

DESCRIPTION

Titel

THERMO-PROTECTION-STORAGE-CELL FOR COLD TRANSPORT-BOX

Technical area

0001 The invention concerns a thermo-protection-storage-cell (short: thermo-cell) analogous to the generic term of an independent claim 1 as well as a transport-box with this kind of thermo-protection-storage-cell and the use of it.

0002 Thermo-cells with a thermo-cell body and at least one filling chamber which is positioned in the thermo-cell body, can be used for the ensuring of a temperature range from a lower temperature exposure limit to an upper temperature exposure limit.

State of the art

0003 For the ensuring of goods in a temperature range which is preferred or even needed for it, different kinds of equipment are used nowadays. Among other things, there is the possibility of using cold boxes or rather cold transport-boxes to transport goods. Often it is enormously important that the demanded temperature range is guaranteed during the whole transport when transporting pharmaceuticals and particularly biopharmaceuticals. If the temperature range cannot be ensured, these pharmaceuticals may not be used.

0004 Examples of known cold transport-boxes 10 are shown in fig. 3, 4 and 5. These cold transport-boxes 10 are basically constructed similarly to each other. Usually they comprise a set of warmth- 11 and cold energy storage cells 12 as simple constructions of thermo-cells which wrap up the good 13 inside the internal space 14 such as biopharmaceuticals or classical pharmaceuticals or groceries. The wrapped-up internal space 14 is used to ensure that the temperature of the good is e.g. from 2 to 8 degrees Celsius. Other layers are an insulation 15 placed outside the warmth – and cold energy storage cell 11, 12 an outer corrugated cardboard-box 16. If the entire weight exceeds the weight of 30 kg, a wooden pallet is used as a stabilization and simplification of the handling.

0005 These solution approaches are known in the state of art: One is the possibility of separated warmth- and cold energy storage cell 11, 12 shown in fig. 3 and 4 and the second is a warmth-cold-combination-cell shown 11/12 in fig. 5.

0006 The first solution is to fill up the warmth energy storage cell which must be pre-conditioned in a cold storage room with 5 degrees Celsius either with paraffin or with water. The cold energy storage cell which is filled with water is pre-conditioned in the freezer to -20 degrees Celsius respectively -10 degrees Celsius.

0007 The second solution is to fill up the warmth-cold-combination-cell which has to be pre-conditioned in a high-precision cold storage room with 3.5 degrees Celsius to ± 0.5 degrees Celsius with paraffin.

0008 The separated warmth- and cold energy storage cells in the first solution have a high difference in temperature which can lead to a cannibalization of the thermal-performance of transport-box. If e.g. a cold transport-box is left behind at an airport cargo terminal or a customs clearance for several days, the pharmaceuticals freeze and cannot be administered to patients.

0009 The disadvantage of the second solution is the division of the thermal performance into cooling and heating. A other disadvantage of this solution is the costly, precise pre-conditioning as well as the paraffin variation of composition.

0010 Both of the described solutions of the state of the art comprise typically the ecological and the economical weak point that the different used cold transport-boxes as well as the thermos-cells are not reusable and need to be disposed after using.

0011 The purpose of the new invention is the efficient and secure ensuring of a temperature-sensitive good in a simple and useful way particularly during the transport in a certain temperature range.

Description of the invention

0012 According to the invention the task is solved with a thermo-cell which is defined through the characteristics of the independent claim 1 as well as with a cold box which is defined through characteristics of the independent claim 10. Advantageous execution varieties of invention are the result of the dependent claims.

0013 The base of the invention consists of the following: A thermo-cell for the ensuring of the temperature range from a lower temperature exposure limit to a upper temperature exposure limit

consists of a thermo-cell body and at least one filling chamber which is positioned in the thermo-cell body. The filling chamber is filled with a first phase-change material (short: pcm) which changes its phase at the lower point of temperature. The at least one filling chamber is filled in addition with a second phase-change material which changes its phase at the upper point of temperature.

00014 The term “phase” in context with the pcm can refer as an aggregate phase of the pcm. The terms “phase” and “aggregate phase” can be used synonymous.

0015 The term “ensuring” in the context with the invention can refer to a keeping in certain conditions during a certain period of time. These certain conditions contain the temperature at which a temperature-sensitive good should be kept. The ensuring can refer to a certain period of time in which a good should be kept in a certain range of temperature e.g. which is needed for transport.

0016 The term “temperature-sensitive good” can refer to an object respectively a material which is damaged in composition or quality when kept outside its demanded temperature range. The quality can be damaged when kept outside its demanded temperature range during a certain period of time. The temperature-sensitive good can be e.g. a pharmaceutical and especially a biopharmaceutical.

0017 The thermo-cell body can be made of e.g. a solid material like polyethylene or similar.

0018 The at least one filling chamber can take the pcm safely. It should contain a tamper-evident safety seal which can guarantee the originality of the pcm. A manipulation of the pcm can therefore be prevented.

0019 The invention uses a warmth-cold-combination cell which can be used in a cold transport-box respectively transport-box respectively cold-box. According to the invention's at least one filling chamber concurrent can be equipped with a warmth-cold protective function.

0020 The lower temperature differs typically from the upper temperature. The upper temperature is higher than the lower temperature. Therefore, the temperature range can be established with subtracting the lower temperature from the upper temperature. Typical pcm can be aqueous saline solutions, water, salt-hydrates and paraffines which consists of alkanes.

0021 The invention uses the comparatively high latent heat of fusion, heat of solution or heat of absorption whilst using the enthalpy of the pcm aggregate phase change for the protective purposes of the good. The use of the enthalpy with the phase transition between e.g. solid and liquid is reversible thermodynamic process with a high no-degradation after a large number of freeze/melt cycle. The enthalpy can be measured with differential scanning calorimetry in J/g shown in fig. 2. If

the storage temperature of the good is fixed to a certain range of temperature, the ensuring in the thermo-cell respectively a transport within must be in the same temperature range.

0022 This is how the maximum and minimum barrier temperature respectively the upper and the lower temperature of the temperature range are set. The thermo-cell prevents the transgression of the temperature range. An active cooling respectively heating does not take place.

0023 The thermo-cell possesses two independent protective functions: One for the protection of the minimum barrier temperature and one for the protection of the maximum barrier temperature.

0024 For the protection of the minimum barrier temperature from the chillness side, an adequate quantity of the first pcm is placed at the borderline. If coldness respectively coldness energy approaches the thermo-cell, the coldness energy leads to a phase-change of the e.g. liquid pcm to a e.g. solid respectively crystalline phase.

0025 For the protection of the maximum barrier temperature from heat, an adequate quantity of the second pcm is placed at the borderline. If warmness respectively warmness energy approaches the thermo-cell, the warmness energy leads to a phase-change of the e.g. solid respectively crystalline pcm to a e.g. liquid phase.

0026 The invention offers advantages compared with the state of the art:

0027 The temperature can be set efficiently to the needs of the goods in using different kinds of first and second pcm. For example, the temperature range can be set to a pharmaceutical scope of protection if the good is a pharmaceutical.

0028 Furthermore the two different pcm in the at least one thermo-cell can protect the maximum and minimum barrier temperature exactly and without latent heat loss.

0029 The thermo-cell can possess several times the protective performance respectively performance-weight ratio because the two pcm obtain a relatively high latent heat storage volume because no cannibalization of the thermal-performance takes place and so a heat loss can be prevented.

0030 The relatively high protective performance of the thermo-cell can reduce the wall thickness of the cold transport-box respectively cold box and therefore it leads to a potency factor three higher box-exploitation volume in comparison with conventional transport-boxes.

0031 The danger of biopharmaceutical-freeze can be minimized respectively eliminated. This could be important if e.g. a cold transport-box is left behind at an airport cargo terminal or a customs clearance for several days because the other way around the thermo-cell can be charged or recharged at the lower or the upper temperature.

0032 According to the invention the thermo-cell facilitates an efficient and safe ensuring of the temperature-sensitive good in the temperature range in a simple and useful way especially during its transport.

0033 Preferably the first pcm changes between a solid and a liquid phase approximately at the lower temperature. The second pcm changes analogously between a solid and a liquid phase approximately at the upper temperature. This kind of pcm facilitate an efficient and precise implementation of the thermo-cell.

0034 The lower temperature is preferably 2 degrees Celsius and the upper temperature is preferably 8 degrees Celsius. This kind of minimum and maximum barrier temperature defines a temperature range which is desired in various areas. E.g. the pharmaceuticals and especially the biopharmaceuticals should be kept in this range of temperature. Also groceries such as milk products, meat or vegetables need to be kept in this temperature range.

0035 Alternatively, the lower temperature is approximately 15 degrees Celsius and the upper temperature is approximately 25 degrees Celsius. This kind of temperature limits facilitate to define a temperature range which cover the normal room temperature. This range of normal room temperature can be desired for e.g. the storage of various pharmaceuticals.

0036 Alternatively, the upper temperature is in an area of approx. 15 to 25 degrees Celsius. An upper temperature can be desired in various areas as room temperature range.

0037 Alternatively the lower temperature is approx. -25 degrees Celsius and the upper temperature is about -18 degrees Celsius. This kind of temperature limits facilitate the determination of frozen temperature range. This kind of temperature range can be desired in areas in which goods must be held as storage for a long period of time. E.g. it can be used for the freezing or storing of groceries.

0038 Alternatively, the lower temperature is approx. -90 degrees Celsius and the upper temperature is -70 degrees Celsius. This kind of temperature limits facilitate the temperature range which is desired in pharmaceutical industry regularly.

0039 Preferably the at least one filling chamber contain at least or exactly two filling chambers from which one of the at least two filling chambers contains the first pcm and the second of the at least two filling chambers contains the second pcm. With such a thermo-cell it is possible to choose the

pcm independently from each other. It can be prevented that the two pcm must be blended and as a result eventually interact with each other. The two pcm can be chosen appropriately to their purpose of use without considering if they damage each other.

0040 Another aspect of the invention concerns a transport-box for the transport of a temperature-sensitive good in a temperature range from a lower temperature to a upper temperature. The transport-box contains an internal space to take in the temperature-sensitive good and a cell wall which surrounds the internal space. At least one thermo-cell is arranged in the cell wall as it is described before.

0041 The term “take in” can either mean to put, to lay or to place the good in the internal space of the thermo-cell. Therefore, the internal space must accessible as e.g. it must have the possibility to be opened. The good can now be put, laid or placed inside the internal space and then it can be closed again. The internal space is completely closable so that the good is fully surrounded by the cell wall.

0042 This kind of described thermo-cells can be used in transport-boxes of any kind such as small transport-boxes for self-medication patients or courier transport-boxes or pallet-based transport-boxes in the size of air containers or shipment containers. The described effects and advantages of the thermo-cell can be efficiently implemented with this kind of transport-boxes. These effects and advantages can be achieved when the transport-boxes are highly used.

0043 The thermo-cells of the transport-boxes, according to the invention, or the whole transport-boxes can be reused in various ways. They can be used e.g. as cold boxes for groceries after their use for a transport of pharmaceuticals. This can be advantageous and useful ecologically as well as economically.

0044 The at least one thermo-cell in the transport-box should be covered by an insulation. The term “cover” can implement in this context that the thermo-cell is surround at least partly from the outside. E.g. the at least one thermo-cell can be surrounded by an insulation in this way.

0045 The insulation can either be a loose material which is put tightly to the cell wall or it can consist from a solid material such as a panel or similar.

0046 This kind of insulation can improve the efficiency of the transport-box. Especially the transfer of extreme variations in temperature outside the transport-box to the thermo-cell can be reduced.

0047 Preferably the transport-box contains a protective covering which is arranged at the inside wall which borders the internal space. This kind of protective covering can facilitate a highly efficient,

conserving and safe take in of the good. The protective covering can be made of e.g. corrugated cardboard in form of the inner box.

0048 Another aspect of the invention concerns preferred uses of a transport-box in the described way.

0049 According to the invention, the transport-box can be used for the transport of a pharmaceutical whereby the lower temperature is approx. 2 degrees Celsius and the upper temperature is approx. 8 degrees Celsius, the lower temperature is approx. 15 degrees Celsius and the upper temperature is approx. 25 degrees Celsius, the lower temperature is approx. -25 degrees Celsius and the upper temperature is approx. -18 degrees Celsius, the lower temperature is approx. -90 degrees Celsius and the upper temperature is approx. -70 degrees Celsius.

0050 According to the invention the transport-box can be used for the transport of groceries whereby the lower temperature is approx. -25 degrees Celsius and the upper temperature is approx. -18 degrees Celsius or the lower temperature is approx. 2 degrees Celsius and the upper temperature is approx. 8 degrees Celsius.

0051 According to the invention the transport-box can be used for the transport a human or an animal organ whereby the lower and the upper temperature must be adapted to the human or animal organ.

0052 The invention is described in its favorite form of design, but many changes and variations can be made without crossing the extent of the invention. Therefore, it is foreseen that the enclosed claims cover changes and variations which are part of the extent of the invention.

Short description of the drawings

0053 The schematic drawings show some more details and advantages of the invention. Especially the thermo-cell, according to the invention, and the transport-box, according to the invention, (fig. 1 and 2) are described with more details. In fig 3, 4 and 5 the state of the art is shown as described above. It shows:

Fig.1: An example of design of a transport-box, according to the invention, with a thermo-cell, according to the invention

Fig.2: A diagram of the course of the heat flow of the pcm measured with differential scanning calorimetry

Fig.3: a first form of design of a transport-box of the state of the art

Fig.4: a second form of design of a transport-box of the state of the art

Fig.5: a third form of design of a transport-box of the state of the art

Way(s) of invention execution

0054 Certain terms are used in the following description for practical reasons and are not restrictive. The terms “right”, “left”, “bottom” and “top” are directions in the drawing. The terms “to the inside”, “to the outside”, “below”, “above”, “left”, “right” or similar are used for the description of the arrangement of individual parts, the movement of individual parts and the directions to or from the geometric center of the invention as well as individual parts shown in the drawings. E.g. if a part of the drawing is turned around, elements and characteristics which are described as “below” are “above” afterwards. The terminology contains the terms mentioned above as well as derivations and synonyms.

0055 Fig. 1 shows a cold-transport box 7 as a form of design of a transport-box, according to the invention. The cold-transport box 7 present an internal space 6 of approx. 8 liters which is surrounded by a cell wall 91 to take in a temperature-sensitive good. One side of the cell wall 91 is equipped with a protective layer 8 which restricts the internal space 6. The internal space 6 has a square cross section with an even, horizontal bottom wall, vertical side walls and a horizontal lid wall. The pharmaceutical can be placed on the bottom wall of the internal space 6.

0056 The cell wall 91 is equipped with several thermo-cells 1 which are arranged around the internal space 6. At every side, bottom or lid wall, a thermo-cell borders to the internal space 6. The thermo-cells 1 contain each a cell body 2 in which two filling chambers 3 are arranged. The filling chambers 3 are flatly side by side so that both borders the corresponding wall of the internal space 6. Both of the filling chambers 3 of each thermo-cell 1 contains a first and a second filling chamber 3. The first filling chamber 3 is filled with a first pcm 4 which changes its phase at a temperature of approx. 2 degrees Celsius. The second filling chamber 3 is filled with a second pcm 5 which changes its phase at a temperature of approx. 8 degrees Celsius. The first and the second pcm 4, 5 change their phases between solid and liquid at a temperature of 2 degrees Celsius respectively at a temperature of 8 degrees Celsius.

0057 To the outside, the cell wall 91 is surrounded by a insulation 92. That way the thermo-cells 1 are wrapped up in the insulation 92 and consequently they are protected from short-termed variations of temperature and from irradiation. The isolation 92 shows a transport-box bottom and a transport-box lid. The transport-box lid of the insulation 92 can be lifted and consequently the inner part can be made accessible. To the outside the transport-box 1 is finished by an outside wall 93. The outside wall 93 contains every part of the transport-box 1. It can be opened from the top. The outside wall 93 can be made of cardboard or corrugated cardboard.

0058 The internal space 6 can be held at a temperature from 2 to 8 degrees Celsius through the first and the second filling chambers 3 respectively the pcm 4, 5 inside the filling chambers 3. The pharmaceuticals which are positioned in the internal space 6 can be ensured during their transport.

0059 If the coldness below 2 degrees Celsius penetrates the insulation 92, the first pcm 4 in the first filling chambers 3 change their phase from liquid to solid. That way the internal space 6 stays protected from the coldness irradiation. The first pcm 4 works as a coldness barrier.

0060 If the warmness above 8 degrees Celsius penetrates the insulation 92, the second pcm 5 in the second filling chambers 3 change their phase from solid to liquid. That way a relatively adequate quantity of warmness can be absorbed and the internal space 6 stays protected from the warmness irradiation. The second pcm 5 works as a warmness barrier.

0061 Fig. 2 shows exemplarily how the heat flow runs through the second pcm 5 of the thermo-cell 1. It is obvious that from -50 degrees Celsius to +50 degrees Celsius there is an almost constant heat flow of approx. 1mW. At the temperature of -24 degrees Celsius there is a deflection to approx. 4mW. Approx. 18 J/g can be taken in during this deflection. A second, bigger deflection is shown at a temperature of approx. 8 degrees Celsius at which point the second pcm 5 changes its phase from solid to liquid. Approx. 150 J/g of the second pcm 5 can be taken in during this deflection. With this kind of analysis, respectively like in the measurement of fig. 2, pcm which fulfill exactly the demanded conditions can be identified. Especially the material shown in fig. 2 is useful as a temperature barrier for the temperature of 8 degrees Celsius.

0062 Although the invention is described by means of the figures and their description, this portrayal is an illustrative example and should not restrict the extent the invention. To not transfigure the invention, some structures and techniques are not shown in detail. Needless to say that experts can make changes or variations without exceeding the extent of the invention. The invention covers furthermore embodiments with a variety of combinations of characteristics which can differ from the described characteristics. E.g. the invention can be realised like the following:

- The first and the second pcm can be filled into a common filling chamber. This can simplify the construction of the thermo-cells. But it is important that the two pcm do not damage respectively influence each other.
- The transport-boxes on pallets or with air or shipment container can be equipped with an opening at the side instead of a lid.

0063 This disclosure contains a variety of forms of design with any combinations of characteristics. It contains also individual characteristics in the figure even when they are shown with different kind of characteristics which are named. The alternatives from the form of design which are shown in the figures and the descriptions can be excluded. The disclosure contains forms of design which contain exclusively characteristics named in the claims respectively in the examples of design as well as some kind of forms which contain different characteristics.

0064 The term “contain” and its derivations does not exclude other elements or further steps. The term “a” does not exclude a variety of it. The functions of some characteristics which are mentioned in the claims can be fulfilled by a unit respectively a step. The term “approximately” and similar in connection with a quality respectively a result defines exactly the quality respectively exactly the result. The term “approximately” in connection with a value can refer to a quality or an area which lies within 20%, within 10%, within 5% or within 2% of the given value. Every reference sign in the claims are meant as a restriction to the extent of the invention.

CLAIMS

Claim 1: Thermo-protection-storage-cell (1) for ensuring a temperature range from a lower temperature to an upper temperature; comprising:

a cell body (2) and

at least one filling chamber (3) which is arranged in the cell body (2),

characterized in that

the at least one filling chamber (3) is filled with a first phase-change material (4) which changes its phase approximately at the lower temperature and

the at least one filling chamber (3) is filled with a second phase-change material (5) which changes its phase approximately at the upper temperature.

Claim 2: The thermo-protection-storage-cell (1) of claim 1, wherein the first phase-change material (4) changes its phase between solid and liquid approximately at the lower temperature.

Claim 3: The thermo-protection-storage-cell (1) of claim 1 or 2, wherein the second phase-change material (5) changes its phase between solid and liquid approximately at the upper temperature.

Claim 4: The thermo-protection-storage-cell (1) of any one of the preceding claims, wherein the lower temperature is approximately 2 degrees Celsius and the upper temperature is approximately 8 degrees Celsius.

Claim 5: The thermo-protection-storage-cell (1) of any one of claims 1 to 3, wherein the lower temperature is approximately 15 degrees Celsius and the upper temperature is approximately 25 degrees Celsius.

Claim 6: The thermo-protection-storage-cell (1) of any one of claims 1 to 3, wherein the lower temperature is approximately -25 degrees Celsius and the upper temperature is approximately -18 degrees Celsius.

Claim 7: The thermo-protection-storage-cell (1) of any one of claims 1 to 3, wherein the lower temperature is approximately -90 degrees Celsius and the upper temperature is approximately -70 degrees Celsius.

Claim 8: The thermo-protection-storage-cell (1) of any one of the preceding claims, wherein the at least one filling chamber (3) has a seal.

Claim 9: The thermo-protection-storage-cell (1) of any one of the preceding claims, wherein the at least one filling chamber (3) comprises at least two filling chambers (3), whereby a first chamber of the at least two filling chambers (3) is filled with the first phase-change material (4) and a second chamber of the at least two filling chambers (3) is filled with the second phase-change material (5).

Claim 10: Transport box (7) for the transport of a temperature-sensitive good in a temperature range between a lower temperature and an upper temperature, comprising:

an internal space (6) to receive the temperature-sensitive good, and

a cell wall (91), which surrounds the internal space (6),

characterized in that

at least one thermo-protection-storage-cell (1) according to any one of the preceding claims is arranged in the cell wall (91).

Claim 11: The transport-box (7) of claim 10, which comprises an insulation (92), wherein the insulation (92) covers the at least one thermo-protection-storage-cell (1).

Claim 12: Use of a transport-box (7) according to claim 10 or 11 for the transport of a pharmaceutical medicament, whereby the lower temperature is approximately 2 degrees Celsius and the upper temperature is approximately 8 degrees Celsius; or the lower temperature is approximately 15 degrees Celsius and the upper temperature is approximately 25 degrees Celsius; or the lower temperature is approximately -25 degrees Celsius and the upper temperature is

approximately -18 degrees Celsius; or the lower temperature is approximately -90 degrees Celsius and the upper temperature is approximately -70 degrees Celsius.

Claim 13: Use of a transport-box (7) according to claim 10 or 11 for the transport of groceries, wherein the lower temperature is approximately -25 degrees Celsius and the upper temperature is approximately -18 degrees Celsius; or the lower temperature is approximately 2 degrees Celsius and the upper temperature is approximately 8 degrees Celsius.

Claim 14: Use of a transport-box (7) according to claim 10 or 11 for the transport of a human or of an animal organ, wherein the lower temperature and the upper temperature are adapted to the human or to the animal organ.