

TITLE OF THE INVENTION

RECLAMATION PROCESSES INCLUDING AZEOTROPIC
AND OTHER CLOSE-BOILING THERMAL FLUIDS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of priority of U.S. Provisional Application 63/541,498 filed September 29, 2023, U.S. Provisional Application 63/599,883 filed November 16, 2023, U.S. Provisional Application 63/627,372 filed January 31, 2024, and U.S. Provisional Application 63/564,043 filed March 12, 2024, the disclosure of each of which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

[0002] The present disclosure relates to systems and processes of thermal fluid reclamation. More specifically, the present disclosure relates to systems and processes of converting spent thermal fluids into reclaimed azeotropic, azeotrope-like, and other close-boiling thermal fluids.

BACKGROUND OF THE INVENTION

[0003] Thermal fluid or refrigerant reclamation has long attracted significant attention due to regulatory requirements and increasing emphasis on circularity, emissions reduction, and resource efficiency. An efficient and effective reclamation process benefits both the environment and the global economy. Indeed, in the absence of such a reclamation process, the thermal fluids would have to be destroyed or otherwise disposed of, such as by thermal oxidation, which is very energy intensive and results in a loss of product to the circular economy.

[0004] Historically, most reclamation processes have simply been achieved by removing contaminants from the thermal fluids and rebalancing the purified blends by addition of components. Historically, where separation has been used, refrigerant reclamation has been limited essentially to single-compound fluids.

[0005] Conventional reclamation requires sending the used refrigerants to a reclamation site for further processing, including purification, which may include drying, acids removal, and/or separation of various components by distillation.

During the process, the used refrigerants are often combined in a mixed tank at the reclamation site. Although this simplifies the storage process, it brings challenges and complexity in separation, especially for close-boiling, azeotrope-like, and azeotropic components in the recovered mixture. For example, to obtain pure close-boiling, azeotrope-like, and azeotropic components, a large separation column may be required, in addition to technical processes such as extraction distillation, all of which may be energy-intensive, labor-intensive, and time-consuming.

[0006] Efficient and effective reclamation of azeotropic, azeotrope-like, and other close-boiling thermal fluids would further benefit both the environment and the global economy.

SUMMARY OF THE INVENTION

[0007] In an example embodiment, a process of thermal fluid reclamation includes combining at least two recovered thermal fluids including a first refrigerant compound and a second refrigerant compound to form a consolidated thermal fluid. The consolidated thermal fluid is a blend including the first refrigerant compound and the second refrigerant compound with a consolidated composition. The process also includes testing the consolidated thermal fluid and validating that the consolidated thermal fluid has greater than about 95 wt%, about 96 wt%, about 97 wt%, about 98 wt%, about 99 wt%, or about 99.5 wt% organic purity. The process further includes treating the consolidated thermal fluid to form a reclaimed thermal fluid. In one embodiment, the treatment comprises distilling the consolidated thermal fluid to form at least one distillate including the first refrigerant compound and the second refrigerant compound as a reclaimed thermal fluid. The reclaimed thermal fluid has a reclaimed composition different from the consolidated composition and the reclaimed thermal fluid is azeotropic, azeotrope-like, or close-boiling. The process yet further includes using or supplying the reclaimed thermal fluid as a thermal fluid product or for formation of a thermal fluid product.

[0008] Other features and advantages of the present invention will be apparent from the following more detailed description, taken in conjunction with the accompanying drawings which illustrate, by way of example, the principles of this disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 schematically shows a system for reclaiming thermal fluid compositions as azeotropes or azeotrope-like or close-boiling compositions, in accordance with one embodiment of the present invention.

[0010] Wherever possible, the same reference numbers will be used throughout the drawings to represent the same parts.

DETAILED DESCRIPTION OF THE INVENTION

[0011] In exemplary embodiments, an integrated business and engineering process effectively and efficiently recovers multiple used single component thermal fluids and/or multicomponent thermal fluid blends, combines and purifies those recovered fluids, and provides product streams of reclaimed azeotropic, azeotrope-like, and/or close-boiling thermal fluids for the manufacture of new product streams that reduces both manufacture of virgin thermal fluids and the need for energy intensive destruction of out-of-specification (conventionally unreclaimable) spent thermal fluids.

[0012] In exemplary embodiments, systems and processes of thermal fluid reclamation combine at least two recovered thermal fluids including at least two refrigerant compounds to form a consolidated thermal fluid. In one embodiment, systems and processes of the present invention involve recovery of a thermal fluid comprised of at least two refrigerant compounds to form a consolidated thermal fluid.

[0013] In one embodiment, at least two recovered thermal fluids are collected from different air conditioning, heating or refrigeration systems, but may comprise the same primary refrigerant compounds or may have the same ASHRAE 34 designation. However, it will be understood by those skilled in the art that, even where the primary refrigerant compounds are the same, slight differences may be present in the compositions of the recovered thermal fluids 10, 12, 14. For example, different minor compounds may be present or absent in the fluids 10, 12, 14, the primary refrigerant compounds may be present in different amounts in the fluids 10, 12, 14, and the like. In other embodiments, the refrigerant compounds contained in each of the recovered thermal fluids are different from each other.

[0014] The consolidated thermal fluid is a blend of at least two refrigerant compounds and has a consolidated composition. The systems and processes test the consolidated thermal fluid and validate that the consolidated thermal fluid has greater than about 95 wt%, about 96 wt%, about 97 wt%, about 98 wt%, about 99 wt%, or about 99.5 wt% organic purity. The systems and processes treat the consolidated thermal fluid to form at least one reclaimed thermal fluid. In one embodiment, the treatment comprises distilling the consolidated thermal fluid to form at least one reclaimed thermal fluid. The systems and processes further include analyzing and purifying the reclaimed thermal fluid. The reclaimed thermal fluid has a reclaimed thermal fluid composition different from a consolidated thermal fluid composition of the consolidated thermal fluid and the at least one reclaimed thermal fluid is azeotropic, azeotrope-like, or close-boiling.

[0015] As used herein, "refrigerant compound" refers to any fluorocarbon (FC), hydrofluorocarbon (HFC), hydrochlorofluorocarbon (HCFC), chlorofluorocarbon (CFC), hydrochloroolefin (HCO), hydrofluoroolefin (HFO), chlorofluoroolefin (CFO), hydrochlorofluoroolefin (HCFO), hydrocarbon (HC), or carbon dioxide (R-744) that may be used alone or in a blend with other refrigerant compounds as a thermal fluid.

[0016] As used herein, "thermal fluid" refers to any fluid used for heat transfer in a closed-loop system.

[0017] As used herein, "azeotrope-like" refers to a composition of two or more refrigerant compounds that behaves like an azeotropic composition (i.e., has constant boiling characteristics or a tendency not to fractionate upon boiling or evaporation). Hence, during boiling or evaporation, the vapor and liquid compositions, if they change at all, change only to a minimal or negligible extent. In contrast, the vapor and liquid compositions of non-azeotrope-like compositions change to a substantial degree during boiling or evaporation.

[0018] As used herein, "azeotrope-like behavior" refers to a behavior exhibiting dew point pressure and bubble point pressure with virtually no pressure differential. In some embodiments, the difference in the dew point pressure and bubble point pressure at a given temperature is 10% or less, alternatively 9% or less, alternatively 8% or less, alternatively 7% or less, alternatively 6% or less, alternatively 5% or less,

alternatively 4% or less, alternatively 3% or less, alternatively 2% or less, alternatively 1% or less, or any value, range, or sub-range therebetween.

[0019] As used herein, “close-boiling composition” refers to compositions including at least two refrigerant compounds having a boiling point difference within about 20°C, or within about 18°C, or within about 15°C, or within about 12°C, or within about 10°C. In some embodiments, the boiling point difference is less than about 9°C, alternatively less than about 8°C, alternatively less than about 7°C, alternatively less than about 6°C, alternatively less than about 5°C, alternatively less than about 4°C, alternatively less than about 3°C, alternatively less than about 2°C, or any value, range, or sub-range therebetween.

[0020] As used herein, “virgin thermal fluid” refers to a thermal fluid composition having at least about 95 wt% organic purity, preferably at least about 99 wt% organic purity, most preferably at least about 99.5 wt% organic purity, and that has not yet been used in a thermal fluid application.

[0021] As used herein, “used thermal fluid” refers to a thermal fluid composition having at least about 95 wt% organic purity, preferably at least about 99 wt% organic purity, most preferably at least about 99.5 wt% organic purity, and that has been used as a thermal fluid.

[0022] As used herein, “spent thermal fluid” refers to a thermal fluid composition having less than about 95 wt% organic purity, preferably less than about 99 wt% organic purity, most preferably less than about 99.5 wt% organic purity, and that has been used as a thermal fluid.

[0023] As used herein, “recovered thermal fluid” refers to a spent thermal fluid or a used thermal fluid composition drained or otherwise removed from a thermal management device, such as, for example, a refrigeration, an air-conditioning system or a heat pump.

[0024] As used herein, “consolidated thermal fluid composition” refers to a blend formed by combining two or more different recovered thermal fluid types.

[0025] As generally used herein, “reclaimed thermal fluid” refers to a thermal fluid having at least about 95 wt% organic purity, preferably at least about 99 wt% organic purity, most preferably at least about 99.5 wt% organic purity and meeting

conventional specifications for commercial use or sale as a thermal fluid. In some embodiments, “reclaimed thermal fluid”, as used herein, refers to a distillation product of a consolidated thermal fluid having at least about 95 wt% organic purity, preferably at least about 99 wt% organic purity, most preferably at least about 99.5 wt% organic purity and meeting conventional specifications for commercial use or sale as a thermal fluid.

[0026] As used herein, “partially reclaimed thermal fluid” refers to a thermal fluid which comprises, at least in part, a reclaimed thermal fluid.

[0027] As used herein, “organic purity” refers to the degree to which a fluid or fluid composition is free of contaminants such as oil and inorganic materials, such as water, acid, non-absorbable gases (NAGs), particulates/solids, and the like.

[0028] In some embodiments, “virgin thermal fluid”, “used thermal fluid”, “spent thermal fluid”, “recovered thermal fluid”, “consolidated thermal fluid composition”, “partially reclaimed fluid” and/or “reclaimed thermal fluid”, as used herein, refer to a thermal fluid composition as each is defined above, and optionally further comprising at least one stabilizer, particularly when the thermal fluid composition includes an HFO refrigerant compound, such as R-1234yf. In some embodiments, the stabilizer comprises at least one inhibitor compound that inhibits, if not eliminates, a fluoroethylene from interacting with another compound and forming dimers, oligomers, homopolymers, or polymeric products. In some embodiments, the at least one inhibitor is selected from hydrocarbons such as cyclic monoterpenes (e.g., limonene, pinene, α -pinene, β -pinene, and terpinene); lipophilic organic compounds such as tocopherols (e.g., α -tocopherol) or butylated hydroxytoluene (BHT); phenols or aromatic organic compounds having at least one chemical moiety $-C_6H_4(OH)$ (e.g., benzene-1,4-diol, 4-methoxyphenol); and mixtures thereof. Specific examples of inhibitor compounds may include at least one member selected from limonene (particularly D-limonene), α -terpinene, pinene, α -pinene, β -pinene, α -tocopherol, butylated hydroxytoluene (BHT), 4-methoxyphenol, benzene-1,4-diol, and mixtures thereof. In one embodiment, the thermal fluid composition of any of a “virgin thermal fluid”, “used thermal fluid”, “spent thermal fluid”, “recovered thermal fluid”, “consolidated thermal fluid composition”, “partially reclaimed fluid” and/or “reclaimed thermal fluid”, each as defined above, comprises R-1234yf and at least one stabilizer

comprising at least one inhibitor selected from hydrocarbons including at least cyclic monoterpene; lipophilic organic compounds; or phenols, aromatic organic compounds having at least one chemical moiety $-C_6H_4(OH)$, and more particularly selected from limonene (particularly D-limonene), α -terpinene, pinene, α -pinene, β -pinene, α -tocopherol, butylated hydroxytoluene (BHT), 4-methoxyphenol, benzene-1,4-diol, and mixtures thereof.

[0029] In another embodiment, the stabilizer comprises an acid scavenger, such as, but not limited to, hindered amines and epoxy compounds such as epoxy butene. In one embodiment, the thermal fluid composition of any of a “virgin thermal fluid”, “used thermal fluid”, “spent thermal fluid”, “recovered thermal fluid”, “consolidated thermal fluid composition”, “partially reclaimed fluid” and/or “reclaimed thermal fluid”, each as defined above, comprises at least one refrigerant compound, such as an HFO or HFC refrigerant compound, and at least one stabilizer comprising at least one acid scavenger, such as, but not limited to, hindered amines and epoxy compounds such as epoxy butene.

[0030] Further details of the optional stabilizer are provided herein.

[0031] FIG. 1 shows a system for reclaiming thermal fluid compositions from three different recovered thermal fluids 10, 12, 14. It will be understood by those skilled in the art that the present invention is not limited to three recovered thermal fluids, but instead encompasses a lesser number or a greater number of recovered thermal fluids.

[0032] The three different recovered thermal fluids 10, 12, 14 are combined and mixed together in a consolidation tank 16 to form a consolidated thermal fluid of a consolidated composition of at least two different refrigerant compounds. Each recovered thermal fluid 10, 12, 14 may be of a single refrigerant compound or a blend of two or more refrigerant compounds. In some embodiments, the system may contain multiple consolidation tanks 16, and what refrigerant compounds are in each recovered thermal fluids 10, 12, 14 is known or determined prior to adding the recovered thermal fluids 10, 12, 14 to the consolidation tank 16, where a recovered thermal fluid 10, 12, 14 is added to a selected consolidation tank 16 based on the refrigerant compounds in the recovered thermal fluid 10, 12, 14. The recovered

thermal fluids may be individually tested and/or validated for organic purity, but preferably the consolidated thermal fluid is tested and/or validated for organic purity.

[0033] In one embodiment, the recovered thermal fluids and/or the consolidated thermal fluid is/are tested to determine the composition, water content, NAG content, acidity content, and/or the organic purity.

[0034] In one embodiment, the recovered thermal fluids and/or the consolidated thermal fluid is/are validated or treated, such as by purifying as needed for water content, NAG content, acidity content, and/or removing one or more impurities to achieve an organic purity of at least about 95 wt%, or about 96 wt%, or about 97 wt%, or about 98 wt%, or about 99 wt%, or about 99.5 wt%.

[0035] The tested and validated consolidated thermal fluid may then be further treated (e.g., distilled) as needed to form a reclaimed thermal fluid or a blending component for formation of a reclaimed or partially reclaimed thermal fluid (also sometimes referred to herein as a reclaimed thermal fluid building block or blend constituent), or may be suitable for use as-is as a reclaimed thermal fluid or as a reclaimed thermal fluid building block.

[0036] More particularly, in one embodiment, the tested and validated (also referred to herein as treated) consolidated thermal fluid is fed as needed to at least one distillation column or other appropriate distillation system 18, from which one or more distillate fractions are collected and stored in respective reclaimed storage tanks until needed for a further application. In one embodiment, as shown in FIG. 1, four fractions 20, 22, 24, 26 of distillates are collected from the distillation system 18 and stored as reclaimed thermal fluids in reclaimed storage tanks 30, 32, 34, 36, respectively, one for each reclaimed thermal fluid composition, until needed for a further application. It will be understood by those skilled in the art that that while the description herein primarily refers to the four reclaimed thermal fluid compositions 20, 22, 24, 26 of the exemplary embodiment of FIG. 1, the invention applies to any number of collected distillate fractions and any number of reclaimed thermal fluid compositions and is not limited to four such fractions and compositions as shown in FIG. 1.

[0037] At least one of the reclaimed thermal fluids 20, 22, 24, 26 is azeotropic, azeotrope-like, or a close-boiling composition of two or more refrigerant compounds.

Alternatively, in some embodiments, two, three, or all of the reclaimed thermal fluids 20, 22, 24, 26 are azeotropic, azeotrope-like, or close-boiling compositions of two or more refrigerant compounds. The system may operate on a continuous, batch, or semi-batch basis.

[0038] In another embodiment, the tested and validated (also referred to herein as treated) consolidated thermal fluid is not subjected to distillation or other processing, and instead may be stored as-is as a reclaimed thermal fluid in one or more reclaimed storage tanks until needed for a further application, as will be described in further detail herein. For example, referring to Fig. 1, the distillation system 18, if present, may be bypassed, and the tested and validated consolidated thermal fluid 16 may be stored as-is as a reclaimed thermal fluid 24 in one or more reclaimed storage tanks (e.g., storage tank 34) until needed for a further application. In one embodiment, the reclaimed thermal fluid is azeotropic, azeotrope-like, or a close-boiling composition of two or more refrigerant compounds.

[0039] The discussion of the reclaimed thermal fluids 20, 22, 24, 26 and the reclaimed storage tanks 30, 32, 34, 36 provided herein refers to the various embodiments disclosed herein. For example, the reclaimed thermal fluids 20, 22, 24, 26 may have been formed without distillation and stored in the reclaimed storage tanks 30, 32, 34, 36 or may have been formed as a result of distillation system 18 and stored in the reclaimed storage tanks 30, 32, 34, 36.

[0040] The reclaimed thermal fluids 20, 22, 24, 26 in the reclaimed storage tanks 30, 32, 34, 36 may each individually be subjected to a final purification and analysis to confirm their composition and that they are commercial grade. The final purification and analysis may include analyzing and purifying as needed for water content, NAG content, acidity content of other impurities, and/or organic purity.

[0041] In some embodiments, all or a portion of an azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid 20, 22, 24, 26 may be packaged and sold as a reclaimed thermal fluid building block, such as for forming commercial thermal fluid blends. For example, as shown in FIG. 1, all or a portion of an azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid 24 may be packaged and sold as a reclaimed thermal fluid building block 40, such as for forming commercial thermal fluid blends.

[0042] In some embodiments, all or a portion of an azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid 20, 22, 24, 26 may be combined with all or a portion of a virgin, a used, or other reclaimed thermal fluid(s) sharing the same refrigerant compounds to adjust their composition ratios, such as to make an azeotropic or zeotropic composition or azeotropic or zeotropic commercial thermal fluid blend. For example, as shown in FIG. 1, all or a portion of an azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid 24 may be combined with all or a portion of a virgin, a used, or other reclaimed thermal fluid(s) 42 sharing the same refrigerant compounds to adjust their composition ratios, such as to make an azeotropic or zeotropic composition or azeotropic or zeotropic commercial thermal fluid blend 44.

[0043] In some embodiments, all or a portion of an azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid 20, 22, 24, 26 may be combined with all or a portion of a virgin, a used, or other reclaimed thermal fluid(s) having at least one additional refrigerant compound to make an azeotropic or zeotropic composition or azeotropic or zeotropic commercial thermal fluid blend. For example, as shown in FIG. 1, all or a portion of an azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid 24 may be combined with all or a portion of a virgin, a used, or other reclaimed thermal fluid(s) 46 having at least one additional refrigerant compound, such as an HFO or HFC, to make an azeotropic or zeotropic composition or azeotropic or zeotropic commercial thermal fluid blend 48.

[0044] In some embodiments, the system of the present invention may be located at a site separate and distinct from the site of a blending facility or a refrigerant manufacturing facility which produces virgin material or may be co-located with a blending facility or refrigerant manufacturing facility.

[0045] Other systems may be designed and constructed to include other numbers and combinations of different recovered thermal fluids and produce other numbers of different reclaimed thermal fluids. The types of reclaimed thermal fluids may be the same or different from the types of recovered fluids.

[0046] In some embodiments, a consolidation tank receives at least a portion of each of the types of recovered thermal fluids, such that the consolidation tank includes some or all of the refrigerant compounds present in the system. Some

systems may have more than one consolidation tank, where additional consolidation tanks receive more than one but not all of the types of recovered thermal fluids and contain more than one but not necessarily all of the refrigerant compounds present in the system. In exemplary embodiments, each consolidation tank includes at least two refrigerant compounds. The types of recovered thermal fluids directed to a consolidation tank may be selected based on the refrigerant compounds that they include and the refrigerant compounds in the reclaimed thermal fluid to be formed from the consolidated thermal fluid.

[0047] In exemplary embodiments, when the reclaimed thermal fluid includes at least one HFO refrigerant compound, the reclamation process includes adding a stabilizer package to the thermal fluid. In exemplary embodiments, the stabilizer package includes an effective amount of at least one inhibitor such that the thermal fluid remains substantially free of oligomeric, homopolymeric, or other polymeric products derived from the thermal fluid. In some embodiments, at least one inhibitor is selected from hydrocarbons such as cyclic monoterpenes (e.g., limonene, pinene, α -pinene, β -pinene, and terpinene); lipophilic organic compounds such as tocopherols (e.g., α -tocopherol) or butylated hydroxytoluene (BHT); phenols or aromatic organic compounds having at least one chemical moiety $-C_6H_4(OH)$ (e.g., benzene-1,4-diol, 4-methoxyphenol); and mixtures thereof. Specific examples of inhibitor compounds may include at least one member selected from limonene (particularly D-limonene), α -terpinene, pinene, α -pinene, β -pinene, α -tocopherol, butylated hydroxytoluene (BHT), 4-methoxyphenol, benzene-1,4-diol, and mixtures thereof. In one embodiment, the inhibitor composition includes a liquid at a temperature from about -80°C to about 180°C , about -70°C to about 170°C , and in some cases about -60°C to about 160°C . By “stabilized” it is meant to refer to a composition including an effective amount of at least one inhibitor compound that inhibits, if not eliminates, a fluoroethylene from interacting with another compound and forming dimers, oligomers, homopolymers, or polymeric products.

[0048] In some embodiments, the stabilizer package further comprises at least one acid scavenger. Examples of the acid scavengers that may be included in the present compositions include, but are not limited to, the stabilizers and/or the epoxide component of the stabilizers disclosed in U.S. Patent No. 8,535,555 and the acid scavengers disclosed in International Application Publication No.

WO 2020/222864, the disclosure of each of which is incorporated herein by reference in its entirety.

[0049] In some embodiments, the acid scavenger may comprise one or more epoxides, one or more amines and/or one or more hindered amines, such as, for example but not limited to, epoxybutane.

[0050] In some embodiments, an analyzer determines the composition and organic purity of one or more of the thermal fluids of the system and process. In some embodiments, the analyzer determines the type of recovered thermal fluid and organic purity as it is being recovered from a thermal management device. The analyzer may alternatively determine the type and organic purity of the consolidated thermal fluid and/or the reclaimed thermal fluid. If the analyzed thermal fluid is determined to be organically pure (≥ 95 wt%, or ≥ 96 wt%, or ≥ 97 wt%, or ≥ 98 wt%, or ≥ 99 wt%, or >99.5 wt%) and of a single type by the analyzer, the thermal fluid may be transferred to an appropriate recovery tank. If, however, there are impurities (or the organic purity is less than 95 wt%, or 96 wt%, or 97 wt%, or 98 wt%, or 99 wt%, or 99.5 wt%), such as, oil, water, dirt, and/or acid, found in the analyzed thermal fluid by the analyzer, the analyzed thermal fluid may be sent to a regenerator for reprocessing.

[0051] In some embodiments, a regenerator purifies the recovered thermal fluid, the consolidated thermal fluid and/or the reclaimed thermal fluid to a state that meets AHRI Standard 700 purity specifications. The regenerator can include at least a compressor, a separator, a filter dryer, and may further include a distiller, a diluter, or a reformulator. In some embodiments, the compressor is driven to circulate the thermal fluid in a refrigerant circuit such that a voltage is applied to reduce or remove oil, such as the refrigerating machine oil, in the thermal fluid. In some embodiments, the separator is a type of oil separator. In some embodiments, the filter dryer reduces or removes water and acid included in the thermal fluid. The regenerator can also determine information on the appropriateness of the oil, water, and acid included in the thermal fluid after the regeneration processing and compile the thermal fluid composition, the weight, and the like.

[0052] In some embodiments, the reclaimed thermal fluid is selected from, and meets the standards of, *Standard for Specifications for Refrigerants*, Air-

Conditioning, Heating & Refrigeration Institute (AHRI), (AHRI 700), which is incorporated by reference in its entirety herein. AHRI 700 specifies acceptable levels of contaminants (purity requirements) for fluorocarbon, hydrocarbon, and carbon dioxide refrigerants regardless of source and lists acceptable test methods. These refrigerants are as referenced in the ANSI/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 34 with Addenda, which is also incorporated by reference in its entirety herein. The compositions of certain blends can be found in “Factsheet 1: Update on New Refrigerants Designations and Safety Classifications”, ASHRAE, April 2023; or at <https://www.ashrae.org/technical-resources/standards-and-guidelines/ashrae-refrigerant-designations>; or in ISO 817 (International Organization for Standardization), each of which is incorporated by reference in its entirety herein.

[0053] Appropriate refrigerant compounds for systems and methods of the present disclosure may include, but are not limited to, CO₂; R-11; R-12; R-13; R-22; R-23; R-32; R-50; R-113; R-114; R-115; R-116; R-123; R-124; R-125; R-134a; R-141b; R-142b; R-143a; R-152a; R-170; R-218; R-227ea; R-236fa; R-245fa; R-290; R-600; R-600a; R-601; R-601a; R-610; R-744; R-1132a; R-1132(E); R-1132(Z); R-1132a; R-1150; R-1233zd(E); R-1233zd(Z); R-1234yf; R-1234ze(Z); R-1234ze(E); R-1224yf(E); R-1224yd(Z); R-1243yc; R-1252zc; R-153-10mczz; R-43-10mee; R-1270; R-1336mzz(E) and R-1336mzz(Z).

[0054] Appropriate zeotropic blend thermal fluids for systems and methods of the present disclosure may include, but are not limited to, R-401A; R-401B; R-402A; R-402B; R-403A; R-403B; R-404A; R-405A; R-406A; R-407A; R-407B; R-407C; R-407D; R-407E; R-407F; R-407G; R-407H; R-407I; R-408A; R-409A; R-409B; R-410A; R-410B; R-411A; R-411B; R-412A; R-413A; R-414A; R-414B; R-415A; R-415B; R-416A; R-417A; R-417B; R-417C; R-418A; R-419A; R-419B; R-420A; R-421A; R-421B; R-422A; R-422B; R-422C; R-422D; R-422E; R-423A; R-424A; R-425A; R-426A; R-427A; R-428A; R-429A; R-430A; R-431A; R-432A; R-433A; R-433B; R-433C; R-434A; R-435A; R-436A; R-436B; R-437A; R-438A; R-439A; R-440A; R-441A; R-442A; R-443A; R-444A; R-444B; R-445A; R-446A; R-447A; R-447B; R-448A; R-449A; R-449B; R-449C; R-450A; R-451A; R-451B; R-452A; R-452B; R-452C; R-453A; R-454A; R-454B; R-454C; R-454D; R-455A; R-455B; R-455C; R-456A; R-457A; R-457B; R-457C; R-457D; R-458A; R-459A; R-459B;

R-460A; R-460B; R-461A; R-462A; R-463A; R-464A; R-465A; R-466A; R-467A; R-468A; R-468B; R-468A; R-469A; R-470A; R-471B; R-471A; R-472A; R-472B; R-473A; R-474A; R-475A; R-476A; R-479A; R-482A; and R-491A.

[0055] Appropriate azeotropic blend thermal fluids for systems and methods of the present disclosure may include, but are not limited to, R-500; R-502; R-503; R-507A; R-508A; R-508B; R-509A; R-510A; R-511A; R-512A; R-513A; R-513B; R-514A; R-515A; 515B; 516A; and R-516B.

EXAMPLES

[0056] The invention will be described in greater detail by way of specific examples. The following examples are offered for illustrative purposes and are not intended to limit the invention in any manner. Those of skill in the art will readily recognize a variety of non-critical parameters which can be changed or modified to yield essentially the same results.

Example 1

[0057] Two or more different used or spent thermal fluids are recovered, tested and validated and combined to form a consolidated thermal fluid composition. The consolidated thermal fluid composition includes at least 1,1,1,2-tetrafluoroethane ($\text{CF}_3\text{CH}_2\text{F}$, R-134a) and 2,3,3,3-tetrafluoropropene ($\text{CF}_3\text{CF}=\text{CH}_2$, R-1234yf). If the impurities are greater than 5%, the composition may be purified to reduce the level of impurities to less than 5%; or if the impurities are greater than 0.5%, the composition may be purified to reduce the level of impurities to less than 0.5%.

[0058] The consolidated thermal fluid composition is distilled and at least one distillation fraction containing R-134a and R-1234yf is collected to provide an azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid containing R-134a and R-1234yf.

[0059] The azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is sold or used as-is as a reclaimed thermal fluid building block.

[0060] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid comprises R-1234yf; R-134a; one or more additional compounds selected from HFO-1225ye, HFO-1243zf, E-HFO-1234ze, HFC-236ea,

HCFC-244bb, HFC-245fa, HFC-245eb, HFC-245cb, 3,3,3-trifluoropropyne, HFC-152a, FO-1114, CFO-1123, HCFO-1131a, trans-HCFO-1131, HCO-1140, HCFO-1214ya, HFO-1216, HCFO-1224yd, HFO-1252 isomers, HFC-143a, HCFC-225, HFC-254eb, HFC-263fb, HFC-236fa, HCFC-142b, HCFC-244cc, HCFO-1223, HFO-1132a and HCC-40; and one or more additional compounds selected from HFC-143a, HFO-1225zc, HFC-245cb, HFC-134, HFC-152a, HFO-1225ye, HFC-161, E-HFO-1234ze, HCFC-22, HFO-1243zf, CHFC-124, HCC-40, CHFO-1122, HCFC-31, CFC-114, CFC-114a and HCO-1140.

[0061] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-134a and/or R-1234yf to adjust the ratio of R-134a to R-1234yf to form a commercial thermal fluid. Appropriate commercial thermal fluids of blends of R-134a and R-1234yf include, but are not limited to, R-513A and/or R-513B.

[0062] In other embodiments, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids containing R-134a and/or R-1234yf and/or at least one virgin, used or reclaimed other refrigerant compound to form a commercial thermal fluid. Appropriate commercial thermal fluids of blends containing R-134a and R-1234yf and at least one other refrigerant compound include, but are not limited to, R-448A, R-448B, R-449A, R-449B, R-449C, R-451A, R-451B, R-475A and/or R-516A.

Example 2

[0063] Two or more different used or spent thermal fluids are recovered, tested and validated and combined to form a consolidated thermal fluid composition. The consolidated thermal fluid composition includes at least E-1,3,3,3-tetrafluoropropene ($\text{CF}_3\text{CH}=\text{CHF}$, R-1234ze(E)) and 1,1,1,2,3,3,3-heptafluoropropane ($\text{CF}_3\text{-CHF-CF}_3$, R-227ea). If the impurities are greater than 5%, the composition may be purified to reduce the level of impurities to less than 5%; or if the impurities are greater than 0.5%, the composition may be purified to reduce the level of impurities to less than 0.5%.

[0064] The consolidated thermal fluid composition is distilled and at least one distillation fraction containing R-1234ze(E) and R-227ea is collected to provide an

azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid containing R-1234ze(E) and R-227ea.

[0065] The azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is sold as-is as a reclaimed thermal fluid building block.

[0066] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid comprises R-1234ze(E); R-227ea; one or more additional compounds selected from HFO-1234yf, HFC-245cb, HFO-1225yf(E), HFO-1225yf(Z), HFO-1225zc, HFC-236fa, HFC-152a, HFC-143a, HFC-125, HFC-134a, HFO-1234zc, HFO-1233xf, HFO-1233zd, CFC-114, HCFC-124, 2223, HFO-1234ze(Z), HFC-245fa, HFC-227ea, HFO-1243zf, HFC-263fb and HFC-134; and one or more additional compounds selected from HFC-23, FC-1216, HFC-143a, HFC-134a, HCFC-22, HCFC-124, FC-218, HFC-236fa and HFO-1225zc.

[0067] In some embodiments, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-1234ze(E) and/or R-227ea to adjust the ratio of R-1234ze(E) to R-227ea to form a commercial thermal fluid. Appropriate commercial thermal fluids of blends of R-1234ze(E) and R-227ea include, but are not limited to, R-515A and/or R-515B.

[0068] In other embodiments, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids containing R-1234ze(E) and/or R-227ea and/or at least one virgin, used or reclaimed other refrigerant compound to form a commercial thermal fluid. Appropriate commercial thermal fluids of blends containing R-1234ze(E) and R-227ea and at least one other refrigerant compound include, but are not limited to, R-464A, R-470A, R-470B, R-471A and/or R-478A.

Example 3

[0069] Two or more different used or spent thermal fluids are recovered, tested and validated and combined to form a consolidated thermal fluid composition. The consolidated thermal fluid composition includes at least 1,1-difluoroethane ($\text{CHF}_2\text{-CH}_3$, R-152a) and R-134a. If the impurities are greater than 5%, the composition may be purified to reduce the level of impurities to less than 5%; or if the impurities

are greater than 0.5%, the composition may be purified to reduce the level of impurities to less than 0.5%.

[0070] The consolidated thermal fluid composition is distilled and at least one distillation fraction containing R-152a and R-134a is collected to provide an azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid containing R-152a and R-134a.

[0071] The azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is sold as-is as a reclaimed thermal fluid building block.

[0072] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid comprises R-152a; R-134a; one or more additional compounds selected from HFC-161, HCC-40, isobutane, HCO-1140, HCC-160 and CFC-114a; and one or more additional compounds selected from HFC-143a, HFO-1225zc, HFC-245cb, HFC-134, HFC-152a, HFO-1225ye, HFC-161, E-HFO-1234ze, HCFC-22, HFO-1243zf, CHFC-124, HCC-40, CHFO-1122, HCFC-31, CFC-114, CFC-114a and HCO-1140.

[0073] In some embodiments, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-152a and/or R-134a to adjust the ratio of R-152a to R-134a to form a commercial thermal fluid. Appropriate commercial thermal fluids of blends of R-152a and R-134a include, but are not limited to, R-512A.

[0074] In other embodiments, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-152a and/or R-134a and/or at least one virgin, used or reclaimed other refrigerant compound to form a commercial thermal fluid including R-152a and/or R-134a and/or at least one other refrigerant compound. Appropriate commercial thermal fluids of blends containing R-152a and R-134a with at least one other refrigerant compound include, but are not limited to, R-478A and/or R-516A.

Example 4

[0075] Two or more different used or spent thermal fluids are recovered, tested and validated and combined to form a consolidated thermal fluid composition. The

consolidated thermal fluid composition includes at least R-1234yf and R-152a. If the impurities are greater than 5%, the composition may be purified to reduce the level of impurities to less than 5%; or if the impurities are greater than 0.5%, the composition may be purified to reduce the level of impurities to less than 0.5%.

[0076] The consolidated thermal fluid composition is distilled and at least one distillation fraction containing R-1234yf and R-152a is collected to provide an azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid containing R-1234yf and R-152a.

[0077] The azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is sold as-is as a reclaimed thermal fluid building block.

[0078] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid comprises R-1234yf; R-152a; one or more additional compounds selected from HFO-1225ye, HFO-1243zf, E-HFO-1234ze, HFC-236ea, HCFC-244bb, HFC-245fa, HFC-245eb, HFC-245cb, 3,3,3-trifluoropropyne, HFC-152a, FO-1114, CFO-1123, HCFO-1131a, trans-HCFO-1131, HCO-1140, HCFO-1214ya, HFO-1216, HCFO-1224yd, HFO-1252 isomers, HFC-143a, HCFC-225, HFC-254eb, HFC-263fb, HFC-236fa, HCFC-142b, HCFC-244cc, HCFO-1223, HFO-1132a and HCC-40; and one or more additional compounds selected from HFC-161, HCC-40, isobutane, HCO-1140, HCC-160 and CFC-114a.

[0079] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-1234yf and/or R-152a to adjust the ratio of R-1234yf to R-152a to form a commercial thermal fluid which is a blend of R-1234yf and R-152a.

[0080] In other embodiments, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-1234yf and/or R-152a and/or at least one virgin, used or reclaimed other refrigerant compound to form a commercial thermal fluid including R-1234yf and/or R-152a and/or at least one other refrigerant compound. Appropriate commercial thermal fluids of blends containing R-1234yf, R-152a, and at least one other refrigerant compound include, but are not limited to, R-457A, R-457B, R-457C, R-457D and/or R-516A.

Example 5

[0081] Two or more different used or spent thermal fluids are recovered, tested and validated and combined to form a consolidated thermal fluid composition. The consolidated thermal fluid composition includes at least R-1234yf, R-152a, and R-134a. If the impurities are greater than 5%, the composition may be purified to reduce the level of impurities to less than 5%; or if the impurities are greater than 0.5%, the composition may be purified to reduce the level of impurities to less than 0.5%.

[0082] The consolidated thermal fluid composition is distilled and at least one distillation fraction containing R-1234yf, R-152a, and R-134a is collected to provide an azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid containing R-1234yf, R-152a, and R-134a.

[0083] The azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is sold as-is as a reclaimed thermal fluid building block.

[0084] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid comprises R-1234yf; R-134a; R-152a; one or more additional compounds selected from HFO-1225ye, HFO-1243zf, E-HFO-1234ze, HFC-236ea, HCFC-244bb, HFC-245fa, HFC-245eb, HFC-245cb, 3,3,3-trifluoropropyne, HFC-152a, FO-1114, CFO-1123, HCFO-1131a, trans-HCFO-1131, HCO-1140, HCFO-1214ya, HFO-1216, HCFO-1224yd, HFO-1252 isomers, HFC-143a, HCFC-225, HFC-254eb, HFC-263fb, HFC-236fa, HCFC-142b, HCFC-244cc, HCFO-1223, HFO-1132a and HCC-40; one or more additional compounds selected from HFC-161, HCC-40, isobutane, HCO-1140, HCC-160 and CFC-114a; and one or more additional compounds selected from HFC-143a, HFO-1225zc, HFC-245cb, HFC-134, HFC-152a, HFO-1225ye, HFC-161, E-HFO-1234ze, HCFC-22, HFO-1243zf, CHFC-124, HCC-40, CHFO-1122, HCFC-31, CFC-114, CFC-114a and HCO-1140.

[0085] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-1234yf, R-152a, and/or R-134a to adjust the ratio of R-1234yf to R-152a to R-134a to form a commercial thermal fluid. Appropriate commercial thermal fluids of blends of R-1234yf, R-152a and R-134a include, but are not limited to, R-516A.

[0086] In other embodiments, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-1234yf and/or R-152a and/or R-134a and/or at least one other refrigerant compound to form a commercial thermal fluid including R-1234yf, R-152a, R-134a, and at least one other refrigerant compound.

Example 6

[0087] Two or more different used or spent thermal fluids are recovered, tested and validated and combined to form a consolidated thermal fluid composition. The consolidated thermal fluid composition includes at least pentafluoroethane ($\text{CF}_3\text{-CHF}_2$, R-125) and 1,1,1-trifluoroethane ($\text{CF}_3\text{-CH}_3$, R-143a). If the impurities are greater than 5%, the composition may be purified to reduce the level of impurities to less than 5%; or if the impurities are greater than 0.5%, the composition may be purified to reduce the level of impurities to less than 0.5%.

[0088] The consolidated thermal fluid composition is distilled and at least one distillation fraction containing R-125 and R-143a is collected to provide an azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid containing R-125 and R-143a.

[0089] The azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is sold as-is as a reclaimed thermal fluid building block.

[0090] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid comprises R-125; R-143a; one or more additional compounds selected from HFC-23, HFC-32, HFC-143a, HFC-134a, CFC-115, CFCO-1113 and HCC-40; and one or more additional compounds selected from CFC-115, HFC-134a, HFC-152a, HCFC-22, CFC-12, HCFC-124, CFC-114a and HCFC-133a.

[0091] In some embodiments, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids R-125 and/or R-143a to adjust the ratio of R-125 to R-143a to form a commercial thermal fluid. Appropriate commercial thermal fluids of blends of R-125 and R-143a include, but are not limited to, R-507A.

[0092] The azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-125 and/or R-143a and/or at least one virgin, used or reclaimed other refrigerant compound to form a commercial thermal fluid including R-125, R-143a, and at least one other refrigerant compound. Appropriate commercial thermal fluids of blends containing R-125 and R-143a and at least one other refrigerant compound include, but are not limited to, R-404A, R-408A, R-427A, R-427B, R-428A, R-434A, R-461A and/or R-462A.

Example 7

[0093] Two or more different used or spent thermal fluids are recovered, tested and validated and combined to form a consolidated thermal fluid composition. The consolidated thermal fluid composition includes at least difluoromethane (CH_2F_2 , R-32) and (E)-1,2-difluoroethylene ($\text{CHF}=\text{CHF}$, R-1132(E)). If the impurities are greater than 5%, the composition may be purified to reduce the level of impurities to less than 5%; or if the impurities are greater than 0.5%, the composition may be purified to reduce the level of impurities to less than 0.5%.

[0094] The consolidated thermal fluid composition is distilled and at least one distillation fraction containing R-32 and R-1132(E) is collected to provide an azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid containing R-32 and R-1132(E).

[0095] The azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is sold as-is as a reclaimed thermal fluid building block.

[0096] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid comprises R-32; R-1132(E); one or more additional compounds selected from HFC-143a, HFC-41, HFC-134a, HCFC-22, CFC-12 and HCC-40; and one or more additional compounds selected from HFC-32, HFC-125, HCFO-E-1122a, HCFO-Z-1122a, HFO-1123, HFO-1141, HCFC-133, HCFC-133b, HCFC-123, HFC-152, HFC-143, HFC-41, HCFC-22, ethylene, HCFC-142a, HFO-1132a, HCFO-1131a, HCFO-E-1131, HCFO-Z-1131, HCFO-1122, acetylene and HCO-1140.

[0097] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal

fluids of R-32 and/or R-1132(E) to adjust the ratio of R-32 to R-1132(E) to form a commercial thermal fluid which is a blend of R-32 and R-1132(E).

[0098] In some embodiments, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-32 and/or R-1132(E), and/or at least one virgin, used or reclaimed other refrigerant compound to form a commercial thermal fluid including R-32, R-1132(E), and at least one other refrigerant compound. Appropriate commercial thermal fluids of blends containing R-32 and R-1132(E) and at least one other refrigerant compound include, but are not limited to, R-479A.

Example 8

[0099] Two or more different used or spent thermal fluids are recovered, tested and validated and combined to form a consolidated thermal fluid composition. The consolidated thermal fluid composition includes at least R-1234yf and (Z)-1,2-difluoroethylene (CHF=CHF, R-1132(Z)). If the impurities are greater than 5%, the composition may be purified to reduce the level of impurities to less than 5%; or if the impurities are greater than 0.5%, the composition may be purified to reduce the level of impurities to less than 0.5%.

[0100] The consolidated thermal fluid composition is distilled and at least one distillation fraction containing R-1234yf and R-1132(Z) is collected to provide an azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid containing R-1234yf and R-1132(Z).

[0101] The azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is sold as-is as a reclaimed thermal fluid building block.

[0102] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid comprises R-1234yf; R-1132(Z); one or more additional compounds selected from HFO-1225ye, HFO-1243zf, E-HFO-1234ze, HFC-236ea, HCFC-244bb, HFC-245fa, HFC-245eb, HFC-245cb, 3,3,3-trifluoropropyne, HFC-152a, FO-1114, CFO-1123, HCFO-1131a, trans-HCFO-1131, HCO-1140, HCFO-1214ya, HFO-1216, HCFO-1224yd, HFO-1252 isomers, HFC-143a, HCFC-225, HFC-254eb, HFC-263fb, HFC-236fa, HCFC-142b, HCFC-244cc, HCFO-1223, HFO-1132a and HCC-40; and one or more additional compounds selected from

difluoromethane (HFC-32), 1,1,1,2,2 pentafluoroethane (HFC-125), E-1-chloro-1,2-difluoroethylene (HCFO-E-1122a), Z-1-chloro-1,2-difluoroethylene (HCFO-Z-1122a), 1,1,2-trifluoroethylene (HFO-1123), fluoroethylene (HFO-1141), 1-chloro-1,2,2-trifluoroethane (HCFC-133), 1-chloro-1,1,2-trifluoroethane (HCFC-133b), 1,1-dichloro-2,2,2-trifluoroethane (HCFC-123), 1,2-difluoroethane (HFC-152), 1,1,2-trifluoroethane (HFC-143), fluoromethane (HFC-41), chlorodifluoromethane (HCFC-22), ethylene, 1-chloro-1,2-difluoroethane (HCFC-142a), 1,1-difluoroethylene (HFO-1132a), 1-chloro-1-fluoroethene (HCFO-1131a), E-1-chloro-2-fluoroethene (HCFO-E-1131), Z-1-chloro-1-fluoroethene (HCFO-Z-1131), 1-chloro-2,2-difluoroethylene (HCFO-1122), HFO-E-1132, vinyl chloride (HCO-1140), acetylene and fluoroacetylene.

[0103] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-1234yf and/or R-1132(Z) to adjust the ratio of R-1234yf to R-1132(Z) to form a commercial thermal fluid which is a blend of R-1234yf and R-1132(Z).

[0104] In other embodiments, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-1234yf and/or R-1132(Z) and/or at least one virgin, used or reclaimed other refrigerant compound to form a commercial thermal fluid including R-1234yf, R-1132(Z), and at least one other refrigerant compound.

Example 9

[0105] Two or more different used or spent thermal fluids are recovered, tested and validated and combined to form a consolidated thermal fluid composition. The consolidated thermal fluid composition includes at least (E)-1,3,3,3-tetrafluoropropene (R-1234ze(E)) and R-1132(Z). If the impurities are greater than 5%, the composition may be purified to reduce the level of impurities to less than 5%; or if the impurities are greater than 0.5%, the composition may be purified to reduce the level of impurities to less than 0.5%.

[0106] The consolidated thermal fluid composition is distilled and at least one distillation fraction containing R-1234ze(E) and R-1132(Z) is collected to provide an

azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid containing R-1234ze(E) and R-1132(Z).

[0107] The azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is sold as-is as a reclaimed blending building block.

[0108] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid comprises R-1234ze(E); R-1132(Z); one or more additional compounds selected from HFO-1234yf, HFC-245cb, HFO-1225yf(E), HFO-1225yf(Z), HFO-1225zc, HFC-236fa, HFC-152a, HFC-143a, HFC-125, HFC-134a, HFO-1234zc, HFO-1233xf, HFO-1233zd, CFC-114, HCFC-124, 2223, HFO-1234ze(Z), HFC-245fa, HFC-227ea, HFO-1243zf, HFC-263fb and HFC-134; and one or more additional compounds selected from difluoromethane (HFC-32), 1,1,1,2,2 pentafluoroethane (HFC-125), E-1-chloro-1,2-difluoroethylene (HCFO-E-1122a), Z-1-chloro-1,2-difluoroethylene (HCFO-Z-1122a), 1,1,2-trifluoroethylene (HFO-1123), fluoroethylene (HFO-1141), 1-chloro-1,2,2-trifluoroethane (HCFC-133), 1-chloro-1,1,2-trifluoroethane (HCFC-133b), 1,1-dichloro-2,2,2-trifluoroethane (HCFC-123), 1,2-difluoroethane (HFC-152), 1,1,2-trifluoroethane (HFC-143), fluoromethane (HFC-41), chlorodifluoromethane (HCFC-22), ethylene, 1-chloro-1,2-difluoroethane (HCFC-142a), 1,1-difluoroethylene (HFO-1132a), 1-chloro-1-fluoroethene (HCFO-1131a), E-1-chloro-2-fluoroethene (HCFO-E-1131), Z-1-chloro-1-fluoroethene (HCFO-Z-1131), 1-chloro-2,2-difluoroethylene (HCFO-1122), HFO-E-1132, vinyl chloride (HCO-1140), acetylene and fluoroacetylene.

[0109] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-1234ze(E) and/or R-1132(Z) to adjust the ratio of R-1234ze(E) to R-1132(Z) to form a commercial thermal fluid which is a blend of R-1234ze(E) and R-1132(Z).

[0110] In other embodiments, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-1234ze(E) and/or R-1132(Z) and/or at least one virgin, used or reclaimed other refrigerant compound to form a commercial thermal fluid including R-1234ze(E), R-1132(Z), and at least one other refrigerant compound.

Example 10

[0111] Two or more different used or spent thermal fluids are recovered, tested and validated and combined to form a consolidated thermal fluid composition. The consolidated thermal fluid composition includes at least R-1234ze(E) and R-152a. If the impurities are greater than 5%, the composition may be purified to reduce the level of impurities to less than 5%; or if the impurities are greater than 0.5%, the composition may be purified to reduce the level of impurities to less than 0.5%.

[0112] The consolidated thermal fluid composition is distilled and at least one distillation fraction containing R-1234ze(E) and R-152a is collected to provide an azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid containing R-1234ze(E) and R-152a.

[0113] The azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is sold as-is as a reclaimed thermal fluid building block.

[0114] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid comprises R-1234ze(E); R-152a; one or more additional compounds selected from HFO-1234yf, HFC-245cb, HFO-1225yf(E), HFO-1225yf(Z), HFO-1225zc, HFC-236fa, HFC-152a, HFC-143a, HFC-125, HFC-134a, HFO-1234zc, HFO-1233xf, HFO-1233zd, CFC-114, HCFC-124, 2223, HFO-1234ze(Z), HFC-245fa, HFC-227ea, HFO-1243zf, HFC-263fb and HFC-134; and one or more additional compounds selected from HFC-161, HCC-40, isobutane, HCO-1140, HCC-160 and CFC-114a.

[0115] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-1234ze(E) and/or R-152a to adjust the ratio of R-1234ze(E) to R-152a to form a commercial thermal fluid which is a blend of R-1234ze(E) and R-152a.

[0116] In other embodiments, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-1234ze(E) and/or R-152a and/or at least one virgin, used or reclaimed other refrigerant compound to form a commercial thermal fluid including R-1234ze(E), R-152a, and at least one other refrigerant compound. Appropriate commercial thermal fluids of blends containing R-1234ze(E), R-152a and at least

one other refrigerant compound include, but are not limited to, R-444A, R-444B and/or R-478A. For example, an azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid of R-1234ze(E) and R-152a may be combined with virgin, used, or reclaimed R-32, and optionally also combined with virgin, used, or reclaimed R-1234ze(E) and/or R-152a if needed, to form R-444A other reclaimed thermal fluids of R-1234ze(E) and/or R-152a.

Example 11

[0117] Two or more different used or spent thermal fluids are recovered, tested and validated and combined to form a consolidated thermal fluid composition. The consolidated thermal fluid composition includes at least R-125 and R-32. If the impurities are greater than 5%, the composition may be purified to reduce the level of impurities to less than 5%; or if the impurities are greater than 0.5%, the composition may be purified to reduce the level of impurities to less than 0.5%.

[0118] The consolidated thermal fluid composition is distilled and at least one distillation fraction containing R-125 and R-32 is collected to provide an azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid containing R-125 and R-32.

[0119] The azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is sold as-is as a reclaimed thermal fluid building block.

[0120] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid comprises R-125; R-32; one or more additional compounds selected from HFC-23, HFC-32, HFC-143a, HFC-134a, CFC-115, CFCO-1113 and HCC-40; and one or more additional compounds selected from HFC-143a, HFC-41, HFC-134a, HCFC-22, CFC-12 and HCC-40.

[0121] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-125 and/or R-32 to adjust the ratio of R-125 to R-32 to form a commercial thermal fluid. Appropriate commercial thermal fluids of blends of R-125 and R-32 include, but are not limited to, R-410A and/or R-410B. In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-125 and/or R-32 to adjust the ratio of R-32 to R-125 to be about 1.75:1 to about 2:1, or about 9:1 to about 11.5:1.

[0122] In other embodiments, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-125 and/or R-32 and/or at least one virgin, used or reclaimed other refrigerant compound to form a commercial thermal fluid including R-125, R-32, and at least one other refrigerant compound. Appropriate commercial thermal fluids of blends containing R-125 and R-32 and at least one other refrigerant compound include, but are not limited to, R-407A, R-407B, R-407C, R-407D, R-407E, R-407F, R-407G, R-407H, R-407I, R-427A, R-427B, R-438A, R-447A, R-447B, R-448A, R-448B, R-449A, R-449B, R-449C, R-452A, R-452B, R-452C, R-453A, R-458A, R-460A, R-460B, R-460C, R-462A, R-463A, R-464A, R-466A, R-467A, R-469A, R-470A, R-470B and/or R-478A. In some embodiments, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid portion of the commercial thermal fluid has a ratio of R-32 to R-125 of about 1.75:1 to about 2:1, or about 9:1 to about 11.5:1.

Example 12

[0123] Two or more different used or spent thermal fluids are recovered, tested and validated and combined to form a consolidated thermal fluid composition. The consolidated thermal fluid composition includes at least R-125 and R-32. If the impurities are greater than 5%, the composition may be purified to reduce the level of impurities to less than 5%; or if the impurities are greater than 0.5%, the composition may be purified to reduce the level of impurities to less than 0.5%.

[0124] The consolidated thermal fluid composition containing R-125 and R-32 is collected to provide an azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid containing R-125 and R-32.

[0125] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid comprises R-125; R-32; one or more additional compounds selected from HFC-23, HFC-32, HFC-143a, HFC-134a, CFC-115, CFCO-1113 and HCC-40; and one or more additional compounds selected from HFC-143a, HFC-41, HFC-134a, HCFC-22, CFC-12 and HCC-40.

[0126] The azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is sold as-is as reclaimed commercial fluid, such as R-410A or R-410B, optionally after adjustment of the ratio of the components by combination with virgin, used, or other

reclaimed thermal fluids of R-125 and/or R-32 as needed to meet R-410A specifications. Alternatively, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is sold as-is as a reclaimed thermal fluid building block to be combined with a single other refrigerant compound or another refrigerant blend, virgin, used or reclaimed, to form a thermal fluid product. In some embodiments, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid portion of the commercial thermal fluid has a ratio of R-32 to R-125 of about 1.75:1 to about 2:1, or about 9:1 to about 11.5:1.

[0127] In other embodiments, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-125 and/or R-32 and/or at least one virgin, used or reclaimed other refrigerant compound to form a commercial thermal fluid including R-125, R-32, and at least one other refrigerant compound. Appropriate commercial thermal fluids of blends containing R-125 and R-32 and at least one other refrigerant compound include, but are not limited to, R-407A, R-407B, R-407C, R-407D, R-407E, R-407F, R-407G, R-407H, R-407I, R-427A, R-427B, R-438A, R-447A, R-447B, R-448A, R-448B, R-449A, R-449B, R-449C, R-452A, R-452B, R-452C, R-453A, R-458A, R-460A, R-460B, R-460C, R-462A, R-463A, R-464A, R-466A, R-467A, R-469A, R-470A, R-470B and/or R-478A. In some embodiments, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid portion of the commercial thermal fluid has a ratio of R-32 to R-125 of about 1.75:1 to about 2:1, or about 9:1 to about 11.5:1.

[0128] For example, in one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or reclaimed R-134a and R-1234yf to form the commercial thermal fluid R-449. In one embodiment, virgin, used, or reclaimed R-1234ze(E) may additionally be added to form the commercial thermal fluid R-448A. If needed, the ratio of the components may be adjusted, e.g., via the addition of virgin or reclaimed component, to obtain the desired commercial thermal fluid blend.

[0129] For example, in one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is R-410A or R-410B and is combined with virgin, used, or reclaimed R-513A to form the commercial thermal fluid R-449, optionally with adjustment of the ratios of the components by addition of virgin, used or

reclaimed components as needed to meet specifications for R-449. In one embodiment, virgin, used, or reclaimed R-1234ze(E) may additionally be added to form the commercial thermal fluid R-448A. If needed, the ratio of the components may be adjusted, e.g., via the addition of virgin or reclaimed component, to obtain the desired commercial thermal fluid blend.

Example 13

[0130] Two or more different used or spent thermal fluids are recovered, tested and validated and combined to form a consolidated thermal fluid composition. The consolidated thermal fluid composition includes at least R-1234ze(E) and R-227ea. If the impurities are greater than 5%, the composition may be purified to reduce the level of impurities to less than 5%; or if the impurities are greater than 0.5%, the composition may be purified to reduce the level of impurities to less than 0.5%.

[0131] The consolidated thermal fluid composition containing R-1234ze(E) and R-227ea is collected to provide an azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid containing R-1234ze(E) and R-227ea.

[0132] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid comprises R-1234ze(E); R-227ea; one or more additional compounds selected from HFO-1234yf, HFC-245cb, HFO-1225yf(E), HFO-1225yf(Z), HFO-1225zc, HFC-236fa, HFC-152a, HFC-143a, HFC-125, HFC-134a, HFO-1234zc, HFO-1233xf, HFO-1233zd, CFC-114, HCFC-124, 2223, HFO-1234ze(Z), HFC-245fa, HFC-227ea, HFO-1243zf, HFC-263fb and HFC-134; and one or more additional compounds selected from HFC-23, FC-1216, HFC-143a, HFC-134a, HCFC-22, HCFC-124, FC-218, HFC-236fa and HFO-1225zc.

[0133] The azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is sold as-is as reclaimed commercial fluid, such as R-515A or R-515B, optionally after adjustment of the ratio of the components by combination with virgin, used, or other reclaimed thermal fluids of R-1234ze(E) and/or R-227ea as needed to meet R-515A or R-515B specifications. Alternatively, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is sold as-is as a reclaimed thermal fluid building block to be combined with a single other refrigerant compound or another refrigerant blend, virgin, used or reclaimed, to form a thermal fluid product.

[0134] In other embodiments, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-1234ze(E) and/or R-227ea and/or at least one virgin, used or reclaimed other refrigerant compound to form a commercial thermal fluid including R-1234ze(E), R-227ea, and at least one other refrigerant compound. Appropriate commercial thermal fluids of blends containing R-1234ze(E) and R-227ea and at least one other refrigerant compound include, but are not limited to, R-464A, R-470A, R-470B, R-471A and/or R-478A.

[0135] For example, in one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or reclaimed R-1336mzz(E) to form the commercial thermal fluid R-471A. If needed, the ratio of the components may be adjusted, e.g., via the addition of virgin or reclaimed component, to obtain the desired commercial thermal fluid blend.

[0136] For example, in one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is R-515A or R-515B and is combined with virgin, used, or reclaimed R-1336mzz(E) to form the commercial thermal fluid R-471A, optionally with adjustment of the ratios of the components by addition of virgin, used or reclaimed components as needed to meet specifications for R-471A.

Example 14

[0137] Two or more different used or spent thermal fluids are recovered, tested and validated and combined to form a consolidated thermal fluid composition. The consolidated thermal fluid composition includes at least R-1234ze(E) and R-134. If the impurities are greater than 5%, the composition may be purified to reduce the level of impurities to less than 5%; or if the impurities are greater than 0.5%, the composition may be purified to reduce the level of impurities to less than 0.5%.

[0138] The consolidated thermal fluid composition is distilled and at least one distillation fraction containing R-1234ze(E) and R-134 is collected to provide an azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid containing R-1234ze(E) and R-134.

[0139] The azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is sold as-is as a reclaimed thermal fluid building block.

[0140] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid comprises R-1234ze(E); R-134; one or more additional compounds selected from HFO-1234yf, HFC-245cb, HFO-1225yf(E), HFO-1225yf(Z), HFO-1225zc, HFC-236fa, HFC-152a, HFC-143a, HFC-125, HFC-134a, HFO-1234zc, HFO-1233xf, HFO-1233zd, CFC-114, HCFC-124, 2223, HFO-1234ze(Z), HFC-245fa, HFC-227ea, HFO-1243zf, HFC-263fb and HFC-134; and one or more additional compounds selected from HFC-134a, HCFC-124, HCFC-124a, HCFO-1122, HFC-143a, HCFC-31, HFC-32, HFC-125, CFC-114, CFC-114a, FCO-1114, HFC-152a, FCO-1318my, HFC-245cb, FC-C318 and HC-161.

[0141] The azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-1234ze(E) and/or R-134 to adjust the ratio of R-1234ze(E) to R-134 to form a commercial thermal fluid.

[0142] The azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-1234ze(E), R-134, and/or at least one virgin, used or reclaimed other refrigerant compound to form a commercial thermal fluid including R-1234ze(E), R-134, and at least one other refrigerant compound.

Example 15

[0143] Two or more different used or spent thermal fluids are recovered, tested and validated and combined to form a consolidated thermal fluid composition. The consolidated thermal fluid composition includes at least R-1234yf and R-1252zc. If the impurities are greater than 5%, the composition may be purified to reduce the level of impurities to less than 5%; or if the impurities are greater than 0.5%, the composition may be purified to reduce the level of impurities to less than 0.5%.

[0144] The consolidated thermal fluid composition is distilled and at least one distillation fraction containing R-1234yf and R-1252zc is collected to provide an azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid containing R-1234yf and R-1252zc.

[0145] The azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is sold as-is as a reclaimed thermal fluid building block.

[0146] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid comprises R-1234yf; R-1252zc; one or more additional compounds selected from HFO-1225ye, HFO-1243zf, E-HFO-1234ze, HFC-236ea, HCFC-244bb, HFC-245fa, HFC-245eb, HFC-245cb, 3,3,3-trifluoropropyne, HFC-152a, FO-1114, CFO-1123, HCFO-1131a, trans-HCFO-1131, HCO-1140, HCFO-1214ya, HFO-1216, HCFO-1224yd, HFO-1252 isomers, HFC-143a, HCFC-225, HFC-254eb, HFC-263fb, HFC-236fa, HCFC-142b, HCFC-244cc, HCFO-1223, HFO-1132a and HCC-40; and one or more additional compounds selected from methane, ethylene, dichloromethane (HCC-30), fluoroethane (HFC-1141), propane (HC-290), propylene (HC-1270), 2,3,3,3-tetrafluoropropene (HFO-1234yf), allene, 3-fluoro-1-propene (HFO-1261), 1,1,1-trifluoropropane (HFC-263b), 3-fluoro-1-propene (HFO-1261), 2-butene, 2-butene, cyclobutene, 2-methyl-1-propene, 1,1-difluoropropane (HFC-272fb), 2-chloro-3,3,3-trifluoropropene (HCFO-1233xf), 3-chloropropene (HCO-1260zf), C₃H₄FCI (HCFO-1251) and HFO-1243zf.

[0147] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-1234yf and/or R-1252zc to adjust the ratio of R-1234yf(E) to R-1252zc to form a commercial thermal fluid which is a blend of R-1234yf and R-1252zc.

[0148] In other embodiments, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-1234yf and/or R-1252zc and/or at least one virgin, used or reclaimed other refrigerant compound to form a commercial thermal fluid including R-1234yf, R-1252zc, and at least one other refrigerant compound.

Example 16

[0149] Two or more different used or spent thermal fluids are recovered, tested and validated and combined to form a consolidated thermal fluid composition. The consolidated thermal fluid composition includes at least R-1234ze(E) and R-1252zc. If the impurities are greater than 5%, the composition may be purified to reduce the level of impurities to less than 5%; or if the impurities are greater than 0.5%, the composition may be purified to reduce the level of impurities to less than 0.5%.

[0150] The consolidated thermal fluid composition is distilled and at least one distillation fraction containing R-1234ze(E) and R-1252zc is collected to provide an azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid containing R-1234ze(E) and R-1252zc.

[0151] The azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is sold as-is as a reclaimed thermal fluid building block.

[0152] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid comprises R-1234ze(E); R-1252zc; one or more additional compounds selected from HFO-1234yf, HFC-245cb, HFO-1225yf(E), HFO-1225yf(Z), HFO-1225zc, HFC-236fa, HFC-152a, HFC-143a, HFC-125, HFC-134a, HFO-1234zc, HFO-1233xf, HFO-1233zd, CFC-114, HCFC-124, 2223, HFO-1234ze(Z), HFC-245fa, HFC-227ea, HFO-1243zf, HFC-263fb and HFC-134; and one or more additional compounds selected from methane, ethylene, dichloromethane (HCC-30), fluoroethane (HFC-1141), propane (HC-290), propylene (HC-1270), 2,3,3,3-tetrafluoropropene (HFO-1234yf), allene, 3-fluoro-1-propene (HFO-1261), 1,1,1-trifluoropropane (HFC-263b), 3-fluoro-1-propene (HFO-1261), 2-butene, 2-butene, cyclobutene, 2-methyl-1-propene, 1,1-difluoropropane (HFC-272fb), 2-chloro-3,3,3-trifluoropropene (HCFO-1233xf), 3-chloropropene (HCO-1260zf), C₃H₄FCI (HCFO-1251) and HFO-1243zf.

[0153] In one embodiment, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-1234ze(E) and/or R-1252zc to adjust the ratio of R-1234ze(E) to R-1252zc to form a commercial thermal fluid which is a blend of R-1234ze(E) and R-1252zc.

[0154] In other embodiments, the azeotropic, azeotrope-like, or close-boiling reclaimed thermal fluid is combined with virgin, used, or other reclaimed thermal fluids of R-1234ze(E), R-1252zc, and/or at least one virgin, used or reclaimed other refrigerant compound to form a commercial thermal fluid including R-1234ze(E), R-1252zc, and at least one other refrigerant compound.

[0155] For blends containing one or more HFOs, a stabilizer package may be added to the reclaimed thermal fluid to stabilize the HFO in the thermal fluid.

OTHER EMBODIMENTS

[0156] Embodiment 1: a process of thermal fluid reclamation comprising: combining at least two recovered thermal fluids comprising a first refrigerant compound and a second refrigerant compound to form a consolidated thermal fluid, wherein the consolidated thermal fluid is a blend including the first refrigerant compound and the second refrigerant compound with a consolidated composition; testing the consolidated thermal fluid and validating that the consolidated thermal fluid has greater than 95 wt%, preferably greater than 98 wt%, more preferably greater than 99 wt%, most preferably greater than 99.5 wt% organic purity; distilling the consolidated thermal fluid to form at least one distillate comprising the first refrigerant compound and the second refrigerant compound as a reclaimed thermal fluid, wherein the reclaimed thermal fluid has a reclaimed composition different from the consolidated composition and the reclaimed thermal fluid is azeotropic, azeotrope-like, or close-boiling; and supplying the reclaimed thermal fluid for formation of a thermal fluid product.

[0157] Embodiment 2: A process of thermal fluid reclamation comprising: combining at least two recovered thermal fluids comprising a first refrigerant compound and a second refrigerant compound to form a consolidated thermal fluid, wherein the consolidated thermal fluid is a blend including the first refrigerant compound and the second refrigerant compound with a consolidated composition; treating the consolidated thermal fluid to form a reclaimed thermal fluid comprising the first refrigerant compound and the second refrigerant compound, wherein the reclaimed thermal fluid has a reclaimed composition different from the consolidated composition, wherein the reclaimed thermal fluid is azeotropic, azeotrope-like, or close-boiling, and wherein the reclaimed thermal fluid has greater than about 95 wt%, preferably greater than about 99 wt%, most preferably greater than about 99.5 wt% organic purity; and supplying the reclaimed thermal fluid for formation of a thermal fluid product.

[0158] Embodiment 3: the process of embodiment 1 or 2, wherein the supplying comprises packaging the reclaimed thermal fluid for commercial sale.

[0159] Embodiment 4: the process of any of embodiments 1 to 3, wherein the first refrigerant compound and the second refrigerant compound are a pair selected from

the group consisting of R-134a and R-1234yf; R-1234ze(E) and R-227ea; R-152a and R-134a; R-1234yf and R-152a; R-125 and R-143a; R-32 and R-1132(E); R-1234yf and R-1132(Z); R-1234ze(E) and R-1132(Z); R-152a and R-1234ze(E); R-125 and R-32; R-1234ze(E) and R-134; R-1234ze(E) and R-134a; R-1234ze(Z) and R-1336mzz(E); R-1234ze(Z) and R-1233zd(E); R-245fa and R-1234ze(Z); R-245fa and R-1233zd(E); R-1336mzz(Z) and trans-dichloroethylene; R-152a and R-1252zc; R-1132(Z) and R-152a; CO₂ and R-1132a; R-1233zd(E) and R-1336mzz(E); and R-32 and R-290.

[0160] Embodiment 5: the process of any of embodiments 1 to 4, wherein at least two recovered thermal fluids and the reclaimed thermal fluid further comprise a third refrigerant compound.

[0161] Embodiment 6: the process of embodiment 5, wherein the first refrigerant compound, the second refrigerant compound, and the third refrigerant compound are R-1234yf, R-152a, and R-134a.

[0162] Embodiment 7: the process of any of embodiments 1 to 4, wherein the supplying comprises adjusting a ratio of the first refrigerant compound to the second refrigerant compound of the reclaimed composition by adding an additional amount of at least one of the first refrigerant compound and the second refrigerant compound to the reclaimed thermal fluid to form the thermal fluid product.

[0163] Embodiment 8: the process of embodiment 7, wherein the first refrigerant compound and the second refrigerant compound are R-134a and R-1234yf; R-1234ze(E) and R-227ea; R-152a and R-134a; R-1234yf and R-152a; R-125 and R-143a; R-32 and R-1132(E); R-1234yf and R-1132(Z); R-1234ze(E) and R-1132(Z); R-152a and R-1234ze(E); R-125 and R-32; R-1234ze(E) and R-134; and R-1234ze(E) and R-134a.

[0164] Embodiment 9: the process of any of embodiments 7 to 8, wherein the first refrigerant compound and the second refrigerant compound are R-125 and R-32 and the thermal fluid product is selected from the group consisting of R-410A and R-410B.

[0165] Embodiment 10: the process of any of embodiments 7 to 8, wherein the first refrigerant compound is R-134a, the second refrigerant compound is R-1234yf,

and the thermal fluid product is selected from the group consisting of R-513A and R-513B.

[0166] Embodiment 11: the process of any of embodiments 7 to 8, wherein the first refrigerant compound is R-1234ze, the second refrigerant compound is R-227ea, and the thermal fluid product is selected from the group consisting of R-515A and R-515B.

[0167] Embodiment 12: the process of any of embodiments 7 to 8, wherein the first refrigerant compound is R-152a, the second refrigerant compound is R-134a, and the thermal fluid product is selected from the group consisting of R-512A and R-516A.

[0168] Embodiment 13: the process of any of embodiments 7 to 8, wherein the first refrigerant compound is R-125, the second refrigerant compound is R-143a, and the thermal fluid product is selected from the group consisting of R-404A, R-462A, and R-507A.

[0169] Embodiment 14: the process of any of embodiments 1 to 13, wherein the supplying comprises blending the reclaimed composition with at least one blending thermal fluid comprising a third refrigerant compound to form the thermal fluid product, optionally wherein at least one refrigerant compound of the reclaimed composition is an HFC.

[0170] Embodiment 15: the process of embodiment 14, wherein the first refrigerant compound and the second refrigerant compound are R-134a and R-1234yf; R-1234ze(E) and R-227ea; R-152a and R-134a; R-1234yf and R-152a; R-125 and R-143a; R-32 and R-1132(E); R-1234yf and R-1132(Z); R-1234ze(E) and R-1132(Z); R-152a and R-1234ze(E); R-125 and R-32; R-1234ze(E) and R-134; and R-1234ze(E) and R-134a.

[0171] Embodiment 16: the process of embodiment 14, wherein the first refrigerant compound is R-134a, the second refrigerant compound is R-1234yf, and the thermal fluid product is selected from the group consisting of R-448A, R-448B, R-449A, R-449B, R-449C, R-475A, R-513A and R-516A.

[0172] Embodiment 17: the process of embodiment 14, wherein the first refrigerant compound is R-1234ze, the second refrigerant compound is R-227ea, and the

thermal fluid product is selected from the group consisting of R-464A, R-470A, R-470B, and R-471A.

[0173] Embodiment 18: the process of embodiment 14, wherein the first refrigerant compound is R-1234yf, the second refrigerant compound is R-152a, and the third refrigerant compound is R-32, and the thermal fluid product is selected from the group consisting of R-457A, R-457B, R-457C and R-457D.

[0174] Embodiment 19: the process of embodiment 14, wherein the first refrigerant compound is R-125, the second refrigerant compound is R-32, the third refrigerant compound is R-134a, and the thermal fluid product is selected from the group consisting of R-407A, R-407B, R-407C, R-407D, R-407E, R-407F, R-407G, R-407H, and R-407I.

[0175] Embodiment 20: the process of claim 14, wherein the first refrigerant compound is R-1234ze(E), the second refrigerant compound is R-152a, the third refrigerant compound is R-32, and the thermal fluid product is selected from the group consisting of R-444A, R-444B and R-478A, and is preferably R-444A.

[0176] Embodiment 21: the process of any of embodiments 1 to 20, wherein the validating comprises removing one or more impurities from the consolidated thermal fluid such that the consolidated thermal fluid has greater than about 95 wt%, preferably greater than about 99 wt%, most preferably greater than about 99.5 wt% organic purity.

[0177] Embodiment 22: the process of embodiment 21, wherein one or more impurities comprises an oil.

[0178] Embodiment 23: the process of any of embodiments 1 to 22 further comprising adding a stabilizer package to the reclaimed thermal fluid.

[0179] Embodiment 24: the process of any of embodiments 1 to 23, wherein the reclaimed thermal fluid is azeotropic.

[0180] Embodiment 25: the process of any of embodiments 1 to 24, wherein the at least one distillate comprises a first distillate comprising the first refrigerant compound and the second refrigerant compound as a first reclaimed thermal fluid and a second distillate as a second reclaimed thermal fluid, wherein the first

reclaimed thermal fluid and the second reclaimed thermal fluid are azeotropic, azeotrope-like, or close-boiling.

[0181] Embodiment 26: a reclaimed thermal fluid formed by the process of any of embodiments 1 to 25.

[0182] Embodiment 27: The process of any of the foregoing embodiments, alone or in combination, wherein the consolidated thermal fluid comprises R-134a as the first refrigerant compound, R-1234yf as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFO-1225ye, HFO-1243zf, E-HFO-1234ze, HFC-236ea, HCFC-244bb, HFC-245fa, HFC-245eb, HFC-245cb, 3,3,3-trifluoropropyne, HFC-152a, FO-1114, CFO-1123, HCFO-1131a, trans-HCFO-1131, HCO-1140, HCFO-1214ya, HFO-1216, HCFO-1224yd, HFO-1252 isomers, HFC-143a, HCFC-225, HFC-254eb, HFC-263fb, HFC-236fa, HCFC-142b, HCFC-244cc, HCFO-1223, HFO-1132a and HCC-40; and one or more additional compounds selected from the group consisting of HFC-143a, HFO-1225zc, HFC-245cb, HFC-134, HFC-152a, HFO-1225ye, HFC-161, E-HFO-1234ze, HCFC-22, HFO-1243zf, CHFC-124, HCC-40, CHFO-1122, HCFC-31, CFC-114, CFC-114a and HCO-1140.

[0183] Embodiment 28: The process of any of the foregoing embodiments, alone or in combination, wherein the consolidated thermal fluid comprises R-1234ze(E) as the first refrigerant compound, R-227ea as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFO-1234yf, HFC-245cb, HFO-1225yf(E), HFO-1225yf(Z), HFO-1225zc, HFC-236fa, HFC-152a, HFC-143a, HFC-125, HFC-134a, HFO-1234zc, HFO-1233xf, HFO-1233zd, CFC-114, HCFC-124, 2223, HFO-1234ze(Z), HFC-245fa, HFC-227ea, HFO-1243zf, HFC-263fb and HFC-134; and one or more additional compounds selected from the group consisting of HFC-23, FC-1216, HFC-143a, HFC-134a, HCFC-22, HCFC-124, FC-218, HFC-236fa and HFO-1225zc.

[0184] Embodiment 29: The process of any of the foregoing embodiments, alone or in combination, wherein the consolidated thermal fluid comprises R-152a as the first refrigerant compound, R-134a as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFC-161, HCC-40, isobutane, HCO-1140, HCC-160 and CFC-114a; and one or

more additional compounds selected from the group consisting of HFC-143a, HFO-1225zc, HFC-245cb, HFC-134, HFC-152a, HFO-1225ye, HFC-161, E-HFO-1234ze, HCFC-22, HFO-1243zf, CHFC-124, HCC-40, CHFO-1122, HCFC-31, CFC-114, CFC-114a and HCO-1140.

[0185] Embodiment 30: The process of any of the foregoing embodiments, alone or in combination, wherein the consolidated thermal fluid comprises R-1234yf as the first refrigerant compound, R-152a as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFO-1225ye, HFO-1243zf, E-HFO-1234ze, HFC-236ea, HCFC-244bb, HFC-245fa, HFC-245eb, HFC-245cb, 3,3,3-trifluoropropyne, HFC-152a, FO-1114, CFO-1123, HCFO-1131a, trans-HCFO-1131, HCO-1140, HCFO-1214ya, HFO-1216, HCFO-1224yd, HFO-1252 isomers, HFC-143a, HCFC-225, HFC-254eb, HFC-263fb, HFC-236fa, HCFC-142b, HCFC-244cc, HCFO-1223, HFO-1132a and HCC-40; and one or more additional compounds selected from the group consisting of HFC-161, HCC-40, isobutane, HCO-1140, HCC-160 and CFC-114a.

[0186] Embodiment 31: The process of any of the foregoing embodiments, alone or in combination, wherein the consolidated thermal fluid comprises R-125 as the first refrigerant compound, R-143a as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFC-23, HFC-32, HFC-143a, HFC-134a, CFC-115, CFCO-1113 and HCC-40; and one or more additional compounds selected from the group consisting of CFC-115, HFC-134a, HFC-152a, HCFC-22, CFC-12, HCFC-124, CFC-114a and HCFC-133a.

[0187] Embodiment 32: The process of any of the foregoing embodiments, alone or in combination, wherein the consolidated thermal fluid comprises R-32 as the first refrigerant compound, R-1132(E) as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFC-143a, HFC-41, HFC-134a, HCFC-22, CFC-12 and HCC-40; and one or more additional compounds selected from the group consisting of HFC-32, HFC-125, HCFO-E-1122a, HCFO-Z-1122a, HFO-1123, HFO-1141, HCFC-133, HCFC-133b, HCFC-123, HFC-152, HFC-143, HFC-41, HCFC-22, ethylene, HCFC-142a, HFO-1132a, HCFO-1131a, HCFO-E-1131, HCFO-Z-1131, HCFO-1122, acetylene and HCO-1140.

[0188] Embodiment 33: The process of any of the foregoing embodiments, alone or in combination, wherein the consolidated thermal fluid comprises R-1234yf as the first refrigerant compound, R-1132(Z) as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFO-1225ye, HFO-1243zf, E-HFO-1234ze, HFC-236ea, HCFC-244bb, HFC-245fa, HFC-245eb, HFC-245cb, 3,3,3-trifluoropropyne, HFC-152a, FO-1114, CFC-1123, HCFO-1131a, trans-HCFO-1131, HCO-1140, HCFO-1214ya, HFO-1216, HCFO-1224yd, HFO-1252 isomers, HFC-143a, HCFC-225, HFC-254eb, HFC-263fb, HFC-236fa, HCFC-142b, HCFC-244cc, HCFO-1223, HFO-1132a and HCC-40; and one or more additional compounds selected from the group consisting of difluoromethane (HFC-32), 1,1,1,2,2 pentafluoroethane (HFC-125), E-1-chloro-1,2-difluoroethylene (HCFO-E-1122a), Z-1-chloro-1,2-difluoroethylene (HCFO-Z-1122a), 1,1,2-trifluoroethylene (HFO-1123), fluoroethylene (HFO-1141), 1-chloro-1,2,2-trifluoroethane (HCFC-133), 1-chloro-1,1,2-trifluoroethane (HCFC-133b), 1,1-dichloro-2,2,2-trifluoroethane (HCFC-123), 1,2-difluoroethane (HFC-152), 1,1,2-trifluoroethane (HFC-143), fluoromethane (HFC-41), chlorodifluoromethane (HCFC-22), ethylene, 1-chloro-1,2-difluoroethane (HCFC-142a), 1,1-difluoroethylene (HFO-1132a), 1-chloro-1-fluoroethene (HCFO-1131a), E-1-chloro-2-fluoroethene (HCFO-E-1131), Z-1-chloro-1-fluoroethene (HCFO-Z-1131), 1-chloro-2,2-difluoroethylene (HCFO-1122), HFO-E-1132, vinyl chloride (HCO-1140), acetylene and fluoroacetylene.

[0189] Embodiment 34: The process of any of the foregoing embodiments, alone or in combination, wherein the consolidated thermal fluid comprises R-1234ze(E) as the first refrigerant compound, R-1132(Z) as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFO-1234yf, HFC-245cb, HFO-1225yf(E), HFO-1225yf(Z), HFO-1225zc, HFC-236fa, HFC-152a, HFC-143a, HFC-125, HFC-134a, HFO-1234zc, HFO-1233xf, HFO-1233zd, CFC-114, HCFC-124, 2223, HFO-1234ze(Z), HFC-245fa, HFC-227ea, HFO-1243zf, HFC-263fb and HFC-134; and one or more additional compounds selected from the group consisting of difluoromethane (HFC-32), 1,1,1,2,2 pentafluoroethane (HFC-125), E-1-chloro-1,2-difluoroethylene (HCFO-E-1122a), Z-1-chloro-1,2-difluoroethylene (HCFO-Z-1122a), 1,1,2-trifluoroethylene (HFO-1123), fluoroethylene (HFO-1141), 1-chloro-1,2,2-trifluoroethane (HCFC-133),

1-chloro-1,1,2-trifluoroethane (HCFC-133b), 1,1-dichloro-2,2,2-trifluoroethane (HCFC-123), 1,2-difluoroethane (HFC-152), 1,1,2-trifluoroethane (HFC-143), fluoromethane (HFC-41), chlorodifluoromethane (HCFC-22), ethylene, 1-chloro-1,2-difluoroethane (HCFC-142a), 1,1-difluoroethylene (HFO-1132a), 1-chloro-1-fluoroethene (HCFO-1131a), E-1-chloro-2-fluoroethene (HCFO-E-1131), Z-1-chloro-1-fluoroethene (HCFO-Z-1131), 1-chloro-2,2-difluoroethylene (HCFO-1122), HFO-E-1132, vinyl chloride (HCO-1140), acetylene and fluoroacetylene.

[0190] Embodiment 35: The process of any of the foregoing embodiments, alone or in combination, wherein the consolidated thermal fluid comprises R-1234ze(E) as the first refrigerant compound, R-152a as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFO-1234yf, HFC-245cb, HFO-1225yf(E), HFO-1225yf(Z), HFO-1225zc, HFC-236fa, HFC-152a, HFC-143a, HFC-125, HFC-134a, HFO-1234zc, HFO-1233xf, HFO-1233zd, CFC-114, HCFC-124, 2223, HFO-1234ze(Z), HFC-245fa, HFC-227ea, HFO-1243zf, HFC-263fb and HFC-134; and one or more additional compounds selected from the group consisting of HFC-161, HCC-40, isobutane, HCO-1140, HCC-160 and CFC-114a.

[0191] Embodiment 36: The process of any of the foregoing embodiments, alone or in combination, wherein the consolidated thermal fluid comprises R-125 as the first refrigerant compound, R-32 as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFC-23, HFC-32, HFC-143a, HFC-134a, CFC-115, CFCO-1113 and HCC-40; and one or more additional compounds selected from the group consisting of HFC-143a, HFC-41, HFC-134a, HCFC-22, CFC-12 and HCC-40.

[0192] Embodiment 37: The process of any of the foregoing embodiments, alone or in combination, wherein the consolidated thermal fluid comprises R-1234ze(E) as the first refrigerant compound, R-134 as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFO-1234yf, HFC-245cb, HFO-1225yf(E), HFO-1225yf(Z), HFO-1225zc, HFC-236fa, HFC-152a, HFC-143a, HFC-125, HFC-134a, HFO-1234zc, HFO-1233xf, HFO-1233zd, CFC-114, HCFC-124, 2223, HFO-1234ze(Z), HFC-245fa, HFC-227ea, HFO-1243zf, HFC-263fb and HFC-134; and one or more

additional compounds selected from the group consisting of HFC-134a, HCFC-124, HCFC-124a, HCFO-1122, HFC-143a, HCFC-31, HFC-32, HFC-125, CFC-114, CFC-114a, FCO-1114, HFC-152a, FCO-1318my, HFC-245cb, FC-C318 and HC-161.

[0193] Embodiment 38: The process of any of the foregoing embodiments, alone or in combination, wherein the consolidated thermal fluid comprises R-1234yf as the first refrigerant compound, R-1252zc as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFO-1225ye, HFO-1243zf, E-HFO-1234ze, HFC-236ea, HCFC-244bb, HFC-245fa, HFC-245eb, HFC-245cb, 3,3,3-trifluoropropyne, HFC-152a, FO-1114, CFO-1123, HCFO-1131a, trans-HCFO-1131, HCO- 1140, HCFO-1214ya, HFO-1216, HCFO-1224yd, HFO-1252 isomers, HFC-143a, HCFC-225, HFC-254eb, HFC-263fb, HFC- 236fa, HCFC-142b, HCFC-244cc, HCFO-1223, HFO-1132a and HCC-40; and one or more additional compounds selected from the group consisting of methane, ethylene, dichloromethane (HCC-30), fluoroethane (HFC-1141), propane (HC-290), propylene (HC-1270), 2,3,3,3-tetrafluoropropene (HFO-1234yf), allene, 3-fluoro-1-propene (HFO-1261), 1,1,1-trifluoropropane (HFC-263b), 3-fluoro-1-propene (HFO-1261), 2-butene, 2-butene, cyclobutene, 2-methyl-1-propene, 1,1-difluoropropane (HFC-272fb), 2-chloro-3,3,3-trifluoropropene (HCFO-1233xf), 3-chloropropene (HCO-1260zf), C₃H₄FCI (HCFO-1251) and HFO-1243zf.

[0194] Embodiment 39: The process of any of the foregoing embodiments, alone or in combination, wherein the consolidated thermal fluid comprises R-1234ze(E) as the first refrigerant compound, R-1252zc as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFO-1234yf, HFC-245cb, HFO-1225yf(E), HFO-1225yf(Z), HFO-1225zc, HFC-236fa, HFC-152a, HFC-143a, HFC-125, HFC-134a, HFO-1234zc, HFO-1233xf, HFO-1233zd, CFC-114, HCFC-124, 2223, HFO-1234ze(Z), HFC-245fa, HFC-227ea, HFO-1243zf, HFC-263fb and HFC-134; and one or more additional compounds selected from the group consisting of methane, ethylene, dichloromethane (HCC-30), fluoroethane (HFC-1141), propane (HC-290), propylene (HC-1270), 2,3,3,3-tetrafluoropropene (HFO-1234yf), allene, 3-fluoro-1-propene (HFO-1261), 1,1,1-trifluoropropane (HFC-263b), 3-fluoro-1-propene (HFO-1261), 2-butene, 2-butene, cyclobutene, 2-methyl-1-propene, 1,1-difluoropropane (HFC-

272fb), 2-chloro-3,3,3-trifluoropropene (HCFO-1233xf), 3-chloropropene (HCO-1260zf), C₃H₄FCI (HCFO-1251) and HFO-1243zf.

[0195] Embodiment 40: The process of any of the foregoing embodiments, alone or in combination, wherein the consolidated thermal fluid further comprises one or more additional compounds selected from the group consisting of HFO-1225ye, HFO-1243zf, E-HFO-1234ze, HFC-236ea, HCFC-244bb, HFC-245fa, HFC-245eb, HFC-245cb, 3,3,3-trifluoropropyne, HFC-152a, FO-1114, CFO-1123, HCFO-1131a, trans-HCFO-1131, HCO-1140, HCFO-1214ya, HFO-1216, HCFO-1224yd, HFO-1252 isomers, HFC-143a, HCFC-225, HFC-254eb, HFC-263fb, HFC-236fa, HCFC-142b, HCFC-244cc, HCFO-1223, HFO-1132a and HCC-40; one or more additional compounds selected from the group consisting of HFC-161, HCC-40, isobutane, HCO-1140, HCC-160 and CFC-114a; and one or more additional compounds selected from the group consisting of HFC-143a, HFO-1225zc, HFC-245cb, HFC-134, HFC-152a, HFO-1225ye, HFC-161, E-HFO-1234ze, HCFC-22, HFO-1243zf, CHFC-124, HCC-40, CHFO-1122, HCFC-31, CFC-114, CFC-114a and HCO-1140.

[0196] Embodiment 41: The process of any of the foregoing embodiments, alone or in combination, wherein the recovered thermal fluid(s), the consolidated thermal fluid and/or the reclaimed thermal fluid comprises at least one acid scavenger and/or at least one inhibitor selected from the group consisting of hydrocarbons including at least cyclic monoterpene; lipophilic organic compounds; and phenols, aromatic organic compounds having at least one chemical moiety -C₆H₄(OH), preferably at least one member selected from the group consisting of D-limonene, pinene, α -pinene, β -pinene, α -terpinene, α -tocopherol, butylated hydroxytoluene, 4-methoxyphenol, benzene-1,4-diol, and mixtures thereof.

[0197] While this specification contains many specific implementation details, these should not be construed as limitations on the scope of any inventions or of what may be claimed, but rather as descriptions of features specific to particular implementations of particular inventions. Certain features that are described in this specification in the context of separate implementations can also be implemented in combination in a single implementation. Conversely, various features that are described in the context of a single implementation can also be implemented in multiple implementations separately or in any suitable sub-combination. Moreover,

although features may be described above as acting in certain combinations and even initially claimed as such, one or more features from a claimed combination can in some cases be excised from the combination, and the claimed combination may be directed to a sub-combination or variation of a sub-combination.

[0198] Similarly, while operations are depicted in the drawings in a particular order, this should not be understood as requiring that such operations be performed in the particular order shown or in sequential order, or that all illustrated operations be performed, to achieve desirable results. In certain circumstances, multitasking and parallel processing may be advantageous. Moreover, the separation of various system components in the implementations described above should not be understood as requiring such separation in all implementations, and it should be understood that the described program components and systems can generally be integrated together in a single software product or packaged into multiple software products.

[0199] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which example embodiments belong. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0200] While the disclosure has been described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes may be made, and equivalents may be substituted for elements thereof without departing from the scope of the disclosure. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the disclosure without departing from the essential scope thereof. While various aspects and embodiments have been disclosed herein, other aspects and embodiments will be apparent to those skilled in the art. The various aspects and embodiments disclosed herein are for purposes of illustration and are not intended to be limiting, with the true scope and spirit being indicated by the following claims.

CLAIMS

What is claimed is:

1. A process of thermal fluid reclamation comprising:
 - combining at least two recovered thermal fluids comprising a first refrigerant compound and a second refrigerant compound to form a consolidated thermal fluid, wherein the consolidated thermal fluid is a blend including the first refrigerant compound and the second refrigerant compound with a consolidated composition;
 - testing the consolidated thermal fluid and validating that the consolidated thermal fluid has greater than about 95 wt%, preferably greater than about 99 wt%, most preferably greater than about 99.5 wt% organic purity;
 - distilling the consolidated thermal fluid to form at least one distillate comprising the first refrigerant compound and the second refrigerant compound as a reclaimed thermal fluid, wherein the reclaimed thermal fluid has a reclaimed composition different from the consolidated composition and the reclaimed thermal fluid is azeotropic, azeotrope-like, or close-boiling; and
 - supplying the reclaimed thermal fluid for formation of a thermal fluid product.
2. A process of thermal fluid reclamation comprising:
 - combining at least two recovered thermal fluids comprising a first refrigerant compound and a second refrigerant compound to form a consolidated thermal fluid, wherein the consolidated thermal fluid is a blend including the first refrigerant compound and the second refrigerant compound with a consolidated composition;
 - treating the consolidated thermal fluid to form a reclaimed thermal fluid comprising the first refrigerant compound and the second refrigerant compound, wherein the reclaimed thermal fluid has a reclaimed composition different from the consolidated composition, wherein the reclaimed thermal fluid is azeotropic, azeotrope-like, or close-boiling, and wherein the reclaimed thermal fluid has greater than about 95 wt%, preferably greater than about 99 wt%, most preferably greater than about 99.5 wt% organic purity; and
 - supplying the reclaimed thermal fluid for formation of a thermal fluid product.

3. The process of claim 1 or claim 2, wherein the supplying comprises packaging the reclaimed thermal fluid for commercial sale.
4. The process of any of claims 1 to 3, wherein the first refrigerant compound and the second refrigerant compound are a pair selected from the group consisting of R-134a and R-1234yf; R-1234ze(E) and R-227ea; R-152a and R-134a; R-1234yf and R-152a; R-125 and R-143a; R-32 and R-1132(E); R-1234yf and R-1132(Z); R-1234ze(E) and R-1132(Z); R-152a and R-1234ze(E); R-125 and R-32; R-1234ze(E) and R-134; R-1234yf and R-1252zc; R-1234ze(E) and R-1252zc; R-1234ze(E) and R-134a; R-1234ze(Z) and R-1336mzz(E); R-1234ze(Z) and R-1233zd(E); R-245fa and R-1234ze(Z); R-245fa and R-1233zd(E); R-1336mzz(Z) and trans-dichloroethylene; R-152a and R-1252zc; R-1132(Z) and R-152a; CO₂ and R-1132a; R-1233zd(E) and R-1336mzz(E); and R-32 and R-290.
5. The process of any of claims 1 to 4, wherein the at least two recovered thermal fluids and the reclaimed thermal fluid further comprise a third refrigerant compound.
6. The process of claim 5, wherein the first refrigerant compound, the second refrigerant compound, and the third refrigerant compound are R-1234yf, R-152a, and R-134a.
7. The process of any of claims 1 to 4, wherein the supplying comprises adjusting a ratio of the first refrigerant compound to the second refrigerant compound of the reclaimed composition by adding an additional amount of at least one of the first refrigerant compound and the second refrigerant compound to the reclaimed thermal fluid to form the thermal fluid product.
8. The process of claim 7, wherein the first refrigerant compound and the second refrigerant compound are R-134a and R-1234yf; R-1234ze(E) and R-227ea; R-152a and R-134a; R-1234yf and R-152a; R-125 and R-143a; R-32 and R-1132(E); R-1234yf and R-1132(Z); R-1234ze(E) and R-1132(Z); R-152a and R-1234ze(E); R-125 and R-32; and R-1234ze(E) and R-134a.

9. The process of any of claims 7 to 8, wherein the first refrigerant compound and the second refrigerant compound are R-125 and R-32 and the thermal fluid product is selected from the group consisting of R-410A and R-410B.
10. The process of any of claims 7 to 8, wherein the first refrigerant compound is R-134a, the second refrigerant compound is R-1234yf, and the thermal fluid product is selected from the group consisting of R-513A and R-513B.
11. The process of any of claims 7 to 8, wherein the first refrigerant compound is R-1234ze, the second refrigerant compound is R-227ea, and the thermal fluid product is selected from the group consisting of R-515A and R-515B.
12. The process of any of claims 7 to 8, wherein the first refrigerant compound is R-152a, the second refrigerant compound is R-134a, and the thermal fluid product is selected from the group consisting of R-512A and R-516A.
13. The process of any of claims 7 to 8, wherein the first refrigerant compound is R-125, the second refrigerant compound is R-143a, and the thermal fluid product is selected from the group consisting of R-404A, R-462A, and R-507A.
14. The process of any of claims 1 to 13, wherein the supplying comprises blending the reclaimed composition with at least one blending thermal fluid comprising a third refrigerant compound to form the thermal fluid product, optionally wherein at least one refrigerant compound of the reclaimed composition is an HFC.
15. The process of claim 14, wherein the first refrigerant compound and the second refrigerant compound are R-134a and R-1234yf; R-1234ze(E) and R-227ea; R-152a and R-134a; R-1234yf and R-152a; R-125 and R-143a; R-32 and R-1132(E); R-1234yf and R-1132(Z); R-1234ze(E) and R-1132(Z); R-152a and R-1234ze(E); R-125 and R-32; and R-1234ze(E) and R-134a.
16. The process of claim 14, wherein the first refrigerant compound is R-134a, the second refrigerant compound is R-1234yf, and the thermal fluid product is selected from the group consisting of R-448A, R-448B, R-449A, R-449B, R-449C, R-475A, R-513A and R-516A.

17. The process of claim 14, wherein the first refrigerant compound is R-1234ze, the second refrigerant compound is R-227ea, and the thermal fluid product is selected from the group consisting of R-464A, R-470A, R-470B, and R-471A.
18. The process of claim 14, wherein the first refrigerant compound is R-1234yf, the second refrigerant compound is R-152a, and the third refrigerant compound is R-32, and the thermal fluid product is selected from the group consisting of R-457A, R-457B, R-457C and R-457D.
19. The process of claim 14, wherein the first refrigerant compound is R-125, the second refrigerant compound is R-32, the third refrigerant compound is R-134a, and the thermal fluid product is selected from the group consisting of R-407A, R-407B, R-407C, R-407D, R-407E, R-407F, R-407G, R-407H, and R-407I.
20. The process of claim 14, wherein the first refrigerant compound is R-1234ze(E), the second refrigerant compound is R-152a, the third refrigerant compound is R-32, and the thermal fluid product is selected from the group consisting of R-444A, R-444B and R-478A, and is preferably R-444A.
21. The process of any of claims 1 to 20, wherein the validating comprises removing one or more impurities from the consolidated thermal fluid such that the consolidated thermal fluid has greater than about 95 wt%, preferably greater than about 99 wt%, most preferably greater than about 99.5 wt% organic purity.
22. The process of claim 21, wherein the one or more impurities comprises an oil.
23. The process of any of claims 1 to 22, further comprising adding a stabilizer package to the reclaimed thermal fluid.
24. The process of claim 1 or claim 2, wherein the reclaimed thermal fluid is azeotropic.
25. The process of any of claims 1 and 3 to 22, wherein the at least one distillate comprises a first distillate comprising the first refrigerant compound and the second refrigerant compound as a first reclaimed thermal fluid and a second distillate as a second reclaimed thermal fluid, wherein the first reclaimed

thermal fluid and the second reclaimed thermal fluid are azeotropic, azeotrope-like, or close-boiling.

26. A reclaimed thermal fluid formed by the process of any of claims 1 to 25.
27. The process of any of claims 1 to 4, wherein the consolidated thermal fluid comprises R-134a as the first refrigerant compound, R-1234yf as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFO-1225yf, HFO-1243zf, E-HFO-1234ze, HFC-236ea, HCFC-244bb, HFC-245fa, HFC-245eb, HFC-245cb, 3,3,3-trifluoropropyne, HFC-152a, FO-1114, CFO-1123, HCFO-1131a, trans-HCFO-1131, HCO-1140, HCFO-1214ya, HFO-1216, HCFO-1224yd, HFO-1252 isomers, HFC-143a, HCFC-225, HFC-254eb, HFC-263fb, HFC-236fa, HCFC-142b, HCFC-244cc, HCFO-1223, HFO-1132a and HCC-40; and one or more additional compounds selected from the group consisting of HFC-143a, HFO-1225zc, HFC-245cb, HFC-134, HFC-152a, HFO-1225yf, HFC-161, E-HFO-1234ze, HCFC-22, HFO-1243zf, CHFC-124, HCC-40, CHFO-1122, HCFC-31, CFC-114, CFC-114a and HCO-1140.
28. The process of any of claims 1 to 4, wherein the consolidated thermal fluid comprises R-1234ze(E) as the first refrigerant compound, R-227ea as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFO-1234yf, HFC-245cb, HFO-1225yf(E), HFO-1225yf(Z), HFO-1225zc, HFC-236fa, HFC-152a, HFC-143a, HFC-125, HFC-134a, HFO-1234zc, HFO-1233xf, HFO-1233zd, CFC-114, HCFC-124, 2223, HFO-1234ze(Z), HFC-245fa, HFC-227ea, HFO-1243zf, HFC-263fb and HFC-134; and one or more additional compounds selected from the group consisting of HFC-23, FC-1216, HFC-143a, HFC-134a, HCFC-22, HCFC-124, FC-218, HFC-236fa and HFO-1225zc.
29. The process of any of claims 1 to 4, wherein the consolidated thermal fluid comprises R-152a as the first refrigerant compound, R-134a as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFC-161, HCC-40, isobutane, HCO-1140, HCC-160 and CFC-114a; and one or more additional compounds selected from the group consisting of HFC-143a, HFO-1225zc,

HFC-245cb, HFC-134, HFC-152a, HFO-1225ye, HFC-161, E-HFO-1234ze, HCFC-22, HFO-1243zf, CHFC-124, HCC-40, CHFO-1122, HCFC-31, CFC-114, CFC-114a and HCO-1140.

30. The process of any of claims 1 to 4, wherein the consolidated thermal fluid comprises R-1234yf as the first refrigerant compound, R-152a as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFO-1225ye, HFO-1243zf, E-HFO-1234ze, HFC-236ea, HCFC-244bb, HFC-245fa, HFC-245eb, HFC-245cb, 3,3,3-trifluoropropyne, HFC-152a, FO-1114, CFO-1123, HCFO-1131a, trans-HCFO-1131, HCO-1140, HCFO-1214ya, HFO-1216, HCFO-1224yd, HFO-1252 isomers, HFC-143a, HCFC-225, HFC-254eb, HFC-263fb, HFC-236fa, HCFC-142b, HCFC-244cc, HCFO-1223, HFO-1132a and HCC-40; and one or more additional compounds selected from the group consisting of HFC-161, HCC-40, isobutane, HCO-1140, HCC-160 and CFC-114a.
31. The process of any of claims 1 to 4, wherein the consolidated thermal fluid comprises R-125 as the first refrigerant compound, R-143a as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFC-23, HFC-32, HFC-143a, HFC-134a, CFC-115, CFCO-1113 and HCC-40; and one or more additional compounds selected from the group consisting of CFC-115, HFC-134a, HFC-152a, HCFC-22, CFC-12, HCFC-124, CFC-114a and HCFC-133a.
32. The process of any of claims 1 to 4, wherein the consolidated thermal fluid comprises R-32 as the first refrigerant compound, R-1132(E) as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFC-143a, HFC-41, HFC-134a, HCFC-22, CFC-12 and HCC-40; and one or more additional compounds selected from the group consisting of HFC-32, HFC-125, HCFO-E-1122a, HCFO-Z-1122a, HFO-1123, HFO-1141, HCFC-133, HCFC-133b, HCFC-123, HFC-152, HFC-143, HFC-41, HCFC-22, ethylene, HCFC-142a, HFO-1132a, HCFO-1131a, HCFO-E-1131, HCFO-Z-1131, HCFO-1122, acetylene and HCO-1140.

33. The process of any of claims 1 to 4, wherein the consolidated thermal fluid comprises R-1234yf as the first refrigerant compound, R-1132(Z) as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFO-1225ye, HFO-1243zf, E-HFO-1234ze, HFC-236ea, HCFC-244bb, HFC-245fa, HFC-245eb, HFC-245cb, 3,3,3-trifluoropropyne, HFC-152a, FO-1114, CFO-1123, HCFO-1131a, trans-HCFO-1131, HCO-1140, HCFO-1214ya, HFO-1216, HCFO-1224yd, HFO-1252 isomers, HFC-143a, HCFC-225, HFC-254eb, HFC-263fb, HFC-236fa, HCFC-142b, HCFC-244cc, HCFO-1223, HFO-1132a and HCC-40; and one or more additional compounds selected from the group consisting of difluoromethane (HFC-32), 1,1,1,2,2 pentafluoroethane (HFC-125), E-1-chloro-1,2-difluoroethylene (HCFO-E-1122a), Z-1-chloro-1,2-difluoroethylene (HCFO-Z-1122a), 1,1,2-trifluoroethylene (HFO-1123), fluoroethylene (HFO-1141), 1-chloro-1,2,2-trifluoroethane (HCFC-133), 1-chloro-1,1,2-trifluoroethane (HCFC-133b), 1,1-dichloro-2,2,2-trifluoroethane (HCFC-123), 1,2-difluoroethane (HFC-152), 1,1,2-trifluoroethane (HFC-143), fluoromethane (HFC-41), chlorodifluoromethane (HCFC-22), ethylene, 1-chloro-1,2-difluoroethane (HCFC-142a), 1,1-difluoroethylene (HFO-1132a), 1-chloro-1-fluoroethene (HCFO-1131a), E-1-chloro-2-fluoroethene (HCFO-E-1131), Z-1-chloro-1-fluoroethene (HCFO-Z-1131), 1-chloro-2,2-difluoroethylene (HCFO-1122), HFO-E-1132, vinyl chloride (HCO-1140), acetylene and fluoroacetylene.
34. The process of any of claims 1 to 4, wherein the consolidated thermal fluid comprises R-1234ze(E) as the first refrigerant compound, R-1132(Z) as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFO-1234yf, HFC-245cb, HFO-1225yf(E), HFO-1225yf(Z), HFO-1225zc, HFC-236fa, HFC-152a, HFC-143a, HFC-125, HFC-134a, HFO-1234zc, HFO-1233xf, HFO-1233zd, CFC-114, HCFC-124, 2223, HFO-1234ze(Z), HFC-245fa, HFC-227ea, HFO-1243zf, HFC-263fb and HFC-134; and one or more additional compounds selected from the group consisting of difluoromethane (HFC-32), 1,1,1,2,2 pentafluoroethane (HFC-125), E-1-chloro-1,2-difluoroethylene (HCFO-E-1122a), Z-1-chloro-1,2-difluoroethylene (HCFO-Z-1122a), 1,1,2-trifluoroethylene (HFO-1123), fluoroethylene (HFO-1141), 1-chloro-1,2,2-

trifluoroethane (HCFC-133), 1-chloro-1,1,2-trifluoroethane (HCFC-133b), 1,1-dichloro-2,2,2-trifluoroethane (HCFC-123), 1,2-difluoroethane (HFC-152), 1,1,2-trifluoroethane (HFC-143), fluoromethane (HFC-41), chlorodifluoromethane (HCFC-22), ethylene, 1-chloro-1,2-difluoroethane (HCFC-142a), 1,1-difluoroethylene (HFO-1132a), 1-chloro-1-fluoroethene (HCFO-1131a), E-1-chloro-2-fluoroethene (HCFO-E-1131), Z-1-chloro-1-fluoroethene (HCFO-Z-1131), 1-chloro-2,2-difluoroethylene (HCFO-1122), HFO-E-1132, vinyl chloride (HCO-1140), acetylene and fluoroacetylene.

35. The process of any of claims 1 to 4, wherein the consolidated thermal fluid comprises R-1234ze(E) as the first refrigerant compound, R-152a as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFO-1234yf, HFC-245cb, HFO-1225yf(E), HFO-1225yf(Z), HFO-1225zc, HFC-236fa, HFC-152a, HFC-143a, HFC-125, HFC-134a, HFO-1234zc, HFO-1233xf, HFO-1233zd, CFC-114, HCFC-124, 2223, HFO-1234ze(Z), HFC-245fa, HFC-227ea, HFO-1243zf, HFC-263fb and HFC-134; and one or more additional compounds selected from the group consisting of HFC-161, HCC-40, isobutane, HCO-1140, HCC-160 and CFC-114a.
36. The process of any of claims 1 to 4, wherein the consolidated thermal fluid comprises R-125 as the first refrigerant compound, R-32 as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFC-23, HFC-32, HFC-143a, HFC-134a, CFC-115, CFCO-1113 and HCC-40; and one or more additional compounds selected from the group consisting of HFC-143a, HFC-41, HFC-134a, HCFC-22, CFC-12 and HCC-40.
37. The process of any of claims 1 to 4, wherein the consolidated thermal fluid comprises R-1234ze(E) as the first refrigerant compound, R-134 as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFO-1234yf, HFC-245cb, HFO-1225yf(E), HFO-1225yf(Z), HFO-1225zc, HFC-236fa, HFC-152a, HFC-143a, HFC-125, HFC-134a, HFO-1234zc, HFO-1233xf, HFO-1233zd, CFC-114, HCFC-124, 2223, HFO-1234ze(Z), HFC-245fa, HFC-227ea, HFO-1243zf,

HFC-263fb and HFC-134; and one or more additional compounds selected from the group consisting of HFC-134a, HCFC-124, HCFC-124a, HCFO-1122, HFC-143a, HCFC-31, HFC-32, HFC-125, CFC-114, CFC-114a, FCO-1114, HFC-152a, FCO-1318my, HFC-245cb, FC-C318 and HC-161.

38. The process of any of claims 1 to 4, wherein the consolidated thermal fluid comprises R-1234yf as the first refrigerant compound, R-1252zc as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFO-1225ye, HFO-1243zf, E-HFO-1234ze, HFC-236ea, HCFC-244bb, HFC-245fa, HFC-245eb, HFC-245cb, 3,3,3-trifluoropropyne, HFC-152a, FO-1114, CFO-1123, HCFO-1131a, trans-HCFO-1131, HCO-1140, HCFO-1214ya, HFO-1216, HCFO-1224yd, HFO-1252 isomers, HFC-143a, HCFC-225, HFC-254eb, HFC-263fb, HFC-236fa, HCFC-142b, HCFC-244cc, HCFO-1223, HFO-1132a and HCC-40; and one or more additional compounds selected from the group consisting of methane, ethylene, dichloromethane (HCC-30), fluoroethane (HFC-1141), propane (HC-290), propylene (HC-1270), 2,3,3,3-tetrafluoropropene (HFO-1234yf), allene, 3-fluoro-1-propene (HFO-1261), 1,1,1-trifluoropropane (HFC-263b), 3-fluoro-1-propene (HFO-1261), 2-butene, 2-butene, cyclobutene, 2-methyl-1-propene, 1,1-difluoropropane (HFC-272fb), 2-chloro-3,3,3-trifluoropropene (HCFO-1233xf), 3-chloropropene (HCO-1260zf), C₃H₄FCI (HCFO-1251) and HFO-1243zf.
39. The process of any of claims 1 to 4, wherein the consolidated thermal fluid comprises R-1234ze(E) as the first refrigerant compound, R-1252zc as the second refrigerant compound, and further comprises one or more additional compounds selected from the group consisting of HFO-1234yf, HFC-245cb, HFO-1225yf(E), HFO-1225yf(Z), HFO-1225zc, HFC-236fa, HFC-152a, HFC-143a, HFC-125, HFC-134a, HFO-1234zc, HFO-1233xf, HFO-1233zd, CFC-114, HCFC-124, 2223, HFO-1234ze(Z), HFC-245fa, HFC-227ea, HFO-1243zf, HFC-263fb and HFC-134; and one or more additional compounds selected from the group consisting of methane, ethylene, dichloromethane (HCC-30), fluoroethane (HFC-1141), propane (HC-290), propylene (HC-1270), 2,3,3,3-tetrafluoropropene (HFO-1234yf), allene, 3-fluoro-1-propene (HFO-1261), 1,1,1-trifluoropropane (HFC-263b), 3-fluoro-1-propene (HFO-1261), 2-butene,

2-butene, cyclobutene, 2-methyl-1-propene, 1,1-difluoropropane (HFC-272fb), 2-chloro-3,3,3-trifluoropropene (HCFO-1233xf), 3-chloropropene (HCO-1260zf), C₃H₄FCI (HCFO-1251) and HFO-1243zf.

40. The process of claim 6, wherein the consolidated thermal fluid further comprises one or more additional compounds selected from the group consisting of HFO-1225ye, HFO-1243zf, E-HFO-1234ze, HFC-236ea, HCFC-244bb, HFC-245fa, HFC-245eb, HFC-245cb, 3,3,3-trifluoropropyne, HFC-152a, FO-1114, CFO-1123, HCFO-1131a, trans-HCFO-1131, HCO-1140, HCFO-1214ya, HFO-1216, HCFO-1224yd, HFO-1252 isomers, HFC-143a, HCFC-225, HFC-254eb, HFC-263fb, HFC-236fa, HCFC-142b, HCFC-244cc, HCFO-1223, HFO-1132a and HCC-40; one or more additional compounds selected from the group consisting of HFC-161, HCC-40, isobutane, HCO-1140, HCC-160 and CFC-114a; and one or more additional compounds selected from the group consisting of HFC-143a, HFO-1225zc, HFC-245cb, HFC-134, HFC-152a, HFO-1225ye, HFC-161, E-HFO-1234ze, HCFC-22, HFO-1243zf, CHFC-124, HCC-40, CHFO-1122, HCFC-31, CFC-114, CFC-114a and HCO-1140.
41. The process of any of claims 1 to 40, wherein the recovered thermal fluid(s), the consolidated thermal fluid and/or the reclaimed thermal fluid comprises at least one acid scavenger and/or at least one inhibitor selected from the group consisting of hydrocarbons including at least cyclic monoterpene; lipophilic organic compounds; and phenols, aromatic organic compounds having at least one chemical moiety -C₆H₄(OH), preferably at least one member selected from the group consisting of D-limonene, pinene, α-pinene, β-pinene, α-terpinene, α-tocopherol, butylated hydroxytoluene, 4-methoxyphenol, benzene-1,4-diol, and mixtures thereof.