

CLAIMS

1. A system for forming microspheres, comprising:
 - a dispersed phase needle including:
 - a dispersed phase input fitting at a first end,
 - a needle tube at a second end, and
 - a dispersed phase output fitting oriented between the dispersed phase input fitting and the needle tube,wherein the dispersed phase needle has a hollow bore;
 - a tee or a wye including:
 - a plurality of tubes,
 - a tee input fitting or a wye input fitting,
 - a continuous phase input fitting, and
 - a continuous phase output fitting,wherein the tubes each include a hollow bore; and
 - a pump chamber including:
 - an input tube having an input fitting and a hollow bore,
 - a housing,
 - an output tube having an output fitting and a hollow bore,
 - a hollow interior, and
 - an impeller is oriented within the hollow interior,wherein the impeller includes a plurality of impeller blades and a base, wherein the base includes a magnet to magnetically engage a rotating magnetic field outside of the pump chamber, and wherein the impeller rotates and creates a direction of natural flow of a fluid

through the pump chamber in a direction from the output tube toward the input tube.

2. The system of claim 1, wherein the dispersed phase needle output fitting engages the tee input fitting to create a seal.

3. The system of claim 1, wherein the continuous phase output fitting engages the pump chamber input fitting to create a seal.

4. The system of claim 1, wherein a dispersed phase liquid is pumped through the hollow bore of the dispersed phase needle and into the hollow interior of the pump chamber in a direction opposite the direction of natural flow, and wherein a continuous phase liquid is pumped through the tee or the wye and into the hollow interior of the pump chamber in a direction opposite the direction of natural flow, and wherein the dispersed phase liquid and the continuous phase liquid are homogenized in a high shear environment created by rotation of the impeller within the hollow interior of the pump chamber.

5. A system for forming microspheres, comprising:

a tee or a wye including:

a plurality of tubes,

a tee input fitting or a wye input fitting,

a continuous phase input fitting, and

a continuous phase output fitting,

wherein the tubes each include a hollow bore; and

a pump chamber including:

an input tube having an input fitting and a hollow bore,

a housing,

an output tube having an output fitting and a hollow bore,

a hollow interior, and

an impeller oriented within the hollow interior,

wherein the impeller includes a plurality of impeller blades and a base,

wherein the base includes a magnet to magnetically engage a rotating magnetic field outside of the pump chamber, and

wherein the impeller rotates and creates a direction of natural flow of a fluid through the pump chamber in a direction from the output tube toward the input tube; and

wherein a dispersed phase liquid is pumped through at least one of the plurality of tubes of the tee or the wye and into the hollow interior of the pump chamber in a direction opposite the direction of natural flow,

wherein a continuous phase liquid is pumped through the tee or the wye and into the hollow interior of the pump chamber in a direction opposite the direction of natural flow, and

wherein the dispersed phase liquid and the continuous phase liquid are homogenized in a high shear environment created by rotation of the impeller within the hollow interior of the pump chamber.

6. The system of claim 5, further comprising a dispersed phase needle including:

a dispersed phase input fitting at a first end,

a needle tube at a second end, and

a dispersed phase output fitting oriented between the dispersed phase input fitting and the needle tube,

wherein the dispersed phase needle has a hollow bore.

7. The system of claim 6, wherein the dispersed phase liquid is pumped through the dispersed phase needle, wherein the dispersed phase needle is oriented through the tee or the wye.

8. The system of claim 7, wherein the dispersed phase liquid is pumped through the dispersed phase needle into the hollow interior of the pump chamber in a direction opposite the direction of natural flow.

9. The system of claim 6, wherein the dispersed phase needle output fitting engages the tee input fitting or the wye input fitting to create a seal.

10. The system of claim 5, wherein the continuous phase output fitting engages the pump chamber input fitting to create a seal.

11. A method for making microspheres, comprising:

providing a dispersed phase source;

providing a continuous phase source;

providing a levitating magnetic impeller pump including:

a pump chamber having a hollow interior,

an impeller including a plurality of impeller blades, and

wherein the impeller is oriented within the hollow interior and wherein

the rotation of the impeller creates a direction of natural flow of a fluid;

pumping the dispersed phase under positive pressure into the pump chamber of the levitating magnetic impeller pump via the pump's intended output in a direction opposite the direction of natural flow;

pumping the continuous phase under positive pressure through a tee or a wye and into the pump chamber via the pump's intended output in a direction opposite the direction of natural flow; and

homogenizing the dispersed phase and the continuous phase within the pump chamber.

12. The method of claim 11, wherein the dispersed phase is pumped through a dispersed phase needle and into the pump chamber.

13. The method of claim 11, wherein the impeller rotates, and wherein the rotating impeller creates a high shear environment within the hollow interior of the pump chamber.

14. The method of claim 11, wherein the impeller includes a base, and wherein the base includes a magnet to magnetically engage a rotating magnetic field outside of the pump chamber, and wherein the rotating magnetic field causes the impeller to rotate within the pump chamber.

15. A method for making an emulsion, comprising:

providing a dispersed phase source;

providing an inner aqueous phase source;

wherein the ratio of the inner aqueous phase to the dispersed phase is between 1:1 and 1:80;

combining the dispersed phase and the inner aqueous phase in an emulsion vessel to form a mixture;

providing a pump;

providing a levitating magnetic impeller pump including:

a pump chamber having a hollow interior,

an impeller including a plurality of impeller blades, and

wherein the impeller is oriented within the hollow interior and wherein the rotation of the impeller creates a direction of natural flow of a fluid;

pumping the mixture under a positive pressure into the pump chamber of the levitating magnetic impeller pump via the pump's intended output in a direction opposite the direction of natural flow;

removing the mixture from the pump's intended input and returning the mixture to the emulsion vessel.

16. The method of claim 15, wherein the mixture returned to the emulsion vessel is pumped a second time into the pump chamber via the levitating magnetic impeller pump's intended output in a direction opposite the direction of natural flow.

17. The method of claim 15, wherein the pump used to pump the mixture from the emulsion vessel to the pump chamber is a peristaltic pump.

18. A method for producing microspheres, microparticles, or emulsions using a levitating magnetic impeller pump, comprising:

wherein the levitating magnetic impeller pump includes a chamber having a hollow interior, and a rotating impeller oriented within the hollow interior of the chamber;

wherein a dispersed phase liquid or dispersed phase suspension is pumped into the hollow interior of the levitating magnetic impeller pump's chamber;

wherein a continuous phase liquid is pumped into the hollow interior of the levitating magnetic impeller pump's chamber; and

wherein the dispersed phase liquid and the continuous phase liquid are homogenized in a shear environment created by rotation of the impeller within the hollow interior of the chamber, to form microspheres, microparticles, or emulsions.