dielectric fluid without having to interrupt the operation of an immersion cooling system in fluid communication with the cleaning and recycling system.

[0010] In a first aspect, the present invention relates to a method of recovering a dielectric fluid used for immersion cooling of one or more electronic devices. In some embodiments, the method includes filtering the dielectric fluid to remove a first group of solid contaminants (e.g., medium- to coarse-grained solid contaminants); distilling the filtered dielectric fluid in at least one distillation tank to produce a vaporized dielectric fluid; separating the vaporized dielectric fluid from less volatile contaminants, wherein the vaporized dielectric fluid is introduced as a condensate into a circulation tank; circulating the condensate by pumping the condensate from the circulation tank through at least one filter; filtering the circulating condensate through the at least one filter to remove a second group of contaminants (e.g., fine-grained, solid contaminants, very fine-grained, solid contaminants, oil, water, dissolved liquid contaminants, partially dissolved liquid contaminants, undissolved liquid contaminants, and combinations thereof); and returning the filtered condensate to the circulation tank. The at least one distillation tank includes a first distillation tank in fluid communication with a second distillation tank. Producing and separating the vaporized dielectric fluid includes heating dielectric fluid in the first distillation tank to a first calibrated temperature to vaporize the dielectric fluid, collecting the condensate of the vaporized dielectric fluid in the second distillation tank, heating the collected condensate in the second distillation tank to a second calibrated temperature to vaporize the collected condensate.

[0010a] In one implementation, filtering the dielectric fluid to remove the first group of solid contaminants may include introducing the dielectric fluid into a mechanical filtration process that, in some variations, may consist of or consist essentially of multiple mechanical particle filters of diminishing filter pore size that may be arranged serially from a largest pore size to a smallest pore size. Optionally, in addition to filtering the contaminated dielectric fluid through a mechanical filtration process, the contaminated dielectric fluid may also be filtered through a filter with a desiccant, through a mixed carbon filter, and combinations thereof.

[0011] In some implementations, separating the vaporized dielectric fluid from less volatile contaminants may include condensing the vaporized dielectric fluid in the distillation tank(s) to produce the condensate, collecting the condensate in the circulation tank, and collecting the less volatile contaminants at a bottom portion of the distillation tank(s). In one variation, condensing includes providing, within the distillation tank(s), one or more fluid-cooled

condensing coils, on which the vaporized dielectric fluid condenses, and collecting the condensate includes gravity feeding the condensate from an exterior surface of the fluid-cooled condensing coil to the circulation tank.

[0012] In some applications, filtering the circulating condensate may include passing or forcing the circulating condensate through one or more filters with a desiccant, through one or more mixed carbon filters, and/or through one or more mechanical particle filters that may consist of or consist essentially of multiple mechanical particle filters of diminishing filter pore size arranged serially from a largest pore size to a smallest pore size.

[0013] In some variations, the method may also include one or more of: interrupting distilling if a pressure in the distillation tank(s) exceeds an allowable pressure, interrupting distilling if a level of the filtered dielectric fluid in the distillation tank(s) is less than a minimum allowable fluid level, and/or interrupting circulating the condensate through the circulation tank when a desired electrical resistivity and/or a desired optical transmittance and/or a desired infra-red transmittance are measured in the condensate. In other variations, the method may also include recovering the dielectric fluid directly from an immersion cooling system and/or returning filtered condensate directly to the immersion cooling system.

[0014] In a second aspect, the present invention relates to a system for recovering a dielectric fluid used for immersion cooling of an electronic device(s). In some embodiments, the system may include a first filter device for filtering the dielectric fluid to remove a first group of solid contaminants (e.g., medium- to coarse-grained solid contaminants); at least one distillation tank for distilling the filtered dielectric fluid to produce a vaporized dielectric fluid; a condensing device located within each distillation tank for separating a condensate of the vaporized dielectric fluid from less volatile contaminants; a circulation tank for circulating the condensate of the vaporized dielectric fluid; and at least one second filter device for filtering the circulating condensate to remove a second group of contaminants (e.g., fine-grained solid contaminants, very fine-grained solid contaminants, oil, water, dissolved liquid contaminants, partially dissolved liquid contaminants, undissolved liquid contaminants, and combinations thereof). The at least one distillation tank includes a first distillation tank in fluid communication with a second distillation tank. Separating the condensate of the vaporized dielectric fluid includes heating dielectric fluid in the first distillation tank to a first calibrated temperature to vaporize the dielectric fluid, collecting the condensate of the vaporized dielectric fluid in the second distillation tank, and heating the collected condensate in the second distillation tank to a second calibrated temperature to vaporize the collected condensate.

[0014a] In some applications, the first filter device and/or the second filter device may include one or more mechanical filters that may include multiple mechanical particle filters of diminishing filter pore size arranged serially from a largest pore size to a smallest pore size. In some variations, the first and/or second filter device may also include one or more filters with a desiccant and/or one or more mixed carbon filters.

CLAIMS

1. A method of recovering a dielectric fluid used for immersion cooling of at least one electronic device, the method comprising:

filtering the dielectric fluid to remove a first group of solid contaminants;

distilling the filtered dielectric fluid in at least one distillation tank to produce a vaporized dielectric fluid;

separating the vaporized dielectric fluid from less volatile contaminants, wherein the vaporized dielectric fluid is introduced as a condensate into a circulation tank;

circulating the condensate by pumping the condensate from the circulation tank through at least one filter;

filtering the circulating condensate with the at least one filter to remove a second group of contaminants; and

returning the filtered condensate to the circulation tank,

wherein the at least one distillation tank comprises a first distillation tank in fluid communication with a second distillation tank and producing and separating the vaporized dielectric fluid comprises:

heating dielectric fluid in the first distillation tank to a first calibrated temperature to vaporize the dielectric fluid;

collecting the condensate of the vaporized dielectric fluid in the second distillation tank; and

heating the collected condensate in the second distillation tank to a second calibrated temperature to vaporize the collected condensate.

2. The method of claim 1, wherein filtering the dielectric fluid to remove the first group comprises introducing the dielectric fluid into a mechanical filtration process.

3. The method of claim 2, wherein the mechanical filtration process comprises filtering the dielectric fluid through a plurality of mechanical particle filters of diminishing filter pore size.

4. The method of claim 3, wherein the mechanical filtration process comprises filtering the dielectric fluid through the plurality of mechanical particle filters arranged serially from a largest pore size to a smallest pore size.

5. The method of claim 1, wherein filtering the dielectric fluid to remove the first group comprises introducing the dielectric fluid into a filter with a desiccant.

6. The method of claim 1, wherein filtering the dielectric fluid to remove the first group comprises introducing the dielectric fluid into a mixed carbon filter.

7. The method of claim 1, wherein the second calibrated temperature is less than the first calibrated temperature.

8. The method of claim 1, wherein condensing comprises providing, within the at least one distillation tank, at least one fluid-cooled condensing coil on which the vaporized dielectric fluid condenses.

9. The method of claim 8, wherein collecting the condensate comprises gravity feeding the condensate from a surface of the fluid-cooled condensing coil to the circulation tank.

10. The method of claim 1, wherein filtering the circulating condensate comprises filtering the circulating condensate through at least one filter with a desiccant.

11. The method of claim 1, wherein filtering the circulating condensate comprises filtering the circulating condensate through at least one mixed carbon filter.

12. The method of claim 1, wherein filtering the circulating condensate comprises filtering the circulating condensate through at least one mechanical particle filter.

13. The method of claim 12, wherein filtering the circulating condensate comprises filtering the circulating condensate through a plurality of mechanical particle filters of diminishing filter pore size.

14. The method of claim 13, wherein filtering the circulating condensate comprises filtering the circulating condensate through the plurality of mechanical particle filters arranged serially from a largest pore size to a smallest pore size.

15. The method of claim 1, further comprising interrupting distilling if a pressure in any of the at least one distillation tank exceeds an allowable pressure.

16. The method of claim 1, further comprising interrupting distilling if a level of the filtered dielectric fluid if any of the at least one distillation tank is less than a minimum allowable fluid level.

17. The method of claim 1, further comprising interrupting circulating the condensate through the circulation tank when at least one of a desired electrical resistivity, a desired infra-red spectroscopy, or a desired optical transmittance is measured in the circulating condensate.

18. The method of claim 1, further comprising at least one of:

recovering the dielectric fluid directly from an immersion cooling system; and

returning filtered condensate directly to the immersion cooling system.

19. A system for recovering a dielectric fluid used for immersion cooling of at least one electronic device, the system comprising:

a first filter device for filtering the dielectric fluid to remove a first group of solid contaminants;

at least one distillation tank for distilling the filtered dielectric fluid to produce a vaporized dielectric fluid;

a condensing device located within each distillation tank for separating a condensate of the vaporized dielectric fluid from less volatile contaminants;

a circulation tank for circulating the condensate of the vaporized dielectric fluid; and

at least one second filter device for filtering the circulating condensate to remove a second group of contaminants,

wherein the at least one distillation tank comprises a first distillation tank in fluid communication with a second distillation tank and separating the condensate of the vaporized dielectric fluid comprises:

heating dielectric fluid in the first distillation tank to a first calibrated temperature to vaporize the dielectric fluid;

collecting the condensate of the vaporized dielectric fluid in the second distillation tank; and

heating the collected condensate in the second distillation tank to a second calibrated temperature to vaporize the collected condensate.

20. The system of claim 19, wherein at least one of the first filter device and the second filter device comprises at least one mechanical filter.

21. The system of claim 20, wherein the at least one mechanical filter comprises a plurality of mechanical particle filters of diminishing filter pore size.

22. The system of claim 21, wherein the plurality of mechanical particle filters is structured and arranged, such that the dielectric fluid travels serially through the plurality of mechanical particle filters from a largest pore size to a smallest pore size.

23. The system of claim 19, wherein at least one of the first filter device and the second filter device comprises a filter with a desiccant.

24. The system of claim 19, wherein at least one of the first filter device and the second filter device comprises a mixed carbon filter.

25. The system of claim 19, wherein the at least one distillation tank comprises a first distillation tank in fluid communication with a second distillation tank, such that vaporized dielectric fluid from the first distillation tank, after condensation, can be introduced into the second distillation tank.

26. The system of claim 19, wherein the condensing device comprises at least one fluid-cooled condensing coil on which the vaporized dielectric fluid condenses.

27. The system of claim 19, further comprising an interrupt device configured to interrupt distilling if a pressure in the at least one distillation tank exceeds an allowable pressure.

28. The system of claim 19, further comprising an interrupt device configured to interrupt distilling if a level of the filtered dielectric fluid in the at least one distillation tank is less than a minimum allowable fluid level.

29. The system of claim 19, further comprising at least one of:

a sensing device for sensing electrical resistivity in the circulating condensate;

a sensing device for sensing infra-red spectroscopy in the circulating condensate;

a sensing device for sensing optical transmittance in the circulating condensate; and

an interrupt device for interrupting circulating the condensate through the circulation tank when at least one of a desired electrical resistivity, a desired infra-red spectroscopy, or a desired optical transmittance is measured in the circulating condensate.

30. The system of claim 19, further comprising at least one of:

a conduit for recovering the dielectric fluid directly from an immersion cooling system; and

a conduit for returning the filtered circulating condensate directly to the immersion cooling system.

31. The system of claim 19, wherein the circulation tank and at least one second filter device are configured in a closed loop further comprising at least one pumping system.