



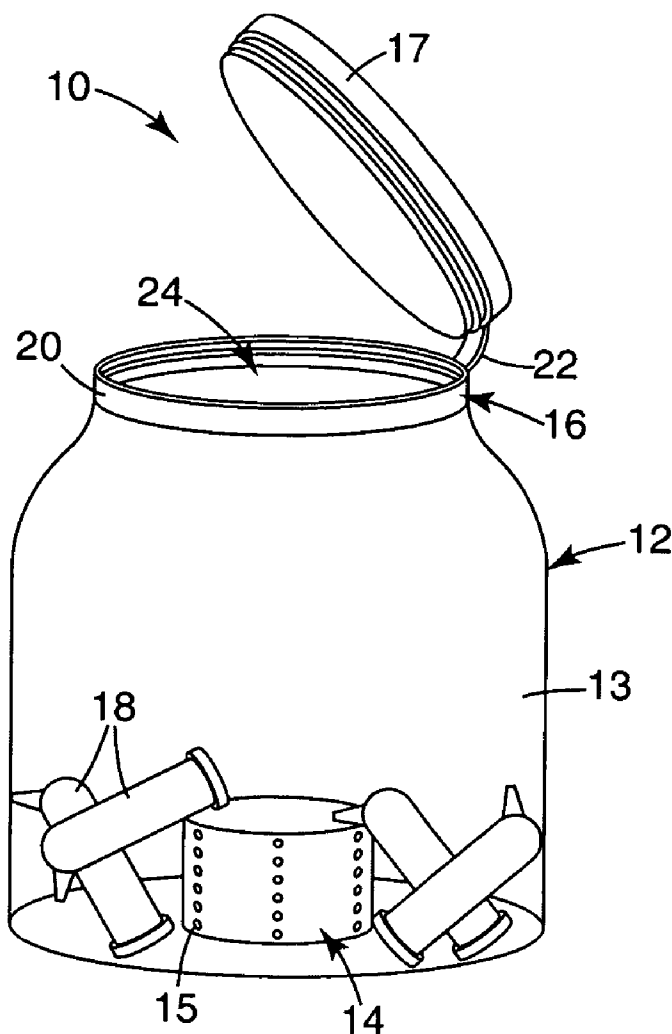
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(19) **United States**(12) **Patent Application Publication****Wu et al.**(10) **Pub. No.: US 2006/0144733 A1**(43) **Pub. Date: Jul. 6, 2006**(54) **CONTAINER ASSEMBLY AND METHOD
FOR HUMIDITY CONTROL****Publication Classification**(75) Inventors: **Dong Wu**, Woodbury, MN (US); **Brian
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ST. PAUL, MN 55133-3427 (US)**(57) **ABSTRACT**(73) Assignee: **3M Innovative Properties Company**(21) Appl. No.: **11/317,992**(22) Filed: **Dec. 22, 2005****Related U.S. Application Data**(60) Provisional application No. 60/640,558, filed on Dec.
30, 2004. Provisional application No. 60/640,975,
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A container assembly has a material storage container defining a sealed chamber therein. A quantity of moisture-sensitive material is disposed in the chamber. The moisture-sensitive material has a desired range of moisture content. A hydrated humidity control substance is also disposed within the chamber, and the humidity control substance is in humidity-transferable communication with the chamber. The humidity control substance regulates a relative humidity within the chamber in order to maintain a moisture content of the moisture-sensitive material within the desired range of moisture content.



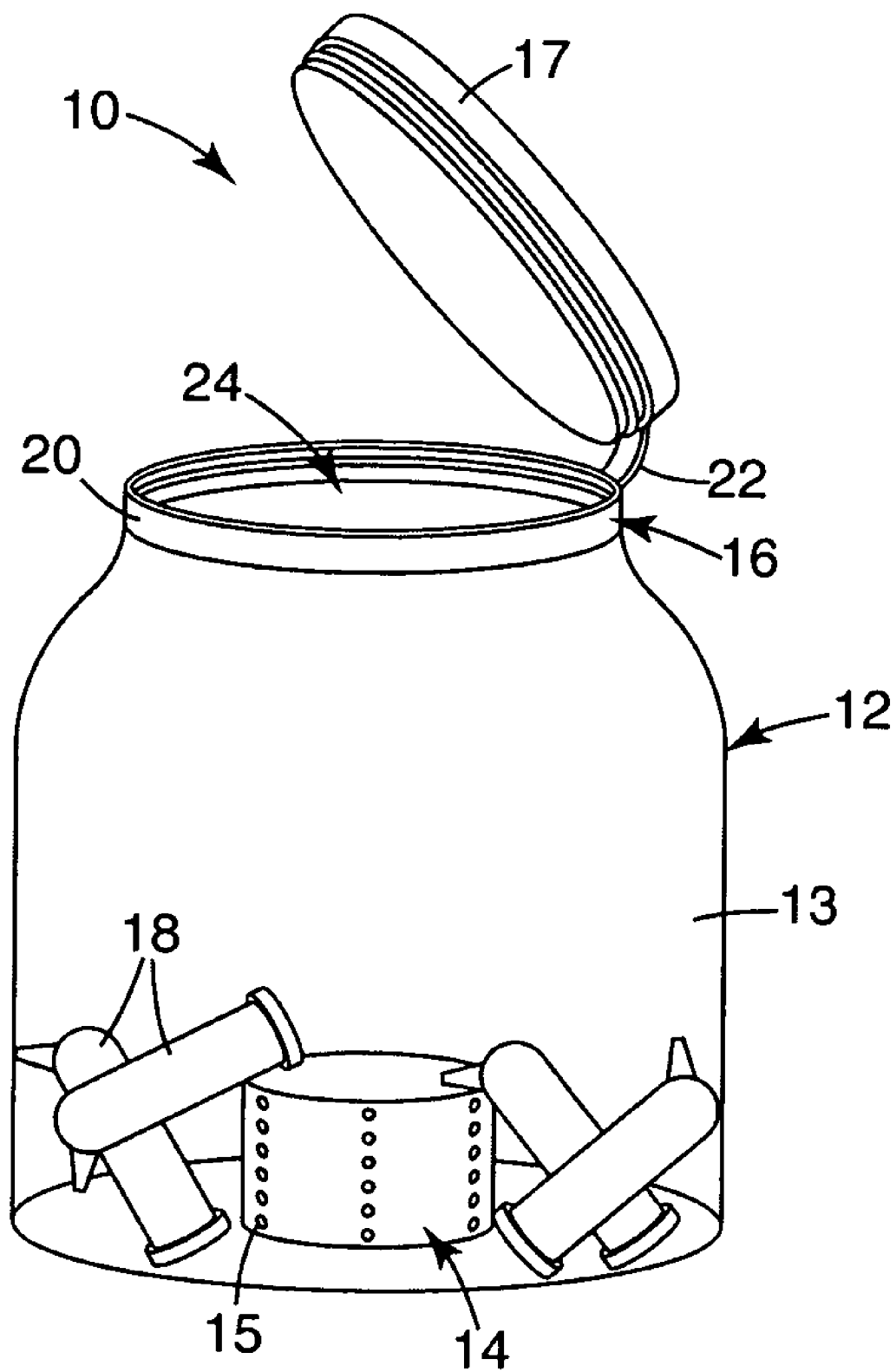


Fig. 1

CONTAINER ASSEMBLY AND METHOD FOR HUMIDITY CONTROL

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] This application claims the benefit of U.S. Provisional Application No. 60/640,558, filed Dec. 30, 2004 and U.S. Provisional Application No. 60/640,975 filed Jan. 3, 2005.

BACKGROUND OF THE INVENTION

[0002] The present invention relates to a container and method for retaining a moisture-sensitive material. More specifically, the present invention relates to a container that has a moisture-sensitive material and a humidity control substance, where the humidity control substance regulates a relative humidity within a chamber of the container in order to help the moisture-sensitive material maintain a desired range of moisture content.

[0003] Moisture-sensitive materials, such as pharmaceutical products, are often stored in hermetically and water-proof resealable containers. When opened for access to those materials, however, there may be an exchange of moisture between the air inside the container and the air outside the container. There may also be an exchange of moisture between the air inside the container and the air outside the container if there is an air leak in the container. The exchange of moisture may adversely affect the properties of the moisture-sensitive material stored in the container. The quality of moisture-sensitive material may be affected if the moisture level (also known as the "humidity level") of the air inside the container falls below or rises above a desired level, in part because the moisture content of the moisture-sensitive material may change. For this and other reasons, many manufacturers place an off-the-shelf humidity control substance in the container to act as a desiccant and adsorb any excess moisture from the air inside the container.

[0004] The desiccant may be any material that adsorbs moisture from the air, such as, but not limited to wood, cotton, bentonite clay, silica gel, montmorillonite clay, molecular sieve, calcium oxide, calcium sulfate, glycerol, sorbitol, sodium PCA, or propylene glycol. The desiccant may be used to help keep the air inside the container at or below a desired moisture level by removing excess moisture from the air inside the container.

[0005] The desiccant may be placed directly in a chamber of a material storage container so that there is nothing separating the desiccant substance from the moisture-sensitive material. However, the desiccant is often packaged in a container ("inner container" or "canister") that has holes in it or a membrane designed to allow moisture into or out of the inner container and keep the desiccant (often in particle form) from leaking out of the inner container. The inner container may be formed of a rigid or non-rigid material. The inner container is usually placed inside a chamber of the material storage container, in order for the desiccant to be in humidity transferable communication with the chamber (and hence, the moisture-sensitive materials stored therein).

[0006] Off-the-shelf inner containers having a desiccant to adsorb any excess moisture from the air inside the chamber of the material storage container have been used. An "off-

the-shelf" inner container being an inner container containing a preset amount of desiccant, where the desiccant has a preset moisture content. When an off-the-shelf inner container is used, the manufacturer or bottler of the moisture-sensitive material has little control over the moisture level inside the chamber of the material storage container, and the manufacturer or bottler can only maintain a generally dry environment. This may be undesirable if the moisture-sensitive material needs to be stored at a specific moisture level in order to maintain its quality and/or if the moisture-sensitive material is readily affected by a large change in moisture level.

BRIEF SUMMARY OF THE INVENTION

[0007] The present invention is a container assembly for retaining a moisture-sensitive material. The container assembly has a container defining a sealed chamber. A humidity control substance is disposed within the chamber of the container and is in humidity-transferable communication with the chamber. The humidity control substance regulates a relative humidity within the chamber of the container in order to help the moisture-sensitive material maintain a desired range of moisture content.

[0008] In one aspect, the present invention is a container assembly including a container defining a sealed chamber therein, a quantity of moisture-sensitive material for healthcare use disposed in the chamber, the moisture-sensitive material having a desired range of moisture content, and a hydrated humidity control substance disposed within the chamber. The humidity control substance is in humidity-transferable communication with the chamber and regulates a relative humidity within the chamber in order to maintain a moisture content of the moisture-sensitive material within the desired range of moisture content.

[0009] In another aspect, the present invention is a method for controlling a relative humidity inside a container for retaining a moisture-sensitive material for healthcare use. The method includes hydrating a humidity control substance to a desired moisture content, introducing the humidity control substance into a chamber of the container in a humidity controlled environment, introducing the moisture-sensitive material into the chamber of the container in the humidity controlled environment, and sealing the container.

[0010] The above summary of the present invention is not intended to describe each disclosed embodiment or every implementation of the present invention. The FIGURE and the detailed description that follow more particularly exemplify illustrative embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The present invention will be further explained with reference to **FIG. 1**, which is a perspective view of an exemplary embodiment a container assembly in accordance with the present invention.

[0012] While the above-identified FIGURE sets forth one embodiment of the invention, other embodiments are also contemplated, as noted in the discussion. In all cases, this disclosure presents the invention by way of representation and not limitation. It should be understood that numerous other modifications and embodiments can be devised by those skilled in the art, which fall within the scope and spirit of the principles of the invention.

DETAILED DESCRIPTION

[0013] The present invention is a container assembly having a material storage container for retaining a moisture-sensitive material, where a desired moisture level is controlled inside a chamber of the container by a humidity control substance. The humidity control substance regulates the moisture level inside the chamber of the container (i.e., buffers changes in moisture level) in order to maintain a moisture content of the moisture-sensitive material within a desired range of moisture content. The moisture-sensitive material may be any healthcare-related material, including, but not limited to, pharmaceutical products, medical products and devices, or dental materials or products, such as, but not limited to one or more capsules containing a dental material composition or dental materials, such as, but not limited to, glass ionomers, resin modified glass ionomers, dental adhesives, orthodontic adhesives, cements, restoratives, coatings, varnishes, sealants, and/or composite crowns.

[0014] The moisture level or humidity level is often expressed in terms of relative humidity ("RH"). Relative humidity may be defined as the ratio of the water vapor density of the air to the saturation water vapor density of the air, and is usually expressed in percent.

[0015] Many moisture-sensitive materials contain moisture, and thus have a moisture content. The moisture content is the weight of water in a material expressed as a percentage of its dry weight. If the moisture-sensitive material is hygroscopic, the moisture content may differ depending upon the temperature and/or the RH of the air surrounding the moisture-sensitive material. If the temperature or the RH of the surrounding air changes, the moisture content of the moisture-sensitive material may change so that it will come into equilibrium with the new condition of the surrounding air.

[0016] If the moisture content of the moisture-sensitive material falls below a desired level, the properties and quality of the moisture-sensitive material may be adversely affected. The present invention addresses the problems that may arise with a change in moisture content of a moisture-sensitive material due to a change in RH of the air surrounding the moisture-sensitive material when the moisture-sensitive material is stored in a material storage container of a container assembly. The present invention allows storage of moisture-sensitive materials in a material storage container assembly that has a RH that remains within a desired range.

[0017] If there is an exchange of air between a material storage container and the air surrounding the container due to air leakage or another reason, the RH inside a chamber of the material storage container may increase or decrease, depending upon the RH of the air surrounding the container. For example, if the RH inside the chamber is lower than the RH surrounding the container and there is an exchange of air, the RH inside the chamber may increase. Similarly, if the RH inside the chamber is higher than the RH surrounding the container and there is an exchange of air, the RH inside the chamber may decrease. The amount of the increase or decrease in RH inside the chamber of the container depends upon the amount of air that is exchanged. The increase or decrease in RH inside the chamber of the container may adversely affect the quality and shelf-life of the moisture-sensitive material stored in the chamber of the container

because the moisture-sensitive material within the chamber may gain or lose some moisture content in order to remain in equilibrium with the RH of the air inside the chamber.

[0018] It may be preferred to store moisture-sensitive material (whether for shipping, storing, and/or during use), such as dental capsules 18 of FIG. 1, in an environment having a stable RH in order to limit the gain or loss of moisture content of the moisture-sensitive material. In an exemplary embodiment of the present invention, a stable RH is defined as a humidity level that stays within 10% of the desired RH. However, a stable humidity level may differ depending upon many variables, including the type of moisture-sensitive material that is to be stored in the container. A person skilled in the art may modify the desired stable RH.

[0019] A humidity control substance may be used to regulate the RH of the air inside the chamber in order to address the problems that may be associated with the possible gain or loss of moisture content of the moisture-sensitive material that arise with a change in RH of the air inside the chamber. The humidity control substance may be any material that adsorbs moisture from the air and/or any hygroscopic ("water-pulling") material that promotes retention of moisture, such as, but not limited to, wood, cotton, bentonite clay, silica gel, montmorillonite clay, molecular sieve, calcium oxide, calcium sulfate, glycerol, sorbitol, sodium PCA, or propylene glycol. The humidity control substance may be used to help the moisture-sensitive material maintain its moisture content by either adding or subtracting moisture to the air inside the container in order to maintain a stable RH. When the humidity control substance subtracts moisture from the air inside the container, it acts as a desiccant; when the humidity control substance adds moisture to the air inside the container, it acts as a humectant.

[0020] The humidity control substance buffers RH changes within a container of a container assembly during shipping and storage of the moisture-sensitive material. In this way, the humidity control substance helps the moisture-sensitive material retain its moisture content within a desired range of moisture content. By helping the moisture-sensitive material retain its moisture content, the humidity control substance may help the moisture-sensitive material retain its properties as well as extend a shelf-life of the moisture-sensitive material, even if the container is opened and closed numerous times. A preferred buffering range for the humidity control substance is a range between about 10% RH to about 100% RH. A buffering range for a humidity control substance is the range of RH for which the humidity control substance can buffer RH changes, either by releasing moisture into the air inside the container or by adsorbing moisture from the air inside the container. The buffering range of a humidity control substance depends on the buffering capacity, M_H , at different RH values, and most humidity control substances have an "optimum" RH range in which the M_H value is high. In order to provide effective RH control ("buffering effect"), it is preferred that the humidity control substance have a high M_H value over the desired RH range for the particular moisture-sensitive material being stored. It is preferred that a container assembly in accordance with the present invention be used for storing moisture-sensitive materials that should be stored at an RH between about 10% to about 100% RH. A more preferred buffering range is

about 30% RH to about 75% RH. A most preferred buffering range is about 30% RH to about 60% RH.

[0021] The amount of humidity control substance that should be used in the container assembly may be calculated by first estimating a maximum expected amount of potential moisture loss (or a value close to the maximum) that the humidity control substance needs to compensate for. The maximum expected amount of potential moisture loss is the maximum amount expected for the particular container in the conditions in which the container assembly is reasonably expected to be used. The amount of potential moisture loss (W_{WATER}) for the particular in the particular conditions is calculated as a function of the moisture concentration (in grams per pound of dry air) at the minimum tolerated RH inside the container (C_{INSIDE}), the moisture concentration (in grams per pound of dry air) at the RH of the air surrounding the container (C_{OUTSIDE}), and the time the container assembly is reasonably expected to be used to store the moisture-sensitive material (T). Moisture concentration is measured as a function of the absolute humidity of the air being measured. Both C_{INSIDE} and C_{OUTSIDE} depend upon the temperature of the air inside and outside the container, respectively. Similarly, the minimum tolerated RH of the air inside the container also depends upon the temperature inside the chamber of the container because moisture level in the air is dependent on temperature.

[0022] The following formula may be used to calculate the potential moisture loss that the humidity control substance may need to compensate for:

$$W_{\text{WATER}} = K(C_{\text{INSIDE}} - C_{\text{OUTSIDE}}) \times T$$

K is the moisture transmission constant of a specific container, and for the first exemplary embodiment, K is calculated as 8.2×10^{-6} (pound of dry air/day). Those skilled in the art can calculate K for a container that is to be used in a particular container assembly. It may not be possible to accurately calculate the moisture concentration of the air surrounding the container (C_{OUTSIDE}) because the exact conditions in which the container will be shipped, stored, and/or used may not be known. However, for purposes of estimating the maximum (or near maximum) potential moisture loss inside the chamber of the container, C_{OUTSIDE} may be estimated by estimating the RH and temperature of the air outside the container at which the moisture content is near the lowest possible moisture content at which the container will be shipping, stored, and/or used.

[0023] After the potential moisture loss of the air inside the chamber is calculated, the amount of humidity control substance that should be used can be calculated using the following formula:

$$W_{\text{HCS}} = (W_{\text{WATER}} [M_{\text{H}} (RH_{\text{START}} - RH_{\text{END}})]) \times 1000.$$

[0024] W_{HCS} is the quantity of the humidity control substance (e.g., silica gel) that should be used in order to help maintain a desired RH range in the chamber of the container, W_{WATER} is the amount of potential moisture loss inside the chamber that was calculated using the formula discussed above, and M_{H} , the buffering capacity of a humidity control substance, which may differ depending upon the type of humidity control substance used. Specifically, M_{H} is the average amount of water (in grams) that is gained or lost by one kilogram (kg) of the humidity control substance for each one percent change in RH. A M_{H} value may also depend

upon the range of RH the humidity control substance is regulating. For example, a regular density silica gel has a higher M_{H} when it is buffering a RH range having a maximum RH at or below about 60% RH. RH_{START} is the RH inside the chamber of the container when the moisture-sensitive material is first placed inside the chamber. RH_{END} is the minimum tolerated RH the moisture-sensitive material may be stored at before its quality is affected.

[0025] Either before or after the amount of humidity control substance that is required is calculated and measured out, the humidity control substance may be hydrated (or "conditioned") to a desired moisture content. The humidity control substance may be hydrated prior to being introduced into the chamber of the container. The proper moisture content of the humidity control substance is usually a moisture content which will allow the humidity control substance to maintain a RH of the air inside the chamber of the container within a range of desired RH, which is also, typically, the approximate range of RH at which the moisture-sensitive material should be stored in order to maintain its desired range of moisture content. The desired moisture content of the humidity control substance will differ depending upon the desired RH range and the buffering capacity of the humidity control substance. In the present invention, the moisture content of the humidity control substance may depend on the RH level at which it is hydrated because different humidity control substances may adsorb different quantities of moisture at the same RH level. If it is known that the container assembly is going to be shipped, stored, and/or otherwise used in a dry environment, the humidity control substance should probably be hydrated to a moisture level that will provide near the top of the desired RH range because it is likely that the container will lose more moisture to the surrounding air than if the container were shipped, stored, and/or otherwise used in a more humid environment.

[0026] One method of hydrating the humidity control substance is by placing the humidity control substance in a constant humidity environment, such as a sealed room or oven, where the humidity of the environment is set within the desired RH range. The humidity control substance should be left in the constant humidity environment long enough for the humidity control substance to become sufficiently hydrated. After the humidity control substance is removed from the constant humidity environment, its moisture content may be measured or tested to ensure the humidity control substance has been sufficiently hydrated. The moisture content of the humidity control substance is measured by placing the humidity control substance in a sealed space with a measuring instrument, such as a hygrometer. If the humidity control substance is not sufficiently hydrated, the hydrating process may be repeated; the humidity control substance may be placed in the constant humidity environment again and retested until the humidity control substance has the correct moisture content. The resulting moisture content of the humidity control substance will differ depending upon the type of humidity control substance used because, as stated above, different humidity control substances will adsorb different quantities of moisture at the same RH level.

[0027] If a hydrated humidity control substance has a moisture content that provides a higher than proper RH for the particular container assembly, the humidity control substance may be dried, such as by using an oven. If after the

drying process, the humidity control substance has a finite moisture content, i.e. it is not “bone dry”, it may still be considered “hydrated”. In the present invention, a “hydrated” humidity control substance is any humidity control substance that has a moisture content that allows it to buffer a RH range between about 10% RH to about 100% RH.

[0028] For moisture-sensitive materials that should be stored at around 40%-60% RH, such as dental capsules **18** of **FIG. 1**, silica gel is a preferred humidity control substance. The most optimum buffering range for silica gel is between 40-60% RH. That is, silica gel has relatively high M_H at a RH between about 40% to about 60%. Silica gel is a porous, granular, chemically inert, amorphous form of silicon dioxide, which is capable of adsorbing and desorbing water vapor in order to reach equilibrium with the surrounding air. Furthermore, most silica gels have an infinite life in terms of the ability to adsorb or desorb moisture, and may be reconditioned and reused indefinitely. There are many different types of silica gel that may be used in the present invention. Those skilled in the art may select a silica gel based upon the silica gel's buffering capacity, the type of container assembly, and/or the type of moisture-sensitive material that is going to be stored in the container assembly.

[0029] Different configurations of silica gel may be used for purposes of regulating a RH in a container assembly. For example, loose silica gel may be used in the container assembly, or the silica gel may be contained in an inner container, such as a flexible packet or a rigid container, which is then introduced into a chamber of a container of the container assembly. If loose silica gel is used, a membrane may be used to isolate the loose silica gel from the moisture-sensitive material stored in the bottle. A rigid container may be a tin or canister. The different configurations of silica gel may also apply to all humidity control substances in accordance with the present invention. In the present invention, a preferred configuration of silica gel for use in a container assembly for retaining moisture-sensitive materials that should be stored at around 40%-60% RH is silica gel contained in a canister. However, any other configuration may also be used.

[0030] Fungal growth may also be a concern when storing moisture-sensitive materials in a humid environment. Fungi generally require at least 60%-65% RH for growth. Thus, the container assembly of the present invention should not support fungal growth as long as the RH in the chamber of the container remains lower than about 60%.

[0031] **FIG. 1** is a perspective view of an exemplary embodiment of a container assembly in accordance with the present invention. Container assembly **10** is formed of container **12**, canister **14**, and cap **16**. Container assembly **10** may be used for storing a healthcare-related moisture-sensitive material, such as, but not limited to a pharmaceutical product, medical product, medical device, or dental product. Examples of dental products that may be used in accord with the present invention include one or more capsules containing a dental material composition, glass ionomers, resin modified glass ionomers, dental adhesives, orthodontic adhesives, cements, restoratives, coatings, varnishes, sealants, and/or composite crowns. More particularly, the moisture-sensitive material may be stored in chamber **13**, which is defined by cap **16** and the bottom and side

walls of container **12**. In the embodiment shown in **FIG. 1**, chamber **13** is sealed by cap **16**.

[0032] Container **12** and canister **14** may be formed of any material that does not react with the moisture-sensitive contents of chamber **13**, such as, but not limited to, a plastic material or a glass material. Container **12** and/or canister **14** may also be formed of a transparent material (as shown for container **12** in **FIG. 1**). Container **12** and canister **14** may also be formed of the same material, but it is not required for the present invention. Although container **12** is shown to be formed in a cylindrically-shaped bottle, container **12** may be formed in any other shape, such as, but not limited to, a square or rectangular box.

[0033] A plurality of dental capsules **18** are stored in chamber **13** of container **12**. An example of dental capsules **18** that may be stored in the chamber of the container of the present invention is 3M ESPE Z100 MP Restorative System, available from 3M Company, St. Paul, Minn., which is sold as nylon capsules containing dental restorative filling material. Nylon capsules containing dental restorative filling material should be stored at a RH within a range of about 40% RH to about 60% RH. Although **FIG. 1** shows a plurality of dental capsules **18** stored in container assembly **10**, any type of healthcare-related moisture-sensitive material may be used with the present invention, including pharmaceutical products, medical products, medical devices, and other dental products (or materials), such as, but not limited to, glass ionomers, resin modified glass ionomers, dental adhesives, orthodontic adhesives, cements, restoratives, coatings, varnishes, sealants, and/or composite crowns. If a glass ionomer or resin modified glass ionomer is stored in container **12**, it is preferred that chamber **13** of container **12** have a RH in a range of about 70% to about 90%.

[0034] A humidity control substance may be stored in canister **14**. Canister **14** may also be known as an “inner container”. Canister **14** of **FIG. 1** is formed in a cylindrical shape. However, canister **14** may be any shape and/or size that minimizes interference with the transfer of dental capsules **18** into or out of chamber **13** of container **12**. It may also be preferred to size canister **14** such that it is not easily removable from container **12**. In an alternate embodiment, canister **14** may be formed of a flexible material, such as in a pillow-shaped pouch.

[0035] The air inside chamber **13** may be set at a desired RH at the time the moisture-sensitive material is deposited inside chamber **13**. As container assembly **10** is used, the RH inside chamber **13** may change, depending upon many factors, including how many times cap **16** is opened and closed, the amount of air that leaks through a joint defined by cap **16** and container **12**, and the RH of the air outside of container **12**. Even before container assembly **10** is opened by a consumer, the RH of the air inside chamber **13** may change. For example, if a seal is formed under cap **16** (such as a foil layer) or over cap **16** after moisture-sensitive material is “bottled” inside container **12** (where the seal is to be broken or removed by the consumer when container assembly **10** reaches the consumer), some moisture may still leak through the seal.

[0036] In general, if the RH of the air surrounding container **12** is not the same as the RH inside chamber **13** and there is air leakage, moisture may transfer between chamber

13 and the surrounding air. Not only may air transfer through possible leaks in the joint between cap 16 and container 12, air may also transfer when cap 16 is opened (through self-sealing flip-top 17 or otherwise), which may cause the RH inside chamber 13 to increase or decrease beyond the desired RH range. An increased or decreased RH inside chamber 13 may compromise the quality of dental capsules 18 contained in chamber 13. The humidity control substance may be used to address an excess or insufficient moisture problem by giving up moisture to a drier atmosphere and absorbing moisture from a humid atmosphere. More specifically, the humidity control substance inside canister 14 may be used to address an excess moisture problem by adsorbing some or all of the excess moisture to regulate the RH inside chamber 13 within a desired range. That is, if the RH in chamber 13 of container 12 exceeds a certain level, the humidity control substance will adsorb the excess moisture. Similarly, the humidity control substance may also release moisture into chamber 13 if the RH inside chamber 13 falls below a desired RH range. In this way, the humidity control substance may be used to help dental capsules 18 retain their moisture content by maintaining a desired range of RH in chamber 13. In this way, the humidity control substance buffers RH changes inside chamber 13.

[0037] A plurality of openings 15 in canister 14 provide a channel for humidity transferable communication between the humidity control substance and chamber 13. That is, openings 15 allow the humidity control substance to either extract or input moisture into chamber 13 of container 12. Openings 15 may be shaped such that the humidity control substance (often in particle form) does not leak from canister 14, or another mechanism may be provided to prevent such leakage, such as a permeable membrane. It may be important to keep substantially all of the humidity control substance sealed in canister 14, because if the humidity control substance contacts dental capsules 18 (or other moisture-sensitive material), the quality of dental capsules 18 may be compromised. The humidity control substance contained in canister 14 helps to keep the dental capsules 18 fresher and may also extend a shelf-life of dental capsules 18, even if container 12 is opened and closed numerous times. The humidity control substance should be designed to maintain the environment inside container 12 at the desired moisture level for as long as container assembly 10 is reasonably expected to be used to store the dental capsules 18.

[0038] Cap 16 provides a selectively resealable opening for access to chamber 13. Cap 16 may be formed of any material that does not react with the moisture-sensitive contents of chamber 13, such as, but not limited to, a plastic material or a glass material. Cap 16 does not necessarily have to be formed of the same material as container 12. In one embodiment, cap 16 has a flip top 17 that is connected to main body 20 of cap 16 by flexible connection 22. Flexible connection 22 may be any connection that allows flip top 17 to be opened and closed a plurality of times without breaking, such as, but not limited to, a living hinge. Flip top 17 allows container 12 to be selectively resealed once it has been opened. When flip top 17 is lifted (as shown in FIG. 1), opening 24 is exposed, and a consumer may extract dental capsules 18 contained in chamber 13 of container 12 through opening 24. Flip top 17 allows a user to easily access the contents of container 12 without removing cap 16.

[0039] Cap 16 may be attached to container 12 by any method known in the art. For example, cap 16 may be "popped" onto container 12 by an interference friction fit, or cap 16 may be a twist-on cap. Although FIG. 1 shows container assembly 10 having cap 16 with flip top 17, cap 16 may be any resealable mechanism. For example, cap 16 may just twist on without having a flip-top. However, a flip-top arrangement may reduce the possibility of a consumer losing cap 16 because cap 16 does not have to be removed in order to access the contents of container 12.

[0040] In the embodiment shown in FIG. 1, it is preferred that dental capsules 18 containing a dental composite material be stored in a container assembly having a RH range of about 30% RH to about 50% RH. Assuming one or more 3M ESPE Z100 MP Restorative System capsules are stored in container 12, container 12 has a volume of about 60 cubic centimeters, the RH outside container 12 is 15% at 25° C., the minimum tolerated RH inside container 12 is 30% at 25° C., K for container 12 is 8.2×10^{-6} (pound of dry air/day) and container 12 is reasonably expected to be used for 180 days, the potential moisture loss of container 12 the silica gel contained in canister 14 may need to compensate for (W_{WATER}) in order to store dental capsules 18 such that dental capsules 18 retain a desired range of moisture content, is calculated using the formula discussed above ($W_{\text{WATER}} = K(C_{\text{INSIDE}} - C_{\text{OUTSIDE}}) \times T$):

$$W_{\text{WATER}} = [(8.2 \times 10^{-6})(41.9 \text{ grams/pound of dry air} - 20.9 \text{ grams/pound of dry air})] \times 180 \text{ days} = 0.031 \text{ grams}$$

[0041] Using the amount of potential moisture loss, the quantity of silica gel that should be used in order to help maintain a desired RH range in chamber 13 of container 12 for can be calculated using the following table (which is also discussed above): $W_{\text{HCS}} = (W_{\text{WATER}} / [M_{\text{H}}(RH_{\text{START}} - RH_{\text{END}})]) \times 1000$. For purposes of the calculation, RH_{START} is 50% RH, where RH_{START} is the RH inside chamber 13 of container 12 when dental capsules 18 are introduced into chamber 13, and RH_{END} is 30% RH, where RH_{END} is the minimum tolerated RH dental capsules 18 may be stored at before their quality is affected.

[0042] The quantity of silica gel will differ depending upon M_{H} , the buffering capacity of the type of silica gel used. The following table shows the minimum quantity of silica gel (which is dried before hydration) needed for three different types of silica gel having three different buffering capacities:

TABLE 1

Quantity of Silica Gel		
Type of Silica Gel	M_{H}	W_{HCS} (in grams)
Type A	2.0	0.78
Type B	4.5	0.34
Type C	8.7	0.178

[0043] Either before or after the amount of silica gel that is required is measured out, the silica gel may be hydrated if necessary. As discussed above, the silica gel may be hydrated by placing the silica gel in a constant humidity room set at a desired RH.

[0044] Although the present invention has been described with reference to preferred embodiments, workers skilled in

the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.

1. A container assembly comprising:
a container defining a sealed chamber therein;
a quantity of moisture-sensitive material for healthcare use disposed in the chamber, wherein the moisture-sensitive material has a desired range of moisture content; and
a hydrated humidity control substance, wherein the humidity control substance is disposed within the chamber and is in humidity-transferable communication with the chamber, and wherein the humidity control substance regulates a relative humidity within the chamber in order to maintain a moisture content of the moisture-sensitive material within the desired range of moisture content.
2. The container assembly of claim 1, wherein the humidity control substance is a silica gel.
3. The container assembly of claim 2, wherein the silica gel is a buffered silica gel.
4. The container assembly of claim 1, wherein the humidity control substance has a preferred buffering range of between 10 percent to about 100 percent relative humidity.
5. The container assembly of claim 4, wherein the humidity control substance has a preferred buffering range of between 30 percent to about 75 percent relative humidity.
6. The container assembly of claim 4, wherein the humidity control substance has a preferred buffering range of between about 30 percent to about 60 percent relative humidity.
7. The container assembly of claim 1, wherein the moisture-sensitive material is a dental material.
8. The container assembly of claim 7, wherein the dental material is selected from a group consisting of glass ionomers, resin modified glass ionomers, dental adhesives, orthodontic adhesives, cements, restoratives, coatings, varnishes, sealants, and composite crowns.
9. The container assembly of claim 7, wherein the moisture-sensitive material is one or more capsules, each capsule containing a dental composition therein.
10. The container assembly of claim 1, wherein the container can be opened and is selectively resealable.

11. The container assembly of claim 1 wherein the container has a single opening for access to the chamber therein, and wherein the container has a cap for resealably covering the opening.

12. The container assembly of claim 11 wherein the cap is flexibly attached to the container.

13. A method for controlling a relative humidity inside a container, where the container is for retaining a moisture-sensitive material for healthcare use, the method comprising:

hydrating a humidity control substance to a desired moisture content;

introducing the humidity control substance into a chamber of the container in a humidity controlled environment;

introducing the moisture-sensitive material into the chamber of the container in the humidity controlled environment; and

sealing the container.

14. The method of claim 13, wherein the step of hydrating comprises:

selecting a desired relative humidity of the chamber of the container as a function of the moisture-sensitive material to be stored in the chamber of the container;

selecting a desired moisture content of the humidity control substance as a function of the desired relative humidity of the chamber of the container;

placing the humidity control substance in a constant humidity environment, where the environment is set at the desired relative humidity;

removing the humidity control substance from the constant humidity environment and placing the humidity control substance in a sealed space; and

testing a moisture content of the humidity control substance to determine whether the humidity control substance has the desired moisture content.

15. The method of claim 13 wherein, prior to introducing the humidity control substance into the chamber of the container, an amount of humidity control substance that should be used in the container is determined by estimating a potential moisture loss from the container.

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