CLAIMS

The invention is claimed as follows:

1. A system for manufacturing a food product, the system comprising:

at least one heat exchanger;

at least one food product tank;

at least one conduit downstream of the food product tank for flow of the food product, wherein the conduit connects the food product tank to the heat exchanger; and

a flow detection device coupled to an exterior of the conduit, the flow detection device comprising a processor and a computer readable medium storing instructions which, when executed, cause the processor to perform a spread spectrum analysis of the flow of the food product through the conduit, wherein the spread spectrum analysis is the use of a wide ultrasonic beam that is refracted by a conduit wall and reflected by particles suspended in the food product to detect a size and concentration of particles in the food product.

2. The system according to Claim 1, wherein the system is an aseptic manufacturing system.

3. The system according to Claims 1 or 2, wherein the flow detection device is an ultrasonic flow detection device.

4. The system according to any one of Claims 1-3, further comprising at least one additional conduit for flow of the food product.

5. The system according to Claim 4, wherein at least one of the additional conduits comprises a flow detection device.

6. The system according to any one of Claims 1-5, wherein the instructions are programmed to cause the processor to transmit an ultrasonic beam from the flow detection device and through the conduit, wherein the beam is (i) refracted by a wall of the conduit and/or (ii) reflected by particles in the food product and received by the flow detection device.

7. The system according to Claim 6, wherein the instructions are programmed to cause the processor to analyze the refracted and/or reflected beams to determine a concentration of the food product.

8. The system according to any one of Claims 1-7, wherein the instructions are programmed to cause the processor to detect a change from a low particle concentration of the food product to a high particle concentration of the food product.

9. The system according to any one of Claims 1-8, further comprising:
a computer having a computer processor; and
a computer-readable medium accessible to the computer and containing a software program therein that is programmed to cause the computer processor to detect a change from a low particle concentration of the food product to a high particle concentration of the food product when the food product flows through the flow path.

10. The system according to any one of Claims 1-9, further comprising additional flow paths connecting other devices in the aseptic manufacturing system, wherein the other devices are selected from the group consisting of tanks, valves, exchangers, and combinations thereof.

11. The system according to any one of Claims 1-10, wherein the instructions are programmed to cause initiating flow of the food product through the conduit.

12. A method for detecting a water/food product interface~~, in an aseptic manufacturing system, the method~~ comprising:
providing a food manufacturing system configured to perform a spread spectrum analysis, wherein the spread spectrum analysis is the use of a wide ultrasonic beam that is refracted by a conduit wall and reflected by particles suspended in the food product to detect a size and concentration of particles in the food product. ~~comprising~~
~~at least one heat exchanger,~~
~~at least one food product tank,~~
~~tubing connecting at least the food product tank to the heat exchanger;~~
~~a computer having a computer processor, and~~

13. A method according to claim 12, wherein the food manufacturing system comprising:

at least one heat exchanger,

at least one food product tank,

tubing connecting at least the food product tank to the heat exchanger,

a computer having a computer processor, and

a computer-readable medium accessible to the computer and containing a software program therein that is programmed to cause the computer processor to detect a change from a low particle concentration of the food product to a high particle concentration of the food product when the food product flows through the tubing.

~~a computer-readable medium accessible to the computer and containing a software program therein that is programmed to cause the computer processor to detect a change from a low particle concentration of the food product to a high particle concentration of the food product when the food product flows through the tubing.~~

~~13.~~14. The method according to Claim 12, wherein the food manufacturing system is selected from the group consisting of those claimed in Claim 1 to Claim 11.

~~14.~~15. The method according to any one of Claims 12-14~~13~~, further comprising the step of initiating flow of the food product through the tubing.

~~15.~~16. The method according to any one of Claims 12-15~~14~~, further comprising the step of executing the software program.

~~16.~~17. The method according to any one of Claims 12-16~~15~~, wherein the system is an aseptic manufacturing system.

~~17.~~18. The method according to any one of Claims 12-17~~16~~, wherein the software program therein that is programmed to cause the computer processor to transmit an ultrasonic beam from the flow detection device and through the tubing, wherein the beam is (i) refracted by a wall of the tubing and/or (ii) reflected by particles in the food product and received by the flow detection device.

~~18.~~19. The method according to any one of Claims 12-18~~17~~, further comprising additional tubing connecting the heat exchanger to other devices in the aseptic manufacturing system, wherein the other devices are selected from the group consisting of tanks, valves, exchangers, and combinations thereof, and, wherein the software program is programmed to cause the computer processor to transmit an ultrasonic beam from the flow detection device and through at least one of the additional tubing, wherein the beam is (i) refracted by a wall of the conduit and/or (ii) reflected by particles in the food product and received by the flow detection device.

~~19.~~20. The method according to Claims 18~~17~~ or 19~~18~~, wherein the software program are programmed to cause the computer processor to analyze the refracted and/or reflected beams to determine a concentration of the food product.

~~20.~~21. The method according to Claims 18~~17~~ or 19~~18~~, wherein the ultrasonic flow detection device is so constructed and arranged to perform a spread spectrum analysis, the spread spectrum analysis is the use of a wide ultrasonic beam that is refracted by a conduit wall and reflected by particles suspended in the food product to detect a size and concentration of particles in the food product.