

DESICCANT-BASED COOLING SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. provisional patent application number 61/527,904 filed 26 August 2011, which is hereby incorporated herein by reference.

TECHNICAL FIELD

[0002] The present invention relates to a system and method of desiccant-based air conditioning.

BACKGROUND

[0003] Air conditioning systems may utilize any of a variety of processes for heating, cooling, dehumidifying, and humidifying air. For example, a vapor-compression system may take advantage of the expansion and compression of a refrigerant to provide cooling and/or heat into different ambient spaces. Another type of air conditioning system uses a hygroscopic material, such as a desiccant, to remove or add water to an airstream, and to cool or heat an ambient environment. Examples of such systems are described in the following patent: US6487872, issued on 3 December 2002, which is hereby incorporated herein by reference.

[0004] Typically desiccant-based systems employ a central unit that uses a desiccant to remove moisture from one airstream, which dilutes the desiccant, and to give up moisture from the desiccant to another airstream, thereby concentrating or regenerating the diluted desiccant. The central unit then provides the conditioned air to an ambient environment, which may be, for example, one or more rooms within a building.

[0005] One limitation of this type of desiccant system is that it may not allow for individual control of the ambient environment within different rooms in a building. Remotely locating different portions of a desiccant system—for example, by having a regenerator outdoors and a

process portion indoors—can require a complex system for balancing the concentration of the desiccant between the regeneration and process activities. Thus, a need exists for a desiccant-based air conditioning system that provides individual control for one or more rooms in a building, without an unduly complex system for desiccant balance.

SUMMARY

[0006] Embodiments of the present invention provide a system and method for conditioning air using a desiccant-based system that allows individual control of the environment in one or more rooms in a building.

[0007] Embodiments of the invention include a system having a first subsystem disposed outside a building whose environment is to be controlled. A second subsystem is located inside the building, in a room where it is desired to control the environment. The second subsystem is connected to the first subsystem, such that desiccant is transferred between the first and second subsystems as required to provide the desired environment within the room.

[0008] Embodiments of the invention also include a desiccant-based air conditioning system having a first subsystem, or outdoor unit, and multiple second subsystems, or indoor units. Each of the indoor units is connected to the outdoor unit, such that desiccant can flow to and from each of the indoor units individually as required to provide separate environmental control for each of the rooms. One way this can be accomplished is by using a float-actuated valve to control the flow of desiccant into the indoor units. A temperature sensor can also be connected to the valve to provide further control so that flow of desiccant into the indoor unit can be a function of both mass and temperature of the desiccant. In this way, a computer algorithm can be employed to control the flow of desiccant into and out of the indoor units individually so that different environmental conditions can be maintained in the respective spaces where the indoor units are located.

[0009] For purposes of cooling and dehumidification, the indoor units will receive cool, concentrated desiccant from the outdoor unit, which is then brought into contact with an airflow from the inside space. The airflow may enter one portion of the indoor unit, where it gives up water

to the desiccant and is simultaneously cooled. The dry, cool air is then exhausted into the ambient environment to provide the desired conditions.

[0010] The diluted desiccant may be gathered in a sump in the indoor unit and transferred back to the outdoor unit, for example, by gravity or a pump system. The diluted desiccant is regenerated in the outdoor unit, where it can be exposed to a combination of heat and a relatively dry airflow that removes water from the desiccant. In some embodiments of the invention, the heat may be provided through one or more heat exchangers that are part of a vapor-compression system. The vapor-compression system also includes at least one evaporator, and this can be the source of cooling for the desiccant that is provided to the indoor units.

[0011] The outdoor unit itself may be divided into separate chambers, a first of which, a first process chamber, receives the diluted desiccant from the indoor units and transfers regenerated desiccant to the indoor units. The second chamber in the outdoor unit performs the regeneration of the diluted desiccant by adding an airflow and/or heat to remove the water from the desiccant. The two chambers may be connected, for example, through an orifice, or some other mechanism effective to transfer the desiccant between the chambers.

[0012] In addition to the foregoing, embodiments of the present invention also provide a mechanism for humidifying and warming the indoor air that is processed by the indoor units. This can be accomplished, for example, by adding water to the desiccant in the outdoor unit so that desiccant being transferred to the indoor units contains a relatively high percentage of water. Thus, when the indoor air is processed by one of the indoor units, it picks up water from the desiccant and exhausts moist air back into the indoor environment. This may be particularly helpful in the winter in cold climates when the air is generally very dry. In this same way, the desiccant in the outdoor unit can be heated so that in addition to providing moisture to the indoor air, it warms the air as it is processed through the indoor unit.

[0013] At least some embodiments of the invention include a system for conditioning air. The system includes a first unit housing a regenerator operable to receive a first airflow and bring the first airflow into contact with a liquid desiccant to transfer water from the liquid desiccant to the

first airflow. The regenerator includes a regenerator sump for collecting the liquid desiccant after water is transferred to the liquid desiccant from the first airflow, the first unit further housing a first portion of a process sump fluidly connected to the regenerator sump. A second unit is remotely located from the first unit and is configured to receive a second airflow and bring the second airflow into contact with the liquid desiccant. The second unit houses a second portion of the process sump for collecting the liquid desiccant after it contacts the second airflow. The first unit is in selective fluid communication with the second unit such that the liquid desiccant can be selectively transferred between the first and second portions of the process sump, and the liquid desiccant transferred from the second portion of the process sump to the first portion of the process sump can be admixed with the liquid desiccant in the regenerator sump prior to the liquid desiccant being returned to the second unit.

[0014] At least some embodiments of the invention include a system for conditioning air that includes a first unit remotely located from an indoor space, and a second unit located within the indoor space and in selective fluid communication with the first unit. The first unit includes a regeneration chamber into which a first airflow is introduced and contacted with a liquid desiccant to transfer water from the liquid desiccant to the first airflow. The regeneration chamber includes a regenerator sump for collecting the liquid desiccant after water is transferred to the liquid desiccant from the first airflow. The first unit further includes a first process chamber separated from the regenerator chamber such that the first airflow is inhibited from entering the first process chamber. The first process chamber includes a first portion of a process sump fluidly connected to the regenerator sump. The second unit includes a second process chamber into which a second airflow is introduced and contacted with the liquid desiccant to transfer water between the second airflow and the liquid desiccant prior to the second airflow being discharged into the indoor space. The second process chamber includes a second portion of the process sump for collecting the liquid desiccant after it contacts the second airflow. The selective fluid communication between the first and second units providing selective transfer of the liquid desiccant between the first and second portions of the process sump.

[0015] At least some embodiments of the invention include a method for conditioning air that includes bringing a first airflow into contact with a liquid desiccant in a regeneration chamber to transfer water from the liquid desiccant to the first airflow during a first mode of operation. The liquid desiccant is collected in a regenerator sump after water is transferred from the liquid desiccant to the first airflow. The liquid desiccant in the regenerator sump is admixed with liquid desiccant in a first portion of a process sump disposed in a first process chamber adjacent the regeneration chamber. Some of the liquid desiccant from the first portion of the process sump is transferred to a second portion of the process sump disposed in a second process chamber located remotely from the first process chamber. A second airflow is brought into contact with the liquid desiccant in the second process chamber to transfer water from the second airflow to the liquid desiccant during the first mode of operation. The second airflow is exhausted from the second process chamber into an ambient environment having air to be conditioned, after the second airflow has contacted the liquid in the second process chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIGURE 1 is a schematic representation of an embodiment of the present invention having an outdoor unit and three indoor units located in separate rooms in a building;

[0017] FIGURE 2 is a schematic representation of an outdoor unit in accordance with an embodiment of the present invention shown as operational in a first mode of operation;

[0018] FIGURES 3A and 3B respectively show front and side schematic views of an indoor unit in accordance with an embodiment of the present invention; and

[0019] FIGURE 4 is a schematic representation of an outdoor unit in accordance with an embodiment of the present invention shown as operational in a second mode of operation.

DETAILED DESCRIPTION

[0020] As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention that may be embodied in various and alternative forms. The figures are not necessarily to scale; some features may be exaggerated or minimized to show details of particular components. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a representative basis for teaching one skilled in the art to variously employ the present invention.

[0021] Figure 1 shows a desiccant-based air conditioning system 10 in accordance with an embodiment of the present invention. The system 10 includes a first unit, or outdoor unit 12, and three “second units”, or indoor units 14, 16, 18, remotely located from the outdoor unit 12. Each of the indoor units 14, 16, 18 is located in a respective room 20, 22, 24 within a building 26. Although at least some of the indoor units 14, 16, 18 appear to be located a relatively long distance from the outdoor unit 12, embodiments of the invention may have first and second units remotely located from each other, but still within a relatively close distance of each other. In general, the term “remotely located” refers to the first and second units being at least substantially located in and working on different ambient environments—e.g., an outdoor and indoor environment.

[0022] As shown in Figure 1, a supply line 28 provides desiccant from the outdoor unit 12 to each of the indoor units 14, 16, 18; similarly, a return line 30 receives desiccant from each of the indoor units 14, 16, 18 and returns it to the outdoor unit 12. Although three indoor units are shown in Figure 1, other embodiments may include more or less than three indoor units. As used herein, the words “indoor” and “building” generally refer to any structure that defines an at least partially enclosed space and separates it from an ambient outdoor environment. For example, a “building” could be a tent or other temporary, partially enclosed structure.

[0023] Figure 2 shows a schematic representation of the outdoor unit 12 shown in Figure 1. The outdoor unit 12 houses a first process chamber 32 where desiccant 34 is transferred to and from the indoor units 14, 16, 18. Any desiccant material effective to produce the desired result may be

used, including liquids in the form of pure liquids, solutions, aqueous solutions, mixtures, and combinations thereof. Lithium chloride (LiCl) and calcium chloride (CaCl₂) are typical of liquid desiccant solutions, but other liquid desiccants may be employed. The outdoor unit 12 also houses a regenerator 35, which includes a regeneration chamber 36 where the desiccant 34 may be regenerated. In the embodiment shown in Figure 2, the desiccant 34 transfers between the first process chamber 32 and the regeneration chamber 36 via an aperture, which may be an orifice 38. In other embodiments, the transfer can be controlled through a float and pump mechanism, or any other method or system effective to transfer the desiccant as desired. More specifically, the desiccant 34 transfers between a first portion of a process sump 42 and a regenerator sump 43, which are separated by a divider 39 having the orifice 38 disposed therein, which allows diffusion of the desiccant 34 between the sumps 42, 43 based on a concentration gradient. As explained in more detail below, the indoor units each include a second portion of the process sump, each of which is in selective fluid communication with the first portion of the process sump 42.

[0024] As shown in Figure 2, the first chamber 32 receives desiccant 34 from the indoor units 14, 16, 18, as indicated by dashed line 40. In this embodiment, the desiccant 34 is held in the first portion of the process sump 42 at the bottom of the first process chamber 32 housed within outdoor unit 12. A first process pump 44 is used to pump the desiccant 34 from the first portion of the process sump 42 through a heat exchanger 46 and then to the indoor units, as indicated by the dashed line 48. In the embodiment shown in Figure 2, the heat exchanger 46 is an evaporator that is part of a refrigeration system, based on a vapor-compression cycle, including a compressor 50, a first condenser 52, a second condenser 54, and a thermal expansion valve 55. In other embodiments, a desiccant may be cooled and heated by other sources, such as a cold water reservoir, solar heat, etc. A bypass valve 57 allows some of the cooled desiccant 34 to be reintroduced into the first process chamber 32, as indicated by the dashed line 59. The addition of the cooled desiccant 34 back into the first portion of the process sump 42 effectively allows the sump 42 to retain cooled desiccant 34 and act as a cold liquid storage which can be drawn from when one or more of the indoor units 14, 16, 18 calls for cooling.

[0025] The vapor-compression system shown in Figure 2 may use any fluid, such as a refrigerant, effective to allow the vapor-compression system to selectively heat and cool the desiccant 34 through heat transfer to and from the refrigerant. Figure 2 shows the outdoor unit 12 in a first mode of operation, which may be used effectively in warm, humid conditions. In this mode, heat from the first condenser 52 is transferred to the desiccant 34 as indicated by the dashed line 56. The desiccant 34 is pumped through the condenser 52 by a regenerator pump 58. After leaving the condenser 52, the desiccant 34 is sprayed over media 60, which may include one or more porous materials that allow the desiccant 34 to flow through them. The second condenser 54 may have associated with it a fan (not shown) for transferring some of the heat from the vapor-compression system into an ambient environment outside of the outdoor unit 12, thereby further cooling the refrigerant prior to the expansion phase of the cycle. Although the compressor 50 and condenser 52 are shown within the regeneration chamber 36, in other embodiments, they may be located outside of a regeneration chamber and either inside another portion of a first unit, or outside of the first unit entirely. Having these components within the regeneration chamber 36 provides additional heat to the regeneration process, thereby helping to evaporate even more water from the desiccant 34.

[0026] As noted above, the desiccant 34 receives heat from the heat exchanger 52, and this process helps to regenerate the desiccant 34 by driving off some of the water that has been picked up by the indoor units 14, 16, 18 from the air in their respective indoor spaces 20, 22, 24. In addition to using heat to drive off some of the moisture from the desiccant 34, the outdoor unit 12 also uses an airflow to further remove moisture. As shown in Figure 2, a first airflow 62 from an ambient outdoor environment enters the second chamber 36 through an intake 64. The airflow 62 is drawn in by a fan 66, which moves the air into the second chamber 36, across the desiccant-laden media 60, and out through an exhaust port 68, where the airflow 62 is now shown as 62', indicating that it is now moisture-laden as it leaves the second chamber 36. Because the orifice 38 is located below the level of the desiccant in the sumps 42, 43, the first process chamber 32 is effectively sealed from any contact with the airflow 62.

[0027] Figures 3A and 3B respectively show front and side views of one of the indoor units 14 shown in Figure 1. As shown in Figure 3A, a valve 70 receives desiccant 34 from the outdoor

unit 12 as shown by dashed line 72, and in particular, it receives the desiccant 34 from the first portion of the process sump 42. The valve 70 is connected to a float system 74, which indicates the level of the desiccant 34 in a second portion of the process sump 76 at the bottom of a second process chamber 77 housed within the indoor unit 14. Thus, in the embodiment illustrated and described herein, the process side of the system 10 is a split between the outdoor unit 12 and the indoor units 14, 16, 18. Having a portion of the process side located within the same unit that houses the regeneration portion of the system 10 significantly reduces the complexity of mass and energy transfer related to balancing the desiccant 34 between the dilute process side desiccant and the more concentrated regenerator side desiccant. Moreover, having another portion of the process side housed within the indoor units allows for individual control over conditioning of the ambient air in different spaces.

[0028] In addition to receiving information regarding the level of the desiccant 34, the valve 70 also receives information from a temperature sensor 78, which measures the temperature of the desiccant 34 in the sump 76. The valve 70 may be, for example, a three-way electronically actuated solenoid valve, which responds to certain inputs, including inputs from the float system 74 and the temperature sensor 78. Control of the valve 70 may be part of a larger control system that also coordinates and controls the operation of the various components of the outdoor unit shown in Figure 2. Such a control system may contain one or more algorithms that allow each of the indoor units 14, 16, 18 to be operated independently of each other to provide for independent control of the environment in their respective rooms 20, 22, 24.

[0029] When the inputs to the valve 70, such as the level of the desiccant 34 indicated by the float system 74 and/or the temperature of the desiccant 34 as indicated by the temperature sensor 78, indicate that the valve 70 should be opened, desiccant from the outdoor unit 12 is provided to the indoor unit 14, as shown by the dashed line 80. In warm, humid environments, the desiccant 34 entering the indoor unit 14 from the outdoor unit 12 will be cool and relatively dry—i.e., undiluted by water. As explained below, this allows the ambient air in the room 20 to be dehumidified and cooled to a desired level.

[0030] Figure 3B shows the indoor unit 14 from a side view, and indicates how air flows through and is processed by the unit 14. First, a second airflow 86 from an ambient indoor environment enters the indoor unit 14; once inside, the airflow 86 is brought into contact with the desiccant 34 as it passes over media 84, as indicated by the arrow 88. The flow of air is controlled by a fan 90, which exhausts the second airflow 86 back into the ambient environment after it has been cooled and dehumidified, now indicated by the label 86'. As the desiccant 34 in the indoor unit 14 continues to collect water, the level of the desiccant 34 in the sump 76 will rise. In addition, the temperature of the desiccant 34 in the second portion of the process sump 76 will increase.

[0031] At some point, some of the desiccant 34 will be pumped back into the outdoor unit as indicated by the dashed line 94 shown in Figure 3A. The desiccant 34 in the indoor unit 14 may flow to the outdoor unit via a gravity feed, or it may be pumped. Thus, the apparatus 96 illustrated schematically in Figure 3A may be, for example, a valve that allows the desiccant 34 to automatically flow out of the indoor unit 14 when it reaches a certain level. Alternatively, the apparatus 96 may be an electronically actuated valve, such as the valve 70 described above. In such a case, the valve 96 may be opened upon the occurrence of certain input signals, such as the temperature and/or level of the desiccant 34 in the sump 76. Upon returning to the outdoor unit 12, the desiccant 34 is regenerated in accordance with the procedures described above.

[0032] Because the indoor units 14, 16, 18 are separately controlled and serve spaces that may have different requirements, the float system 74 may be actuated frequently in some units, while in other units it is actuated very infrequently. In at least some situations, the airflow 86, 86' may recirculate many times through a particular indoor unit before the float system 74 is actuated. This is another advantage of having the process side of a desiccant-based air conditioning system split between the outdoor unit and the individual indoor units—i.e., transfer of desiccant from the indoor units does not need to be based on the concentration of the desiccant in the indoor unit sump (although it can be); rather, it can be based on a temperature or strictly on a volume of liquid in the indoor sump. In this way, the more complex control of balancing the concentration of the desiccant is handled entirely in the outdoor unit, independent of the indoor units.

[0033] The air conditioning described above operates in a first mode of operation to cool and dehumidify ambient air inside a room. The system 10 can, however, also condition air to have an opposite effect—i.e., the system 10 can be operated in a second mode of operation to warm and increase the humidity of ambient air within a space. One way that this can be accomplished is to provide additional water directly to the outdoor unit 12. This is illustrated in Figure 4, by the dashed line 98, which shows the addition of water directly to the first portion of the process sump, labeled in Figure 4 as 42', with the prime symbol (') indicating like components from the other drawing figures, which showed components of the system 10 in a first mode of operation. The regenerator 35' is shut down, and in particular the pump 58' and fan 66' are not operated, so the addition of the water to the outdoor unit 12 directly results in an increased dilution of the desiccant 34 in the sump 42', and water is not evaporated from the desiccant in the regenerator sump 43'.

[0034] In addition to adding water to the desiccant 34, it is also possible to add heat to the desiccant 34 so that a warm, dilute desiccant can be provided to the indoor units 14, 16, 18. Heat can be added by any method effective to achieve the desired result, such as operating the vapor-compression system in reverse. As shown in Figure 4, the compressor 50' now pumps refrigerant to the first condenser 52', which is used to exchange heat with the desiccant 34 being pumped by the first process pump 44' from the first portion of the process sump 42' to the indoor units 14, 16, 18. In this second mode of operation, which may be considered in some cases a “winter mode”, the refrigerant can optionally be pumped through a second condenser 54', and although not shown in Figure 4, the desiccant 34 can be pumped through both condensers 52', 54' to pick up additional heat.

[0035] Alternatively, the system 10 can be provided with solar collectors that are either physically attached or remotely operated to provide heat and/or electricity to the system 10. When this process is followed, the warm, dilute desiccant 34 is passed over the media 84—see Figure 3A—where moisture and heat are collected by the second airflow 86—see Figure 3B—prior to its being exhausted back into the ambient environment.

[0036] While exemplary embodiments are described above, it is not intended that these embodiments describe all possible forms of the invention. Rather, the words used in the

specification are words of description rather than limitation, and it is understood that various changes may be made without departing from the spirit and scope of the invention. Additionally, the features of various implementing embodiments may be combined to form further embodiments of the invention.

WHAT IS CLAIMED IS:

1. A system for conditioning air, comprising:
a first unit housing a regenerator operable to receive a first airflow and bring the first airflow into contact with a liquid desiccant to transfer water from the liquid desiccant to the first airflow, the regenerator including a regenerator sump for collecting the liquid desiccant after water is transferred to the liquid desiccant from the first airflow, the first unit further housing a first portion of a process sump fluidly connected to the regenerator sump; and
a second unit remotely located from the first unit and configured to receive a second airflow and bring the second airflow into contact with the liquid desiccant, the second unit housing a second portion of the process sump for collecting the liquid desiccant after it contacts the second airflow, the first unit being in selective fluid communication with the second unit such that the liquid desiccant can be selectively transferred between the first and second portions of the process sump, and the liquid desiccant transferred from the second portion of the process sump to the first portion of the process sump can be admixed with the liquid desiccant in the regenerator sump prior to the liquid desiccant being returned to the second unit.
2. The system of claim 1, wherein the regenerator sump and the first portion of the process sump are separated by a divider having an aperture disposed therein for facilitating diffusion of the liquid desiccant therebetween.
3. The system of claim 1, wherein the first unit is located outside a building and is configured to receive and exhaust the first airflow from and to an ambient outdoor environment, and the second unit is located inside the building and is configured to receive and exhaust the second airflow from and to an ambient environment inside the building.
4. The system of claim 1, wherein the first and second units are operable in a first mode of operation to transfer water from the second airflow to the liquid desiccant, and in a second mode of operation to transfer water from the liquid desiccant to the second airflow, when the second airflow is brought into contact with the liquid desiccant in the second unit.

5. The system of claim 4, wherein the regenerator is configured to be shut down during the second mode of operation to inhibit evaporation of water from the liquid desiccant in the regenerator sump.

6. The system of claim 4, wherein the first unit further houses at least a portion of a refrigeration system configured to selectively heat and cool the liquid desiccant through heat transfer with a refrigerant.

7. The system of claim 6, wherein the first unit houses at least an evaporator of the refrigeration system, and includes a first process pump configured to pump the liquid desiccant from the first portion of the process sump through the evaporator during the first mode of operation to transfer heat from the liquid desiccant to the refrigerant prior to the liquid desiccant being transferred to the second unit and brought into contact with the second airflow.

8. The system of claim 7, further comprising a bypass valve configured to return a portion of the liquid desiccant leaving the evaporator to the first portion of the process sump prior to the liquid desiccant being transferred to the second unit.

9. The system of claim 6, wherein the first unit includes a regenerator pump configured to pump the liquid desiccant from the regenerator sump through a condenser of the refrigeration system during the first mode of operation to receive heat from the refrigerant prior to being brought into contact with the first airflow.

10. The system of claim of claim 9, wherein the refrigeration system further includes a second condenser configured to further cool the refrigerant prior to an expansion phase of the refrigerant.

11. A system for conditioning air, comprising:
a first unit remotely located from an indoor space; and

a second unit located within the indoor space and in selective fluid communication with the first unit,

the first unit including a regeneration chamber into which a first airflow is introduced and contacted with a liquid desiccant to transfer water from the liquid desiccant to the first airflow, the regeneration chamber including a regenerator sump for collecting the liquid desiccant after water is transferred to the liquid desiccant from the first airflow,

the first unit further including a first process chamber separated from the regenerator chamber such that the first airflow is inhibited from entering the first process chamber, the first process chamber including a first portion of a process sump fluidly connected to the regenerator sump,

the second unit including a second process chamber into which a second airflow is introduced and contacted with the liquid desiccant to transfer water between the second airflow and the liquid desiccant prior to the second airflow being discharged into the indoor space, the second process chamber including a second portion of the process sump for collecting the liquid desiccant after it contacts the second airflow, the selective fluid communication between the first and second units providing selective transfer of the liquid desiccant between the first and second portions of the process sump.

12. The system of claim 11, further comprising a plurality of the second units, each located within a respective indoor space and each in selective fluid communication with the first unit.

13. The system of claim 11, wherein the regenerator chamber and the first process chamber are separated by a divider having an aperture disposed between the regenerator sump and the first portion of the process sump for facilitating diffusion of the liquid desiccant therebetween.

14. The system of claim 11, wherein the first and second units are operable in a first mode of operation to transfer water from the second airflow to the liquid desiccant, and in a second

mode of operation to transfer water from the liquid desiccant to the second airflow, when the second airflow is brought into contact with the liquid desiccant in the second unit.

15. The system of claim 14, wherein the first unit further houses at least a portion of a refrigeration system configured to selectively heat and cool the liquid desiccant through heat transfer with a refrigerant.

16. The system of claim 15, wherein the first unit houses at least an evaporator of the refrigeration system, the first process chamber including a first process pump configured to pump the liquid desiccant from the first portion of the process sump through the evaporator during the first mode of operation to transfer heat from the liquid desiccant to the refrigerant prior to the liquid desiccant being transferred to the second unit and brought into contact with the second airflow.

17. The system of claim 16, further comprising a bypass valve configured to return a portion of the liquid desiccant leaving the evaporator to the first portion of the process sump prior to the liquid desiccant being transferred to the second unit, thereby allowing the first portion of the process sump to retain the cooled desiccant.

18. The system of claim 17, wherein the regeneration chamber includes a regenerator pump configured to pump the liquid desiccant from the regenerator sump through a condenser of the refrigeration system during the first mode of operation to receive heat from the refrigerant prior to being brought into contact with the first airflow.

19. A method for conditioning air, comprising:
bringing a first airflow into contact with a liquid desiccant in a regeneration chamber to transfer water from the liquid desiccant to the first airflow during a first mode of operation;
collecting the liquid desiccant in a regenerator sump after water is transferred from the liquid desiccant to the first airflow;

admixing the liquid desiccant in the regenerator sump with liquid desiccant in a first portion of a process sump disposed in a first process chamber adjacent the regeneration chamber;

transferring some of the liquid desiccant from the first portion of the process sump to a second portion of the process sump disposed in a second process chamber located remotely from the first process chamber;

bringing a second airflow into contact with the liquid desiccant in the second process chamber to transfer water from the second airflow to the liquid desiccant during the first mode of operation; and

exhausting the second airflow from the second process chamber into an ambient environment having air to be conditioned, after the second airflow has contacted the liquid in the second process chamber.

20. The method of claim 19, further comprising inhibiting the first airflow from contacting the liquid desiccant in the regeneration chamber during a second mode of operation; and bringing a second airflow into contact with the liquid desiccant in the second process chamber to transfer water from the liquid desiccant to the second airflow during the second mode of operation.