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(54) **Method for preserving products in an insulated enclosure at low temperature**

(57) The present invention concerns a method for preserving products at low temperature in a container comprising a loading volume and at least one dry ice support, the method comprising the deposit of a dry ice quantity on and/or in the support, at a time before the stay of the products in the loading volume or at the beginning of the stay, said quantity of dry ice is calculated taking into account the amount and/or the nature of the products.

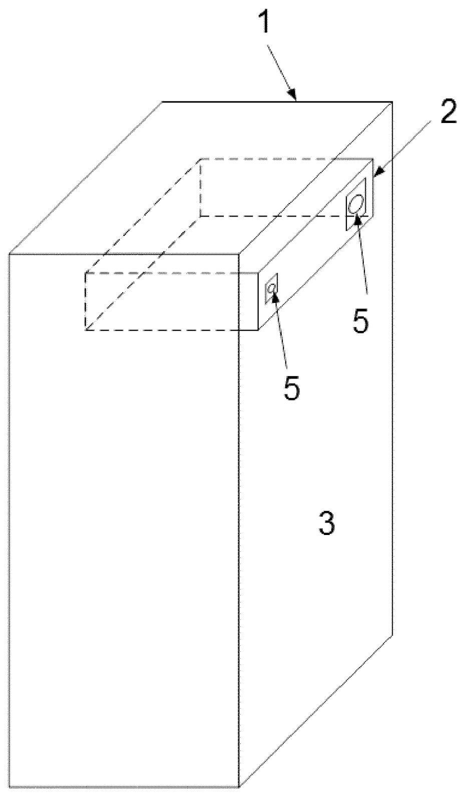

Figure 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to a method of low temperature storage of products in load volume of a thermally insulated enclosure.

BACKGROUND

[0002] During transport of products, in particular food products, a low temperature has to be maintained for preserving the products. Systems using isothermal containers with a load volume for the products and wherein a cassette filled with a cooling medium is introduced are known in the state of the art.

[0003] Patent application EP 0 337 860 describes a removable tray with a thermally insulated enclosure. The tank comprises an open upper face for receiving an amount of dry ice from a container of dry ice in bulk or in the form of pellets. Manual loading is delicate, irrational, causes significant losses in CO_2 and does not allow adjusting the amount of dry ice to the specific needs for conservation of specific products. This type of enclosure is used primarily for storage and transportation of frozen food products. For the transport of fresh food products that do not tolerate all too cold temperatures, e.g. temperature below -4 °C, generally an insulated enclosure is used without reserve of dry ice and precooled to the temperature of refrigerated storage of products before these are stored in the enclosure and the enclosure is shipped, which requires that travel time is minimized.

[0004] The patent application FR 2 706 990 describes a method wherein liquid CO2 is injected under pressure from a reservoir to create dry ice in a tray by evaporative cooling. The liquid CO_2 is injected during a filling time which depends on climatic parameters, on the nature of the products stored in the load volume of the enclosure and on the duration of the stay of the products in the enclosure. Specifically, this document provides, for example, the application of this method in terms of variables such as daily transport in winter or summer, or transport before or during a weekend, and for fresh or frozen products.

[0005] The patent application FR 2,726,353 describes a method wherein liquid CO_2 is injected from a reservoir under pressure into a receptacle for dry ice. The liquid CO_2 is injected during a filling time that depends on climatic parameters such as the season, the expected duration of the stay of the products in the loading volume and the nature of products. The filling time is calculated taking into account the estimated average exterior temperature during the period of the stay. The average exterior temperature is determined by taking as basis a list of the exterior temperatures during the day before the day of the stay. Specifically, the average temperature for the duration of the previous day, which corresponds to the period the stay is planned, to which is added a correction term which takes into account the uncertainties of weather and seasonal variations, can be taken as an estimation of the average exterior temperature during the stay of the products in the load volume of the enclosure.

[0006] The methods described above have several drawbacks. A calculation of the average exterior temperature based on a list of the previous day's temperatures does not guarantee that the temperature calculated by the method described in FR 2,726,353 will be close to that of the day that follows. Such a method is also futile in the case the enclosures are stored and/or transported in an air-conditioned environment, i.e. if they are not exposed to the exterior temperature. In addition, the temperature can vary during a single day, for example if alternating between sun and clouds. Thus, the average temperature is calculated from quite divergent values, which increases the risk of error. Another drawback of the system described above is that it involves several steps of calculation, which also greatly increases the risk of error. All these disadvantages increase the risk of using an amount of cooling medium which is not enough to keep the products of interest fresh. This can lead to products of inferior quality or to total losses of products and a considerable financial loss accompanied there with.

[0007] During transport and/or storage of the container wherein the products are loaded whereby the container is exposed to external weather conditions, the temperature at the outer surface of the container may depend on several variable conditions, such as the presence or absence of the sun, the presence or absence of clouds, what parts of the container exposed to sun or wind, the intensity of the wind, humidity, etc. All these factors change rapidly over time. These variable conditions, and especially the variation of the resulting temperature at the surface of the container, make the use of an average temperature to calculate the amount of cooling means to be introduced into the container non reliable and presenting a risk vis-à-vis the conservation of products. This disadvantage is even more obvious given that it is imprudent and unwise to use an average temperature in a calculation within the scope of systems in thermodynamic disequilibrium.

[0008] During transport and/or storage of the container wherein the products are loaded whereby the container rests within an air-conditioned area which is kept at a predefined temperature, it should be clear that the estimated average exterior temperature is of no importance, unless the ambient temperature within the air-conditioned area is meant. In this respect, document GB2257501 already discloses that the amount of carbon dioxide snow required for a particular application will be influenced by a variety of parameters including i.a. the ambient temperature. Other parameters to be taken into account include the size of the container, its specific heat and insulative properties (i.e. the material of which the container is made and the nature and thickness of any additional insulation), the nature and mass of any goods being transported in the container, the respective initial and desired temperatures within the container, the respective initial and desired temperatures of the goods, the expected duration of transportation to destination, the expected number of times the container is expected to be opened before it reaches its destination.

[0009] In addition, the thermal capacity (heat capacity) of the products contained in the cargo volume and the cooling means may be temperature dependent; in this case, nonlinear effects can play an important role in calculating the heat transfer from temperature differences. In other words, the heat transfer is not always linearly proportional to the temperature difference. In this case, the exterior temperature is a variable much more critical than the average temperature, especially if the heat capacity of the products or means of cooling increases with temperature. This is very common. Indeed, for CO_2 very widespread and popular as a means of cooling, the heat capacity of CO_2 gas in the container increases by over 10% with increasing temperature from -78.2 °C, the sublimation temperature of CO_2 at atmospheric pressure, to room temperature. For products with high water content, one of the most important parameters is the heat capacity of ice which rises over 30% when the temperature rises from -78.2 °C to 0 °C. Other nonlinear effects may result from the thermodynamic characteristics of container construction, a possible presence of insulation in the walls of the container, the amount of water and/or ice that may be undesirable from the container, etc.

[0010] For introducing a quantity of cooling medium in a container, the prior art methods take into account parameters such as the temperature and the travel and stay period of the products in the container. These parameters are highly fluctuating. The transport time for instance depends on the traffic status which changes during the same day according to the road and to the time of the day. The stay period of the products inside the container depends on the time from the loading of the products in the container, the transport time and the time from the arrival of the container to destination to the unload of said container. Given the high fluctuation of these parameters, the processes described in the prior art do not offer a good estimation of the cooling medium quantity that needs to be introduced in the container for a given transport of products between two locations.

[0011] The high fluctuation of the parameters thus leads to the introduction of a very high or low quantity of cooling medium compared to the required quantity. In general a very high quantity of cooling medium is introduced such as to avoid the loss of the transported products; if for instance, the traffic is too slow. When a high or a low quantity of cooling medium is introduced in the container compared to the required quantity, the processes of the prior art do not provide a case by case feedback. Knowing that several containers are used for transporting products and that the transport is performed in a repetitive manner (several times a week), the introduction of a high quantity of cooling medium in the container and/or the cassette results in a considerable loss of cooling medium.

[0012] Furthermore, a certain amount of cooling medium may remain in the container after transport or storage of the food products. In many, if not all, cases this leftover cooling medium has no further use and is lost. However, the amount of cooling medium which remains may provide valuable information on the consumption of cooling medium during the transport or storage of the food products in the container. Further, the remaining cooling medium can be re-used in a subsequent transport or storage of food products in the same or even another container.

[0013] The aim of the present invention is to provide a solution to overcome at least part of the above mentioned disadvantages.

SUMMARY OF THE INVENTION

[0014] The present invention aims to improve the process that determines the amount of cooling means to be used and avoids the disadvantages mentioned above. The method of this invention provides a method for easier use of cooling means, for computing more precise amounts of cooling means used, which maximizes safety and proper storing of products. The method of the present invention overcomes at least partly the shortcomings described above.

[0015] The present invention further provides a method, a system and their use for a better control and determination of the quantity of cooling medium to be introduced in container for a specific travel and in specific conditions. The present invention provides for the traceability of the complete process from loading the products and providing a cooling medium quantity to the container until discharging the products from the containers when it reaches its final destination.

[0016] The terms "enclosure" and "container" are used herein as synonyms. The terms "thermally insulated" and "insulated" are likewise used herein as synonyms. Unless expressly mentioned otherwise, a container as meant in this document, will mean a container comprising insulating means for reducing the heat transfer to and from the volume enclosed by the container.

[0017] The terms "cooling means", "cooling medium" and "cooling agent" are used synonymously in this document.

[0018] In general, the method of the present invention is used to introduce a certain amount of cooling means in a thermally insulated enclosure. Said enclosure can be kept in a same place and/or transported from one place to another in a transport vehicle.

[0019] The method of the present invention can be used to keep a low temperature in a transport vehicle. The method can also be used to keep a low temperature in any thermally insulated enclosure.

[0020] In a first aspect, the present invention provides a method for preserving products at low temperature in a container comprising a loading volume and at least one dry ice support, the method comprising the deposit of a dry ice quantity on and/or in said support, at a time before a stay of the products in the loading volume or at the beginning of the stay, said quantity of dry ice being calculated taking into account the amount of the products and/or the nature of the products and/or the initial temperature of the container.

[0021] It is important to know the amount of the products. Tests have shown that a large amount of products stored in a loading volume increase the efficiency of the cooling. This is in particular dependent on the filling degree of the container, i.e. the amount of volume occupied by the products compared to the loading volume. A small amount of products will lead to a large amount of air inside the container, which appears to lead to more losses as the container may not be air-tight. Hereby the cooling capacity of the cooling means is partially spent in cooling air, which may escape the container. Furthermore, a larger amount of air inside the container leads to more efficient heat transfer due to convection and thus to an increased loss of cooling medium. Therefore, in an embodiment, the quantity of dry ice may be calculated taking into account the filling degree of the container.

[0022] It is important to know the nature of the products. The properties of the products which are important in calculating the quantity of dry ice to be introduced, comprise but are not limited to the heat capacity, the specific weight or density, the water content. The heat capacity is important to compute the thermal mass of the products. The specific weight or density is important to relate mass of the products to volume and vice versa. This can be important, for instance, if the mass can be easily measured, and the filling degree of the container is to be taken into account for computing the quantity of dry ice. The water content may be important to estimate the heat capacity of the products, if the latter is not known, or to know whether or not, and at which temperature, a phase transition may take place with possible latent heat corresponding to it.

[0023] It is important to know both the amount and the nature of the products, in particular to compute the thermal mass of the products which is important to compute the quantity of dry ice which is to be introduced in the container. Therefore, in an embodiment, said quantity of dry ice is calculated taking into account the thermal mass of the products. The thermal mass depends on the amount and on the nature of the products. The amount of a specific product can be easily obtained by weighing or measuring that product before it is introduced in the container. The product can also be in prepackaged units of which volume and/or mass is known. In many cases, the amount of a product to be stored/transported in a container has to be weighed anyway as this amount should correspond with the amount requested by the receiver of the product. The thermal mass also depends on the nature of the product, in particular on the heat capacity of each specific product. Tables of heat capacities of different products are well known in the art. As many products, e.g. food products, may comprise a substantial amount of water, their heat capacity may depend on the temperature, in particular whether the food products or above or below freezing temperature. Most food products, for instance, have a heat capacity between 2.5 and 4.0 kJ/kg°C above freezing temperature and a smaller heat capacity, between 1.0 and 2.0 kJ/kg°C, below freezing temperature. More in particular, the heat capacity of a specific food product may not be a constant, but may be partly continuously increasing or decreasing with temperature, and/or may be partly stepwise increasing or decreasing with temperature.

[0024] It is important to know the initial temperature of the container. The container's initial temperature can preferably be obtained before or at the beginning of the stay of the products, and/or before the cooling medium is introduced in the container. Tests have shown that the container's initial temperature is a very important parameter for computing the amount of cooling medium. This initial temperature can be determined easily with a thermometer or is known when the container has been placed inside an airconditioned room for a while, whereby the temperature of the room is well-known. The container itself provides for a non-negligible thermal mass and the cooling medium which is introduced in the container is also consumed to cool down the container or to keep it cooled down. The thermal mass of the container depends on the container and/or container type, and may vary in time. The amount of cooling medium, e.g. dry ice, which is necessary to cool down the container, e.g. per degree, can be tested, measured, or extracted from recorded previous performances of the container. In some applications, the products are frozen or at least deeply cooled, while the container may be at room temperature. In such cases, the container may heat up the products when these are loaded in the container, and an extra amount of cooling medium for counteract this heat has to be taken into account.

[0025] It is also important to know both the initial temperature of the container and the amount and/or nature of the products, in particular if the products are frozen when they are inserted into the container at a higher temperature, e.g. at room temperature or at cooling room temperature. Frozen products comprise a cooling capacity from themselves, and are able to at least partly cool down the container. When computing the quantity of dry ice to be introduced into the container, one may take into account this cooling capacity of the products.

[0026] In an embodiment, the quantity of dry ice is calculated based on the climatic parameters, the expected duration of the products stored in the loading volume and the nature of the products. The method may be **characterized in that** the amount of dry ice introduced into the container is calculated taking into account the maximum external temperature recorded during the previous day. In an embodiment, the maximum external temperature is recorded during the corresponding period of their stay on the previous day. In another embodiment, the maximum external temperature is estimated for the period of the stay.

[0027] In a second aspect, the present invention provides a method for preserving products at low temperature in a container comprising a loading volume and at least one dry ice support, the method comprising introducing into the container at a time before the stay of products in the loading volume or at the beginning of this stay, at least one cooling means, preferably dry ice, the amount of cooling means being calculated based on the climatic parameters, the expected duration of the products storage in the loading volume and the nature of the products. The method may be **characterized in that** the amount of cooling medium introduced into the container is calculated taking into account the maximum external temperature recorded during the previous day. In an embodiment, the maximum external temperature is recorded during the corresponding period of their stay on the previous day. In another embodiment, the maximum external temperature is estimated for the period of the stay.

[0028] As discussed previously, the maximum external temperature is a more important parameter to take into account than an average temperature, because an average temperature may not be estimated precisely enough, because of non-linear thermal properties of the food products, because of possible phase transitions which may take place during the cooling or heating up of the products, etc.

[0029] In a further aspect, the present invention provides a method for loading products in a container, whereby one of the products comprises an amount of cooling medium, preferably dry ice, preferably whereby said amount of cooling medium is computed as described in this document. In particular, the amount may be calculated taking into account the amount of the products and/or the nature of the products and/or the initial temperature of the container and/or any other parameters which are discussed in this document, or which may be deemed important. As such the cooling medium is treated similarly than any other product which is to be stored in the container. Such a method has the advantage of being easy to implement within a warehouse, especially if the cooling medium comprises solid CO_2, which is more easily stored than e.g. liquid CO_2 for which a pressure vessel is needed.

[0030] In yet a further aspect, the present invention also comprises a system comprising a container comprising a loading volume, said system comprising products, whereby said products comprise an amount of cooling medium, preferably solid CO_2, preferably whereby said amount is computed according to a method as described in this document.

OVERVIEW OF THE FIGURES

[0031]

Figure 1 shows a container which can be filled with a method as described in the present document.

Figure 2 shows a flow chart illustration of the system according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0032] The methods presented in this document relate to preserving products at low temperature in a container comprising a loading volume and at least one cooling medium support, whereby the cooling means preferably comprise dry ice, the method comprising the deposit of a cooling medium quantity on and/or in the support, at a time before the stay of the products in the loading volume or at the beginning of the stay, said quantity of cooling medium being calculated taking into account a number of variables or parameters, the importance of which has not been recognized before, or has at least not been recognized completely. These variable or parameters comprise the amount of the products, the nature of the products and/or the maximum external temperature, and may comprise a number of other parameters or variables which, when taken in combination with the former or with each other, lead to an optimization of the amount of cooling medium which is to be introduced in the container in order to ensure the proper preservation at low temperature of the stored products during the period of storage.

[0033] In an embodiment, the quantity of dry ice may be calculated taking into account the filing degree of the container, whereby an amount of mass needed for maintaining a specified temperature within the container is multiplied by a container loading factor depending on the filling degree, whereby the container loading factor is preferably larger than 1 for a container which is not fully loaded, i.e. for a filling degree smaller than 1. Examples of how to compute the container loading factor can be found further in this text.

[0034] In many applications, the products to be stored or transported at low temperature are already pre-cooled or frozen to a certain temperature. Therefore, in a preferred embodiment, the quantity of dry ice to be introduced in the container may be calculated taking into account the initial temperature of the products, more preferably taking into account the thermal mass of these products at the initial temperature of the food products.

[0035] In one embodiment, the methods of the present invention take into account other parameters, such as the route to the presence of congestion, the reserve of cooling means to predict the time between delivery and the likely time of discharge.

[0036] In one embodiment, the method is **characterized in that** the amount of cooling medium introduced into the enclosure is calculated taking into account the maximum external temperature recorded during the period of the previous stay of products.

[0037] These parameters mentioned here above will be explained below.

[0038] In the case where the enclosure is transported from one place to another, the temperatures are recorded by sensors or stations placed in the path between the place of departure and the place of arrival. The outdoor temperature is measured at each station and during the stay. The maximum external temperature is then the highest temperature recorded in all stations on said path.

[0039] In one embodiment, the maximum external temperature is that recorded in the vehicle transporting said enclosure. A probe that records the temperature is installed in the vehicle. The temperature is recorded every 60 min, preferably every 30 min, more preferably every 20 min and even more preferably every 10 min. The temperature is recorded throughout the journey. The maximum external temperature corresponds to the maximum temperature measured by the probe in the vehicle during the products remained in the loading volume.

[0040] In one embodiment, the present invention provides a method comprising introducing into the enclosure at a time before a stay of the products in the loading volume or at the beginning of this stay, at least one cooling means, the amount of cooling means being calculated based on the climatic parameters, the expected duration of the products remained in the loading volume and the nature of the products **characterized in that** the amount of cooling means is calculated taking into account the maximum external temperature expected for a period which includes the duration of the stay.

[0041] This period includes the duration of stay, and the 200 hours before the stay and the 200 hours after the stay, preferably the duration of stay, and the 150 hours before the stay and the 150 hours after the stay, more preferably the duration of stay, and the 75 hours before the stay and the 75 hours after the stay, even more preferably the duration of stay, and the 25 hours before the stay and the 25 hours after the stay. In one embodiment the time interval may be limited to the duration of the stay of the products stored in the container.

[0042] In the process of the present invention, if the transport of the products is to take place through several climatic regions, we use the highest maximum temperature expected in those regions. The maximum temperature specified will be issued by the competent services, such as the meteorological services.

[0043] In Figure 1, we show an insulated container for the transport of fresh products. The container contains a dry ice tray 2 suspended in the top of the container forming a loading volume for products 3.

[0044] In one embodiment of the present invention, a heat shield extends at a distance from the underside of the tray 2 and separates the latter from the loading volume 3 for fresh food products.

[0045] In one embodiment, the tray is fixedly mounted in the container 1 and has a side provided with at least one access opening 5 for introducing the cooling means. In general, the tray can be any tray described in the prior art and known to the skilled person.

[0046] According to the present invention, the cooling means are placed in a drawer or on a plate or a fixed grill in the container 1.

[0047] In an embodiment of the method of the present invention, the cooling means are introduced in a recipient adapted to be placed in the container. The recipient may be a closed box or an open-top drawer. The cooling means may also be placed on a plate or grill adapted to be placed in the container. The cooling means may also be placed directly in the thermally insulated container.

[0048] It is clear that the isothermal container comprises engaging means and/or fixation means for the recipient, the grill and/or the plate. These means may be of any kind as known in the art, such as rails or introduction gliders.

[0049] The method of the present invention, may take into account other parameters to calculate the amount of cooling means adapted to be introduced into the enclosure. These parameters are:

- The filling degree of the loading volume. It is obvious that the greater the loading volume, the more important the amount of cooling medium is which is to be used.
- The size, the outer area and/or the K-factor of the isothermal container may also be taken into account. The larger the container, the greater the amount of cooling medium which is to be used. Also the outer area will influence the calculation of the amount of cooling means. An insulated container of which the surface does not let external heat pass requires less cooling medium compared to a container which is not well insulated and which lets the external heat pass. The method also takes into account the K-factor for thermal transfer, which represents the heat flux through the surface of the insulated container.
- The outer area and/or K-factor of the transport vehicle in the case where the container must be transported from one place to another. The outer area will influence the calculation of the amount of cooling means. A well-insulated vehicle and whose surface does not or only slightly let pass external heat requires less cooling means compared

to a vehicle not well insulated of which the external area does let the heat pass. The method also takes into account the K-factor for thermal transfer, which represents the heat flux through the surface of the single vehicle. Also the fact whether the vehicle is refrigerated or not is taken into account by the method of the present invention.

- Upon receipt of the container, it is very important to know whether the products will be immediately unloaded and stored at proper temperature or if the container will be stored in a given area over a certain period. In the latter case, the temperature at which the container will be stored and the storage time are also taken into account by the method of the invention.
- If the stay of products includes a length of road transport, the process takes into account the traffic conditions. Today the road traffic conditions can be predicted in advance. The fact that the present invention takes into account this factor, avoids for example the loss of transported products due to very busy traffic. The traffic information can be obtained from the relevant departments.

[0050] The cooling means used in the present invention is selected from the list including liquid CO_2, solid CO_2, carbon snow, dry ice, dry ice in chips, dry ice pellets, dry ice sticks, packed dry ice pellets, slices of dry ice packed in paper, etc. The cooling means, when it is in solid form, can have any shape and size and can be packaged or provided in bulk. Packaging can be of any type known to the skilled person. Furthermore, if the cooling medium to be introduced in the container is solid CO_2, one is capable of more precisely measure the actual amount of cooling medium than with liquid CO_2, which - when introduced into the container at atmospheric or even lower pressures - forms CO_2 gas and CO_2 snow, whereby the exact amount of CO_2 snow is not determined exactly.

[0051] In a preferred embodiment, the cooling medium comprises solid CO_2 with a density higher than 1.14 g/cm^3, preferably higher than 1.18 g/cm^3, more preferably higher than 1.22 g/cm^3, even more preferably higher than 1.26 g/cm^3, yet more preferably higher than 1.30 g/cm^3, still more preferably higher than 1.35 g/cm^3, yet even more preferably higher than 1.4 g/cm^3, and equal to or lower than 1.72 g/cm^3, preferably lower than 1.70 g/cm^3, more preferably lower than 1.68 g/cm^3, even more preferably lower than 1.66 g/cm^3, yet more preferably lower than 1.64 g/cm^3, still more preferably lower than 1.62 g/cm^3, yet even more preferably lower than 1.60 g/cm^3, most preferably about 1.56 g/cm^3.

[0052] If the used cooling means are liquid CO_2, the amount introduced into the insulated container is calculated based on the injection time of the liquid CO_2 into the container tray or volume for liquid CO_2. If the cooling medium is solid CO_2, i.e. if the cooling medium is solid CO_2 before being introduced in the container or in the container tray, the quantity to be introduced in the insulated container is determined by the weight or volume of the cooling means.

[0053] If the cooling means used is liquid CO_2 coming from a pressurized storage tank, the method also takes into account the pressure in said reservoir at the time of injection to calculate the amount of cooling means.

[0054] A conservation facility where cooling means are being used may employ the method of the present invention. The installation comprises a loading station and a storage tank of cooling means. In the case of liquid CO_2, the reservoir has a typical pressure between 14 and 20 x 10^5 Pa and a temperature between -30.6 °C and -19.5 °C, and is sometimes fueled by a refrigeration unit. Liquid CO_2 contained in the tank can be cooled below the equilibrium temperature, in order to improve the conversion from liquid phase to solid phase.

[0055] A supply line for cooling means provided with adequate sluicing may extend from the cooling medium reservoir by a hose. The sluicing is terminated by a dispensing means for introducing the employed cooling means in the insulated container. In the event that a tank provided with an opening is used, the used cooling means is introduced via said opening. In the case where a gate, a plate or a tray is used, the introduction of the cooling means can be carried out via an opening in the upper horizontal face of the container. The drawer can also be removed from the container, filled with the used cooling means and then placed in the container. Also, the grid or the plate can be removed from the container. On the grid or plate the used cooling means removed and the plate or grill delivered into the container. It is obvious that in the latter case, the used cooling means is solid as dry ice.

[0056] The distributor means can be in the form of a gun. The latter can be suspended elastically to an upper frame structure secured to a cowl provided with an articulated awning provided with foldable sides and adapted to be positioned in front of the loading side of the container. Thus, a confining receptacle for cold gases generated during the introduction of the cooling means is created. These gases are vented to the exterior of the workplace by an evacuation device comprising a fan. Preferably, the gases are recovered and directed to a storage tank. Preferably, the gas is compressed and cooled for re-liquefying before being led to said tank. This way the gases are not emitted into the ambient air, which has an environmental benefit. Also recovered gas will be used to maintain a low temperature during the introduction of the cooling means, which limits energy losses.

[0057] In the method of the present invention, the introduction of the cooling means can be carried out in a sealed manner and any gas produced during the introduction of the cooling medium is recovered. The recovered gas may be renewed in the stock cooling means. The recovered gas can also be used to maintain a low temperature of the equipment used in the introduction of the cooling means, which avoids energy losses.

[0058] The suspension means is preferably displaceable along the top of the frame by a carriage to enable correct positioning of the dispensing means opposite the opening through which the introduction of the cooling means will be realized.

[0059] If the used cooling means is liquid CO_2, the introduction will typically be carried out such that the liquid jet undergoes at least one impact in the tray of the container so as to break the jet and cause production and rapid accumulation of carbon snow in the tray.

[0060] The dispensing means typically include a manual opening/closing valve and an upstream solenoid valve. The latter is connected to a control unit which determines the opening times of the solenoid valve, and thus the amount of cooling medium introduced into the insulated container. In the case where the cooling medium is liquid CO_2, the control unit is connected to a pressure switch which gives the value of the pressure in the tank or more precisely in the supply line for the liquid CO_2.

[0061] The control block is provided with means for introducing additional data such as the nature of the products introduced in the loading volume, the filling degree of this volume, duration of stay of products ... etc. The nature of products has the following characteristics: fresh products, frozen products, the water content of these products ... etc.

[0062] All data and parameters mentioned above are transmitted to a control station. The latter can be located at the supplier of the cooling means. The transmission is carried out by means of a telephone network line and/or via an internet connection. The control station manages at the same time the stock of filling means and the conservation facility, and manages the maintenance of this stock. The control center can also be placed close to the conservation facility.

[0063] In an embodiment, the cooling medium is dry ice, wherein the dry ice comes from a reservoir of dry ice. The dry ice reservoir can act as a buffer containing a minimal amount of dry ice to ensure that the next container may be filled with cooling medium without time delays. The reservoir can be provided with dry ice by a dry ice producing apparatus which solidifies liquid CO_2 and preferably compresses the resulting solid CO_2, preferably to a pre-determined density. Therefore, in a preferred embodiment, the dry ice is formed during decompression of liquid CO_2.

[0064] In an embodiment, the dry ice is formed during decompression of liquid CO_2 on and/or in said support, i.e. the dry ice is not pre-made in a separate reservoir by decompression of liquid CO_2, but liquid CO_2 is being compressed and the resulting dry ice is deposited on and/or in the support directly.

[0065] In an embodiment, wherein the quantity of dry ice deposited on and/or in the support is recorded in a database. Alternatively or in addition to the previous, the quantity of dry ice that remains on and/or in the support after or at the end of the stay of the products can be measured and preferably stored in a database. Further, the quantity of dry ice which is consumed during the stay of the products in the container can be recorded in a database, preferably with one or any combination the following data:

- the duration of the stay;
- the outside temperature on one or more times during the stay;
- the indoor temperature on one or more times during the stay;
- the temperature of the container before or at the start of the stay;
- the temperature of the container at or after the end of the stay;
- the nature of the products, preferably comprising the thermal capacity of the products;
- the filling degree of container;
- an identifier of the container, preferably comprising a bar code and/or RFID;
- properties of the container, such as the dimensions of the container or the K-factor.

[0066] The method may be further **characterized in that** consumption of cooling medium is optimized taking into account data from said database. In case the products have to be transport from a location A to a location B, said data may correspond to all information collected at location A and at location B, or during the transport from A to B. In many cases the products need to be cooled during transport from location A to B and for a prior and/or subsequent storage time at location A and/or B respectively. In this case a first data set may correspond to all information collected in the location A at the start of storage while a second data set may correspond to the information collected when the products are taken out of the container at location B. In a preferred embodiment, the first dataset comprises information representing variables such as dependent variables, independent variables and/or parameters as obtained around a first moment in time. The second dataset comprises information representing variables or parameters as obtained around a second moment in time.

[0067] The data stored in the database may be dependent variables, independent variables and/or parameters and may comprise any in the following list: the amount of products, the nature of the products comprising properties of the products such as specific heat and/or specific surface, the initial temperature of the container, climatic conditions such as temperature, pressure, wind strength and/or air humidity, predicted climatic conditions, container properties such as size, including surface area and volume, and k-factor, the external predicted temperature at the geographical regions at which the products are stored and/or through which the products are transported, the duration of the stay of the products in the container, the internal temperature of the transport vehicle, the amount of cooling medium remaining in the container before, during or after the stay, the mass of the products which are to undergo a freezing transition inside the container, the latent heat of freezing of the products which are to undergo a freezing transition inside the container, the mass of products which are to be stored and/or cooled inside the container, the heat capacity of products which are to be stored inside the container, the begin temperature of products, the desired end temperature of the products, the k-factor of the container, the total surface of the container, the expected total duration of the stay of the products in the container, the expected time of transport, the temperature or maximal temperature of the room in which the container is placed for storage, the desired temperature inside the container during the stay of the products in the container and/or the exterior temperature, the exterior maximum temperature, the exterior average temperature, the expected exterior temperature, the expected exterior maximum temperature or the expected exterior average temperature during the stay of the products inside the container.

[0068] In a preferred embodiment, the quantity of dry ice to be introduced is calculated taking into account the data stored in said database.

[0069] In a preferred embodiment, the method comprises any or any combination of the following steps: monitoring and/or controlling the amount of cooling medium present in a cooling medium storage unit; monitoring and/or controlling the amount of resources for producing the cooling medium present in a resource storage unit.

[0070] In a preferred embodiment, the method comprises the step of extracting and/or recuperating cooling medium which remains in said container after and/or at the end of the stay of said products in said container. In this way, loss of cooling medium can be prevented. In a more preferred embodiment, said extracted and/or recuperated cooling medium may be stored in a cooling medium storage unit or in a resource storage unit for storing an amount of resources for producing the cooling medium. There, it can be kept at optimal storage conditions for the cooling medium or for the resources for producing the cooling medium.

[0071] In a preferred embodiment, the method of the present invention comprises the steps of: monitoring and/or controlling the amount of liquid CO_2 present in a liquid CO_2 storage unit; monitoring and/or controlling the amount of solid CO_2 present in a solid CO_2 storage unit; monitoring and/or controlling the amount of gaseous CO_2 present in a gaseous CO_2 storage unit; solidifying liquid CO_2 from a liquid CO_2 storage unit, thereby preferably recuperating gaseous CO_2 in a gaseous CO_2 storage unit; liquefying gaseous CO_2 from a gaseous CO_2 storage unit.

[0072] In a preferred embodiment, the method comprises the step of monitoring, controlling and/or updating control systems and/or said database which may be common to more than one control system, preferably by a telemonitoring system. In a further preferred embodiment the obtaining, controlling, monitoring and/or calculating steps are performed by one, two or more control systems, whereby said control systems are operably linked to a common database.

[0073] In a preferred embodiment, the method comprises the step of identifying the container and the data may comprise information representing container properties or container type. The identification of the container can be done manually, but preferably automatically, e.g. by scanning its identification tag such as a bar code and/or RFID.

[0074] In yet a further aspect, the present invention also concerns a database for monitoring and optimizing dry ice consumption to provide suitable low temperature of products in a container in which an amount of cooling medium, preferably dry ice, is deposited on and/or in a support, at a time before the stay of the products in the loading volume or earlier to the stay, the database comprising the quantity of ice that is consumed during the stay of the products in the container.

[0075] In an embodiment, the database comprises one or any combination of the following data:

- the duration of the stay;
- the outside temperature on one or more times during the stay;
- the indoor temperature on one or more times during the stay;
- the temperature of the container before or at the start of the stay;
- the temperature of the container at or after the end of the stay;
- the nature of the products, preferably comprising the thermal capacity of the products;
- the filing degree of the container;
- an identifier of the container, preferably comprising a bar code and/or RFID;
- properties of the container, such as the dimensions of the container or the K-factor.

[0076] The present invention further concerns a computer readable medium comprising a database as specified in this document.

[0077] The recording method and corresponding database is particularly suitable for providing an estimation of the amount of cooling medium that is required for products transport in a container. The present invention allows to record data at several times of the storage and/or transport of said products. More in particular, the invention provides for the recording of information at the end of the storage and/or transport period. This is very advantageous as said information allows a higher accuracy and precision for the calculation of the amount of cooling medium that is to be used during a next transport in the same or in similar conditions. This is very advantageous as it reduces the use of cooling medium and thereby the costs of products transport. Furthermore, the current invention provides the user with a novel traceability system and method that can be used for optimizing the consumption of cooling medium during the next transport cycles. Another advantage of the recording method and database is that it provides to the user an easy and accurate tool for identifying containers that needs to be discarded or not-used in the future. This applies also for devices, such as cassettes, suitable to be placed in the container and in which the cooling medium can be introduced. For instance, if a container and/or a cassette is broken and/or leaking the consumption of cooling medium will be higher compared to a transport that was previously made for the same and/or similar products and transport conditions. The consumption difference will be obvious to the user and will provide a signal that the container and/or a cassette have to be checked and probably replaced.

EXAMPLES

[0078] As an example, we introduce a way to compute the amount of cooling medium to be introduced into the enclosure, in the case the cooling medium is liquid CO2 coming from a reservoir under pressure and which is injected into a cassette at atmospheric or even lower pressure, hereby resulting in a mixture of CO2 snow and CO2 gas. The amount of liquid CO2 can be expressed as a function of filling time, as they are related by the filling rate which, in most cases, can be kept constant:

$$t_{fill} = \frac{1}{r_{fill} f_{l\to s} \rho_s L_s} \left[\sum_{p'} m_{p'} L_{p'} + \sum_{p} m_p c_p \left(T_{b,p} - T_{e,p}\right) + k\, S\, t_{total}\, (T_{stor} - T_{in}) + k\, S\, t_{travel}\, (T_{max} - T_{stor}) \right]$$

with

- t_{fill} the filling time for the liquid CO_2.
- r_{fill} the filling rate, which may depend on the pressure in the reservoir.
- $f_{l\to s}$ a factor which expresses how much liquid is turned into CO_2 snow. This factor may depend on a number of parameters such as the pressure in the reservoir, the type and size of injection nozzle and the cassette, etc. This parameter may be measured e.g. prior to using an injection installation.
- ρ_s the density of the snow.
- L_s the latent heat of sublimation of the snow, which may depend on the snow density.
- $m_{p'}$ the mass of product p' which is to undergo a freezing transition inside the container. This parameter depends on the amount and nature of the products to be stored inside the container.
- $L_{p'}$ the latent heat of freezing of product p' which is to undergo a freezing transition inside the container. This parameter depends on the nature of the products, such as the water content.
- m_p the mass of product p which is to be stored inside the container. This parameter depends on the amount and nature of the products to be stored inside the container.
- c_p the heat capacity of product p which is to be stored inside the container. This parameter depends on the nature of the products, such as the water content.
- $T_{b,p}$ the temperature of product p at the start of the stay inside the container.
- $T_{e,p}$ the desired temperature of product p at the end of the stay inside the container.
- k the k-factor of the container which expresses the heat gain or heat loss rate through the container walls per unit of surface area.
- S the total surface of the container.
- t_{total} the total duration of the stay (storage time + travelling time).
- t_{travel} the expected time of travelling which depends on e.g. travelling distance, traffic conditions, rest times of the driver, etc.
- T_{stor} the maximal temperature of the storage room, e.g. a freezer room at a product distribution center kept at a well-controlled temperature. If no such storage room is available, T_{stor} may be replaced by T_{max}.
- T_{in} the temperature inside the container during the stay. This temperature is not controlled and may vary in time. However, to be on the safe side, one can use the minimal temperature inside the container, which is -78.2 °C, the sublimation temperature of CO_2 at atmospheric pressure.
- T_{max} the maximum exterior temperature as discussed in this application.

[0079] As the maximal exterior temperature is used in the above described method for computing the filling time, no correction term is needed for ensuring that the products remain cool during the whole stay. Such a correction term would be necessary when an average exterior temperature would be used instead of the maximum exterior temperature, and would be substantially arbitrary.

[0080] Another example of computing the quantity of cooling medium which is to be introduced is the following, where the cooling medium is solid CO_2:

$$M = \left[[(a_1 + 18) * M_1] + \left(\sum_{i=1}^{a2} M_3^i \right) * a_4 \right] * a_5$$

[0081] Wherein the parameters have the following explanation:

- M - mass of solid CO_2 which is to be introduced;
- a_1 - initial container temperature;
- M_1 - mass necessary to cool down the container by 1 °C;
- a_2 - transport time in hourly intervals;
- a_3 - forecast temperature in hourly intervals;
- M_3 - solid CO_2 mass needed for maintaining -18 °C for 1 hour in a container at outside temperature a_3;
- a_4 - container loading factor (> 1 for container not loaded fully), which is an efficiency factor reflecting the filling degree of the container;
- a_5 - correction factor (≥ 1);

[0082] The container loading factor depends on the filling degree of the container and on the container's properties or performance. It can be computed or derived depending on the filling degree in the following way:

- by interpolation of past performances of the container in function of the filling degree of the container during past performances, whereby the filling degrees of a previous storing of products in that container is a number stored in the database, or can be computed from that data (e.g. by computing the volume taken in by the products, which depends on the amount and nature of the products, and divide this volume by the loading volume of the container which e.g. can be computed from its size);
- by modeling the efficiency of the container or container type. If d_f is the filling degree, the container loading factor may be modeled, e.g. as in the following:
  - $a_4 = \frac{1}{1+b_1(1-d_f)}$; whereby b_1 is a parameter which is container specific and can be derived from tests or past performances;
  - $a_4 = \frac{1}{1+b_2(1-d_f)^{b_3}}$; whereby b_2 and b_3 are parameters which are container specific and can be derived from tests or past performances;

[0083] An example of an embodiment of the method and a system implementing a method according to the present invention is illustrated by the flow chart of **Fig. 2.** A liquid CO_2 storage unit **201** is connected to a gaseous CO_2 liquefier **200** and to a gaseous CO_2 storage unit **206.** Evaporated CO_2 produced in the liquid storage unit **201** is evacuated to the gaseous CO_2 storage unit **206** where it is stored. The gaseous CO_2 collected in the gaseous CO_2 storage unit **206** is transferred to the liquefier **200** wherein it is liquefied into liquid CO_2 which is then transferred to the liquid CO_2 storage unit **201.** This avoids emission of gaseous CO_2 in the environment. Moreover a considerable amount of essentially pure CO_2 can be recuperated without extra purification, which leads to a considerable cost reduction. A liquid CO_2 backup **202** can be connected to the liquid CO_2 storage unit **201** to ensure that it is always provided with cooling medium, e.g. in case of a sudden increase in the need of liquid CO_2 or in case of failure of the liquefier. Said liquid CO_2 storage unit **201** is also connected to a solidification unit **203** in which the liquid CO_2 provided by the storage unit **201** is converted to solid CO_2. The latter is stored in the solid CO_2 storage unit **204.** During the production of solid CO_2, an amount of gaseous CO_2 may also be produced, e.g. when liquid CO_2 is solidified using expansion or evaporative cooling. Therefore, the solidification unit **203** is also connected to the gaseous storage unit **206** in order to recuperate the evaporated CO_2. In addition to the solid CO_2 produced by the solidification unit, solid CO_2 can be provided from a solid CO_2 backup reservoir **205** which is also connected to the solid CO_2 storage unit **204,** and which may provide for additional solid CO2 in case of a suddenly increased demand or in case the solidification unit fails. The user has the choice between providing the container **210** with liquid and/or solid CO_2 for the transport of products. It is to be understood that the storage units **201, 204** are each provided with devices for the introduction of the cooling medium in the container. Such devices, such as loading pistols, may be known to the person skilled in the art. Furthermore, the cooling medium might be provided to the container in cassettes that are also known to the person skilled in the art. If the cooling medium that is to be provided to the container is solid CO_2, the system is further provided with a dosing system **208** for determining the quantity of solid CO_2 prior to its introduction in the container. Alternatively the cooling medium could be liquid CO_2 or a combination of liquid CO_2 and solid CO_2 and the liquid CO_2 storage unit **201** could then also be connected to the dosing system **208,** which may determine the quantity of liquid CO_2 and/or solid CO_2 to be introduced in the container. The dosing system **208** can be a weighting device for solid CO_2 for example. The connections described above between the following components of the system: the storage units **201, 204,** the backups **202,205,** the solidifier **203,** the dosing system **208,** the gaseous CO_2 liquefier **200** and the gaseous CO_2 storage unit **206** can be established by tubing, hoses and/or conveyor belts between the different listed components.

[0084] The system illustrated in **Fig. 2** comprises a first control system **207** wherein information about the storage units **201, 204,** the backups **202,205,** the solidifier **203,** the dosing system **208,** the gaseous CO_2 liquefier **200** and the gaseous CO_2 storage unit **206,** or the status thereof, are collected. Said information can be manually introduced by the user, but is preferably automatically exchanged between the different units and the first control system **207** and may work in two directions, i.e. from units to first control system and from first control system to the units. Typical information which is transferred to the first control system is the pressure or amount of gaseous, liquid or solid CO_2 present in the storage units **(206, 201, 204)** and backup units **(202, 205)** and the production rate of the liquefier **200** and solidifier **203.** Additionally, the production rate for liquid and solid CO_2 in liquefier **200** and solidifier **203** respectively, can be controlled by the first control system **207** depending on the demand. Other information can also be exchanged such as the energy consumption of the different units, the amount of resources present in the liquefier or solidifier which are necessary to liquefy or solidify the CO_2, e.g. amount of purification oil, amount of grease oil, fuel or energy levels, etc., the pressure and temperature conditions, the corrosion and pollution level of the units, etc.

[0085] Information which is exchanged between first control system **207** and dosing system **208** comprises the amount and nature of cooling medium **211** that was introduced in the container **210** at a first location **209** at a first moment in time. After storage and/or transport from location **209** to location **212** of the products placed inside the container **210,** a second dataset of information is obtained and sent to a second control system **215.** Said information comprises an indication of the cooling medium amount **213** remaining in the container **210.** Said information may also comprise identification information of the container as obtained from reading the identification tag of the container. This helps to correlate the second dataset with the first dataset.

[0086] The first and the second control system **215,207** are connected to a data system **214** typically containing a database of previous measurements and other variables which influence the consumption of liquid medium. Possible variables which can be stored on the data system **214** are: the amount of products, the nature of the products comprising properties of the products such as specific heat and/or specific surface, the initial temperature of the container, climatic conditions such as temperature, pressure, wind strength and/or air humidity, predicted climatic conditions, container properties such as size and k-factor, the external predicted temperature at the geographical regions at which the products are stored and/or through which the products are transported, the duration of the stay of the products in the container, the internal temperature of the transport vehicle, or any combination thereof, and this at times around said first moment in time, between said first and said second moment and time and around said second moment in time. Also the amount of cooling medium which was introduced into the container at the first moment in time and the amount remaining in the container at the second moment in time can be stored in said database on said data system **214,** where it can be correlated with the specific container or the type of container or the container's properties such as the thermal properties. The database on the data system **214** thereby acts as primarily as a resource of data for computing the optimal dosing of cooling medium, depending on the different variables. More in particular, the control systems may use the data in the database to compute the dose and nature of cooling medium which is to be introduced in the next container, depending on a large number of variables. The algorithms for computing the optimal amount of cooling medium can be implemented on the control systems.

[0087] In addition, the control systems **207, 215,** and the data system **214** may be connected to a telemonitoring system **216.** The connection between the first control system **215,** the second control system **207,** the data system **214** and the telemonitoring system **216** can be via the internet, intranet, Ethernet-network, Bluetooth, wifi, electrical wiring, a telephone network, e-mail or even mail, etc. or a combination thereof. In this way, all the parameters detailed above are recorded during a travel from location **209** to location **212.** For a next travel, the user will be provided by an estimation of the quantity that needs to be introduced in the container for a specific distance in a specific weather and traffic conditions.

[0088] The telemonitoring system **216** can also be used to provide estimations of the specific weather and traffic conditions for the next travel to the control system **207, 215** which controls the dosing system **208.** The telemonitoring system **216** can also provide updates of the data system **214** or the control systems **207, 215,** e.g. via updating the algorithms for computing the dose, and it can be used to telemonitor via the control system **207** the status of the different units such as the storage units **206, 201, 204,** backup units **202, 205** and liquefier **200** or solidifier **203,** and the stocks of CO_2 present at a certain location. As such, a centralized monitoring and tracing method and system for the consumption of CO_2 is achieved.

[0089] It is supposed that the present invention is not restricted to any form of realization described previously and that some modifications can be added to the presented example of fabrication without reappraisal of the appended claims. It is also supposed that the features as given in the previously stated embodiments or examples may be combined for optimizing the present invention.

Claims

1. A method for preserving products at low temperature in a container comprising a loading volume and at least one dry ice support, the method comprising the deposit of a dry ice quantity on and/or in the support, at a time before the stay of the products in the loading volume or at the beginning of the stay, said quantity of dry ice is calculated taking into account the amount and/or the nature of the products.

2. The method according to claim 1, wherein said quantity of dry ice is calculated taking into account the expected duration of the stay of the products in the loading volume.

3. The method according to claim 1 or 2, wherein said quantity of dry ice is calculated taking into account the temperature of the container before or at the beginning of the stay.

4. The method according to any of claims 1-3, wherein the dry ice comes from a reservoir of dry ice.

5. The method according to any of claims 1-4, wherein the dry ice is formed during decompression of liquid CO_2.

6. The method according to any of claims 1-5, wherein the dry ice is formed during decompression of liquid CO_2 on and/or in said support.

7. The method according to any of claims 1-6, wherein the quantity of dry ice deposited on and/or in the support is recorded in a database.

8. The method according to any of claims 1-7, wherein the quantity of dry ice that remains on and/or in the support after or at the end of the stay of the products is measured and preferably stored in a database.

9. The method according to any of claims 1-8, wherein the quantity of dry ice which is consumed during the stay of the products in the container is recorded in a database, preferably with one or any combination of the following data:

   - the duration of the stay;
   - the outside temperature on one or more times during the stay;
   - the indoor temperature to one or more times during the stay;
   - the temperature of the container before or at the start of the stay;
   - the temperature of the container or after the end of the stay;
   - the nature of the products, preferably comprising the thermal capacity of the products;
   - the loading degree of the container;
   - an identifier of the container, preferably comprising a bar code and/or RFID;
   - properties of the container, such as the dimensions of the container or the K-factor.

10. The method according to any of claims 7-9, wherein said quantity of dry ice is calculated taking into account the data stored in said database.

11. A database for monitoring and optimizing dry ice consumption to provide suitable low temperature of the products in a container in which an amount of dry ice is deposited on and/or in a support, at a time before the stay of the products in the loading volume or earlier to the stay, the database comprising the quantity of ice that is consumed during the stay of the products in the container.

12. A database according to claim 11, comprising one or any combination of the following data:

- the duration of the stay;
- the outside temperature on one or more times during the stay;
- the indoor temperature on one or more times during the stay;
- the temperature of the container before or at the start of the stay;
- the temperature of the container at or after the end of the stay;
- the nature of the products, preferably comprising the thermal capacity of the products;
- the loading degree of the container;
- an identifier of the container, preferably comprising a bar code and/or RFID;
- properties of the container, such as the dimensions of the container or the K-factor.

13. A computer readable medium comprising a database according to any of claims 11 or 12.

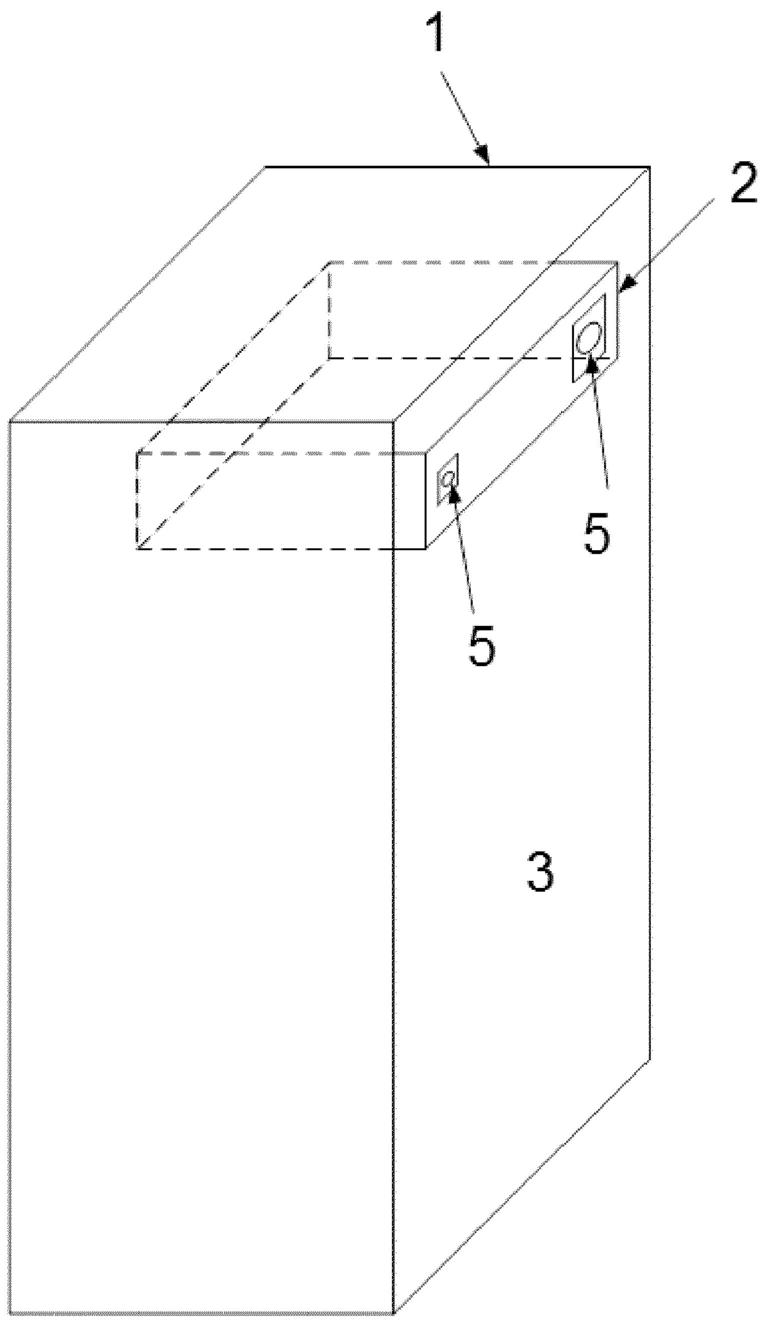

Figure 1

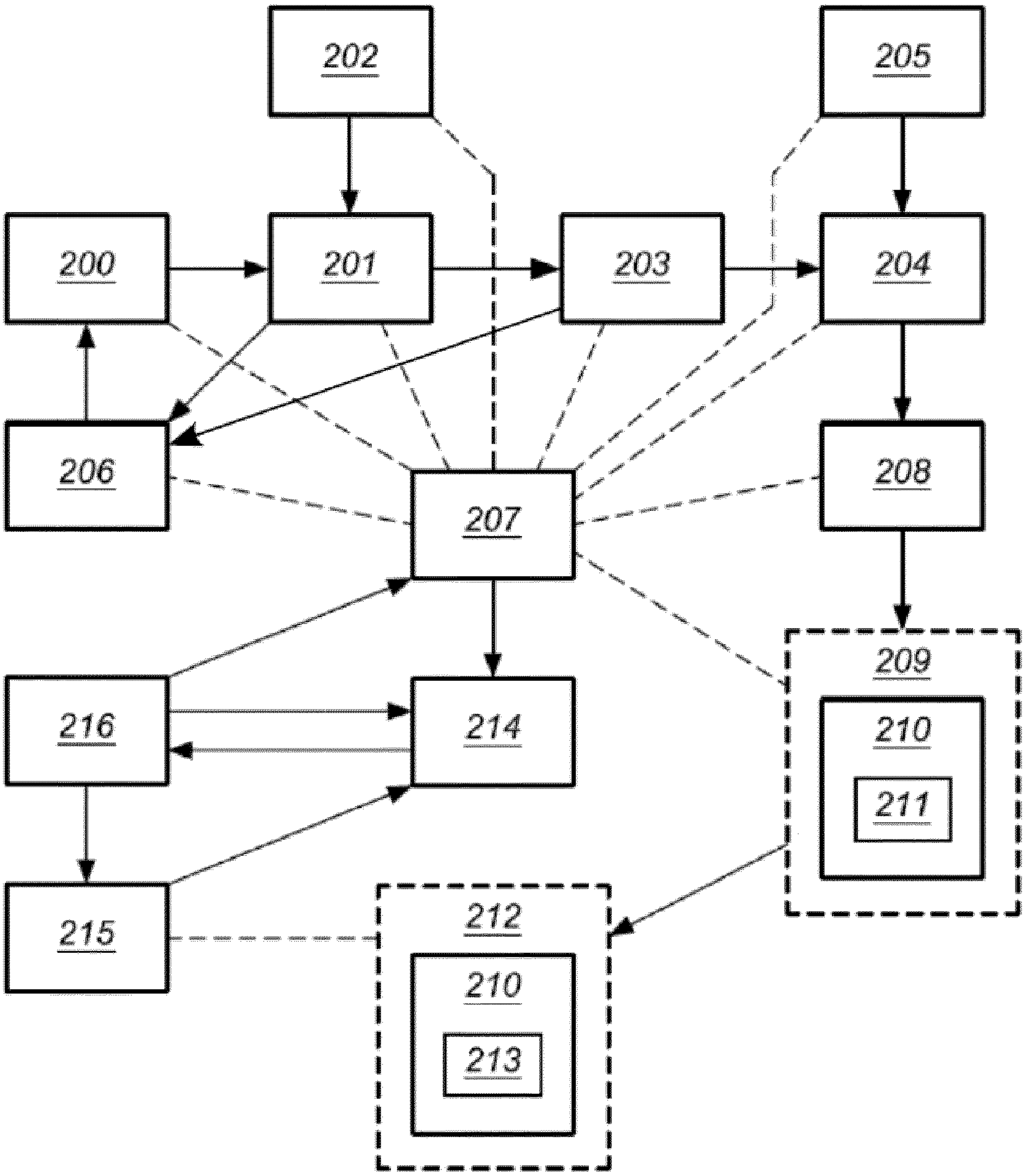
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Figure 2

Europäisches Patentamt
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EUROPEAN SEARCH REPORT

Application Number
EP 12 18 0867

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X,D	FR 2 726 353 A1 (CARBOXYQUE FRANCAISE [FR]) 3 May 1996 (1996-05-03) * abstract; figures 1,2 * * page 2, line 2 - page 4, line 1 * -----	1	INV. F25D3/10 F25D3/12 F25D29/00

TECHNICAL FIELDS SEARCHED (IPC)
F25D

~~The present search report has been drawn up for all claims~~

3

Place of search	Date of completion of the search	Examiner
Munich	31 January 2013	Salaün, Eric

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons
& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

Europäisches Patentamt
European Patent Office
Office européen des brevets

Application Number

EP 12 18 0867

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION SHEET B

Application Number
EP 12 18 0867

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claim: 1

A method for preserving products comprising the deposit of a dry ice quantity on and/or in a support, said quantity of dry ice being calculated taking into account the amount and/or nature of the products.

---

2. claim: 2

A method for preserving products comprising the deposit of a dry ice quantity on and/or in a support, said quantity of dry ice being calculated taking into account the amount and/or nature of the products, as well as the expected duration of the stay of the products in a loading volume.

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3. claim: 3

A method for preserving products comprising the deposit of a dry ice quantity on and/or in a support, said quantity of dry ice being calculated taking into account the amount and/or nature of the products, as well as the temperature of a container before or at the beginning of the stay of the products in a loading volume.

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4. claim: 4

A method for preserving products comprising the deposit of a dry ice quantity on and/or in a support, said quantity of dry ice being calculated taking into account the amount and/or nature of the products, the dry ice coming from a reservoir of dry ice.

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5. claims: 5, 6

A method for preserving products comprising the deposit of a dry ice quantity on and/or in a support, said quantity of dry ice being calculated taking into account the amount and/or nature of the products, the dry ice being formed during decompression of liquid CO_2.

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6. claims: 7(completely); 10(partially)

A method for preserving products comprising the deposit of a dry ice quantity on and/or in a support, said quantity of dry ice being calculated taking into account the amount and/or nature of the products and being recorded in a

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LACK OF UNITY OF INVENTION SHEET B

Application Number
EP 12 18 0867

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

database.

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7. claims: 8(completely); 10(partially)

A method for preserving products comprising the deposit of a dry ice quantity on and/or in a support, said quantity of dry ice being calculated taking into account the amount and/or nature of the products, wherein the quantity of dry ice remaining after or at the end of the stay of the products is measured.

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8. claims: 9, 11-13(completely); 10(partially)

A method for preserving products comprising the deposit of a dry ice quantity on and/or in a support, said quantity of dry ice being calculated taking into account the amount and/or nature of the products, wherein the quantity of dry ice consumed during the stay of the products in a container is recorded in a database - A corresponding database - And a computer readable medium comprising such a database.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 12 18 0867

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The members are as contained in the European Patent Office EDP file on
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31-01-2013

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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- FR 2706990 **[0004]**
- FR 2726353 **[0005] [0006]**
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