path between the first port and the second port and collectively define a second fluid path between the third port and the fourth port;~~

~~a first pressure sensor within the sealed casing configured to detect pressure measurement of input to the first fluid path of the heat transfer module;~~

~~a second pressure sensor within the sealed casing configured to detect pressure measurement of input to the second fluid path of the heat transfer module;~~

~~a first pressure differential sensor within the sealed casing and across the input to output of the first fluid path of the heat transfer module;~~

~~a second pressure differential sensor within the sealed casing and across the input to output of the second fluid path of the heat transfer module;~~

~~a first temperature sensor within the sealed casing configured to detect temperature measurement of the input of the first fluid path of the heat transfer module;~~

~~a second temperature sensor within the sealed casing configured to detect temperature measurement of the output of the first fluid path of the heat transfer module;~~

~~a third temperature sensor within the sealed casing configured to detect temperature measurement of the input of the second fluid path of the heat transfer module;~~

~~a fourth temperature sensor within the sealed casing configured to detect temperature measurement of the output of the second fluid path of the heat transfer module;~~

~~a respective temperature sensor within the sealed casing to detect temperature measurement of output of each fluid path of each heat exchanger of the heat transfer module;~~

and

at least one controller configured to receive data indicative of measurement from the pressure sensors, the pressure differential sensors, and the temperature sensors, and

calculate, from measurement of the pressure sensors, the pressure differential sensors, the temperature sensors, or from external flow sensors, during real-time operation when sourcing a variable load, an actual coefficient value of the heat exchanger.

33. The system as claimed in claim 32, wherein the at least one controller is configured to instruct one or more variable control pumps to operate flow through the heat exchanger.

34. The system as claimed in claim 33, wherein the at least one controller is configured to:

determine a clean coefficient value of the heat exchanger when in a clean state;

determine that the heat exchanger requires maintenance due to fouling of the heat exchanger, including:

calculating a comparison between the actual coefficient value of the heat exchanger and the clean coefficient value of the heat exchanger,

concluding that the heat exchanger requires maintenance due to fouling of the heat exchanger; and

instructing the one or more variable control pumps to operate at a maximum flow setting through the heat exchanger in order to flush the fouling of the heat exchanger.

35. The system as claimed in claim 34, wherein the instructing the one or more variable control pumps is performed during real-time sourcing of the variable load.

36. The system as claimed in claim 33, wherein one of the variable control pumps is attached to the first port, and another one of the variable control pumps is attached to the third port.

37. The system as claimed in claim 32, wherein the calculating the actual coefficient value of the heat exchanger comprises predicting the actual coefficient value of the heat exchanger based on previous measurement of the pressure sensors, the pressure differential sensors, the temperature sensors, or from the external flow sensors during the real-time operation when sourcing the variable load.

38. The system as claimed in claim 32, wherein the actual coefficient value is a flow capacity, a fouling factor (FF), a heat transfer capacity (Qc) or a heat transfer coefficient (U).

39. The system as claimed in claim 32, wherein the at least one controller is at the sealed casing.

40. The system as claimed in claim 32, wherein each of the plurality of parallel heat exchangers is a plate heat exchanger.

41. The system as claimed in claim 32, wherein each of the plurality of parallel heat exchangers is a shell and tube heat exchange or a gasketed plate heat exchanger

42. A system for tracking heat exchanger performance, comprising:

a heat exchanger for installation in a system that has a load;

an output subsystem; and

at least one controller configured to:

determine a clean coefficient value of the heat exchanger when in a clean state,

calculate, from measurement of real-time operation when sourcing the load, an actual coefficient value of the heat exchanger,

calculate a comparison between the actual coefficient value of the heat exchanger and the clean coefficient value of the heat exchanger, and

output to the output subsystem when the comparing satisfies criteria.

43. The system as claimed in claim 42, wherein the outputting comprises sending a signal to control one or more variable control pumps to a maximum flow amount in order to flush the heat exchanger.

~~44. The system as claimed in claim 42, wherein the outputting comprises outputting an alert to the output subsystem, wherein the output subsystem includes a display screen or a communication subsystem.~~

~~45. The system as claimed in claim 44, wherein the alert indicates that flushing or maintenance of the heat exchanger is required.~~

~~46. The system as claimed in claim 44, wherein the alert indicates that there is performance degradation of the heat exchanger.~~

~~47. The system as claimed in claim 42, wherein the coefficient value is a flow capacity, a fouling factor (FF), a heat transfer capacity (Qc) or a heat transfer coefficient (U).~~

~~48. The system as claimed in claim 42, wherein the at least one controller is integrated with the heat exchanger.~~

~~49. The system as claimed in claim 42, wherein the calculating the actual coefficient value of the heat exchanger comprises predicting the actual coefficient value of the heat exchanger based on previous measurement of the real-time operation when sourcing the load.~~

~~50. A method for tracking performance of a heat exchanger for installation in a system that has a load, the method being performed by at least one controller and comprising:~~

~~determining a clean coefficient value of the heat exchanger when in a clean state;~~

~~calculating, from measurement of real-time operation when sourcing the load, an actual coefficient value of the heat exchanger;~~

~~calculating a comparison between the actual coefficient value of the heat exchanger and the clean coefficient value of the heat exchanger; and~~

~~outputting to an output subsystem when the comparing satisfies criteria.~~

~~51. The method as claimed in claim 50, wherein the coefficient value is is a flow capacity, a fouling factor (FF), a heat transfer capacity (Qc) or a heat transfer coefficient (U).~~

~~52. The method as claimed in claim 50, wherein the calculating the actual coefficient value of the heat exchanger comprises predicting the actual coefficient value of the heat~~

~~exchanger based on previous measurement of the real-time operation when sourcing the load.~~

~~53. A non-transitory computer readable medium having instructions stored thereon executable by at least one controller for performing the method as claimed in claim 50.~~