The invention relates to a method for temperature controlled transport. In the method, temperature controlled products are transported. In the method, a passive transport is used, in which the product is packed in an essentially energy tight transport package. In addition, in the method a thermal element, by which the internal temperature of the transport package is maintained as desired without external energy, is included in the transport package. Further, in the method the temperature of the transport package is monitored wirelessly essentially continuously. The invention also relates to a system for temperature controlled transport.
METHOD AND SYSTEM FOR TEMPERATURE CONTROLLED TRANSPORT

[0001] The present invention relates to a method for temperature controlled transport, in which method temperature controlled products are transported. The invention also relates to a system for temperature controlled transport.

[0002] For example, many foodstuffs require temperature controlled transport. Chilled transport is used for fresh produce and refrigerated transport for frozen produce. On the other hand, there are also products that must be kept warm for the entire duration of transportation. In the known manner, transport equipment is designed and dimensioned to correspond to a specific transportation need. For example, refrigerated transport equipment has insulated and sealed load spaces, as well as refrigeration machinery, by means of which the load space is continuously refrigerated.

[0003] First of all, the special equipping of transportation rolling stock leads to costs. Efficiency also suffers from separate transport, as products belonging to different temperature classes must be transported and handled separately. In other words, for example, products requiring chilled transport and products requiring refrigerated transport must be transported using different transportation means, even if the consignee is the same. In addition, the use of refrigeration machinery increases the consumption of fuel and electricity. Despite active freezing, there are often excessive temperature variations particularly when transporting frozen goods, which cut the refrigerated transport chain. In such cases, especially the quality of foodstuffs is endangered and in the worst case they will become unusable. Except for distribution transportation, frozen goods, for example, are transported in large batches between freezing plants and refrigerated warehouses. Transporting small product batches farther than the local area then becomes difficult and often impossible. Also other temperature controlled products are transported on their own totals. Correspondingly, the export of products generally requires the use of special containers or special trailers, the transportation of which to the destination country takes days, if not weeks. In addition, in the prior art the aforementioned container must often be returned empty to the original consignor, leading to additional costs. There are also special transport packages, which are intended to prevent changes in temperature. Such transport packages are, however, heavy and take up much space. In addition, the known transport packages are disposable. In order to keep an even temperature, various media are used, the effect of which is limited and their use in many applications is restricted.

[0004] The invention is intended to create a new type of method for temperature controlled transport, by means of which the limitations of the prior art can be avoided and by means of which an unbroken temperature controlled transport chain can be ensured. In addition, the invention is intended to create a new type of system for temperature controlled transport, by means of which saving are achieved, diversity and flexibility is brought to logistics, and a reliably even temperature is ensured for the entire duration of transportation. The characteristics features of the method according to the present invention are stated in the accompanying Claim 1. Correspondingly, the characteristic features of the system according to the invention are stated in the accompanying Claim 11. In the method according to the invention, a passive system is used, in which there is little energy transfer. Thus, the product will remain at the target temperature for even long periods of time without external energy. At the same time, the means of transport can be selected on the basis of other criteria than only temperature. Even forms of transport that were previously quite unsuitable can be used. At the same time, transportation is accelerated and previously essential intermediate stages can be eliminated.

[0005] In the following, the invention is described in detail with reference to the accompanying drawings depicting some embodiments of the invention, in which

[0006] FIG. 1a shows an example of an application of a transport means used in the method according to the invention,

[0007] FIG. 1b shows an example of an application of a transport package used in the method according to the invention,

[0008] FIG. 2 shows a schematic diagram of the structure of the system according to the invention,

[0009] FIG. 3a shows a warehouse application of the system,

[0010] FIG. 3b shows a second example an application of the transport means used in the method,

[0011] FIG. 4a shows an end view of a fourth example of an application of the transport means used in the method,

[0012] FIG. 4b shows an axonometric view of the transport means of FIG. 4a,

[0013] FIG. 5a shows a third example of an application of the transport means in the transport position used in the method according to the invention,

[0014] FIG. 5b shows the transport means of FIG. 5a in the return-transport position.

[0015] FIG. 1a shows an, as such, transport means 10, which can be used in the method according to the invention for transporting temperature controlled products. Thus, in the method, temperature controlled products are transported, for example, as chilled transport or refrigerated transport. Generally, in temperature controlled transport, the temperature of the product is maintained at a desired level. In the method according to the invention, a passive transport is used, in which the product 11 is packed in an essentially energy tight transport package 12. Thus, in chilled transport for example, the loss of cold to the environment is primarily prevented. Energy tightness also works in the opposite direction. Thus, the heating or cooling effect of the environment is not transmitted to the transport package and thus to the product itself. In addition, the transport package 12 includes a thermal element 13, by means of which the energy binding mass is increased. In addition, the thermal element even the temperature inside the transport package, which is important when maintaining the correct temperature. In other words, the thermal element is used to keep the internal temperature of the transport package as desired, without external energy. Thus, for example, in the refrigerated transport of frozen goods a cold gel mat can be used to store cold in the transport package for even transportation of a long duration. On the other hand, the cold gel mat can be used to keep the transport package evenly chilly even in hot conditions. The cold gel mat can also be used to prevent, for example, sensitive pharmaceutical products from freezing. In other words, it is unnecessary to heat the warehouse or the load space of the means of transport. In addition, the temperature of the transport package 12
is monitored wirelessly essentially continuously, so that the situation with the product being transported will be known the whole time.

[0016] Significant savings are achieved especially if the products are transported in a means of transport that are not temperature controlled. The demands of an energy tight transport package for temperature control are really small, as even an external thermal load will not cause the temperature of the product to rise. Thus, in practice even frozen food can be transported using a means of transport intended for normal piece goods transport, such as a truck, according to FIG. 1a. Separate temperature controlled load spaces are then unnecessary, so that savings are made in equipment and operating costs. The same also applies in the chill conditions in chilled transport.

[0017] Further, savings and flexibility are achieved in logistics when products 11 with different temperature ranges are transported in the same non-temperature controlled means of transport 10. This is entirely possible thanks to the energy tight transport packages. For example, in the truck of FIG. 1a, there are products with two different temperature ranges, along with products that are not temperature controlled. The loading of the means of transport can then be planned optimally, while scarcely having to worry about the contents of the load. In other words, the transport packages of the products at different temperatures can be next to each other and even on top of each other, so that loading can be optimized on the basis of delivery. The transport packages also isolate the products from each other, thus, for example, avoiding the mixing of odours between the products being transported.

[0018] In the method, non-disposable transport packages made from recyclable materials are preferably used. One such transport package 12 is shown in FIG. 1b. In terms of its main structure, the transport package is a box 15 equipped with a lid 14, which can be closed tightly. The size of the transport package can vary and larger totalities of them can be assembled, in order to accelerate handling. For example, two boxes can be stacked on top of each other on a castor pallet. There can also be intermediate lids or walls in the box. A thermal element 13, which keeps the temperature even for considerably longer, can also be advantageously placed around the products or inside an intermediate lid.

[0019] Unlike in FIG. 1b, the transport package can also have many parts. Only the necessary number of parts, which are fitted to each other, need to be used, thus optimizing the size of the transport package for each requirement. For example, a transport package with a maximum capacity of 1000 litres can be reduced to, for example, a capacity of 500 litres, by leaving some parts unused. The multi-part products also facilitate loading, while the parts can be stacked in a smaller space during return transport. At the same time, the temperature controlled volume can be optimized on the basis of the product, whereas in the prior art the entire load space, or at least the insulated part of it must be temperature controlled in its entirety. The dismantling of the transport package and the stacking of its parts substantially reduces the volume of the return transport.

[0020] The transport package is preferably manufactured from EPP material (cellular polypropylene). EPP material is durable but light in weight and has excellent insulation properties in both directions. Despite its insulating power, the wall thicknesses required are small, so that the useful capacity of the transport package will be as great as possible. The cellular structure of EPP material is closed, so that it is hygienic and will withstand water and steam washing. The transport package can thus be easily cleaned. A transport package manufactured from EPP material is also environment friendly, as it is non-toxic and can be used many times and is manufactured from a recyclable material.

[0021] Thermal elements are also referred to as cold gel mats, in which the cold gel is in several small compartments. The compartments are assembled to form a cold gel mat by seaming them inside a lacquered PVC fabric. The cold gel is non-toxic, safe, and decomposes biologically in nature. In use, cold gel is drip-free and can be re-frozen repeatedly. In addition, cold gel freezes faster than pure water. The thermal element is cooled to a temperature of, for example, +1°C in chilled transport and -23°C in refrigerated transport. In chilled transport, the temperature is kept close to zero and in refrigerated transport close to -21°C. The thermal element shapes itself to the product being transported, thus avoiding air pockets. In addition, warm air that may be inside the transport package will rise on top of the thermal element, further away from the product.

[0022] According to the method, the temperature is monitored using a condition monitoring apparatus 16, a separate and independent sensor 17 belonging to which being fitted inside the transport package 12. One such sensor 17 is shown in FIG. 1b. The sensor can also be integrated to form part of the transport package. However, the sensor is preferably an independent device, interference with the operation of which is prevented. In other words, once it has been installed, the sensor monitors the temperature uninterrupted, irrespective of external influences. This avoids errors and abuse by the operator. In addition, the device operates without an external power supply, thanks to a long-life battery. In practice, the life of the battery can be as much as five years. The sensor is preferably remotely read during transport and/or after transport. The wireless and essentially continuous remote reading is fast and reliable. At the same time, the removal of the sensor from the transport package is avoided. In other words, using remotely-readable sensing also avoids unnecessary opening of the transport packages. This clearly facilitates self-monitoring and surveillance by the officials. In addition, unnecessary heat transfer between the transport package and the environment can be avoided. By using suitable means and connections, the remote reading can be further extended more widely than the means of transport, so that several sensors can be monitored from one centre (FIG. 2). The structure of the system will be described in greater detail in connection with FIG. 2.

[0023] Significant savings can be achieved with the aid of the method, even simply from the reduction in the demands placed on the transport means and the combination of transports. In addition, even smaller consignments than previously can be transported quickly and reliably to the consignee. Air freight too now becomes a possible alternative. In the prior art, carbon dioxide ice is used. Because carbon dioxide gas displaces oxygen when it melts, its use in aircraft is limited. Thus, only about 240 kilograms of freight cooled by carbon dioxide ice can be transported in a jumbo jet. Using the system according to the invention, even the entire capacity of a jumbo jet can be utilized to carry similar freight. This is in the order of tens of tonnes. Thanks to the method, the entire transportation chain is straightened and simplified. The manufacturer or producer packs the products into energy tight transport packages along with pre-frozen thermal elements. The products are then transported using the most suitable
transport means at the time, without unnecessary delays and intermediate loading, to the consignee or end user, where the product is removed from the transport package. The product has then been at the correct temperature for the entire duration of transportation, which ensures the preservation and freshness of the product. The emptied transport package is returned to circulation, being, if necessary, cleaned before the next use.

Fig. 2 shows schematically the system, according to the invention, for temperature controlled transport. The system includes one or more means of transport 10 for transporting a temperature controlled product. According to the invention, the system further includes an essentially energy tight transport package 12 for the product. Depending on the size and number of the products, there can be several transport packages, which can be of different sizes. Preferably, general modular dimensioning is otherwise taken into account in the dimensioning of the transport package. In addition, a passive thermal element 13 (Fig. 1b) is fitted inside the transport package 12, in order to keep the internal temperature of the transport package at the desired level without external energy. The system also includes a condition monitoring apparatus 16 for monitoring the temperature wirelessly essentially continuously. The system is used according to the method described above, when significant savings and flexibility are achieved in logistics in both local and long distance transport. Particularly in air freight, the system is arranged in such a way that, prior to the loading of the aircraft, the sensor cuts the link to the condition monitoring apparatus. In other words, the sensor terminates transmission of information, but nevertheless uninterruptedly records the data detected by the sensor. After the aircraft has been unloaded, the sensor again establishes a link with the condition monitoring apparatus, when the data recorded during the flight will be again available. In addition, the sensor supports communications systems used on different continents. For example, in a communications system based on radio frequencies, the sensor selects the frequency and communications protocol appropriate at the time. Thus the consignor or consignee, and especially the forwarding agent need not look after the operation of the links, instead the sensor operates independently.

According to the invention, the condition monitoring apparatus 16 includes the independent and remotely readable sensor 17, which is fitted inside the transport package 12 (Fig. 1b). Fig. 2 shows the core of the condition monitoring apparatus 16, which is server equipment 18 together with the necessary peripherals 19. The server equipment is linked to the sensor through a telecommunications network, such as the Internet, directly or through an auxiliary transmitter, and collects real-time temperature data. The sensor also records humidity, acceleration, and position data. In addition, the sensor can record data on the actual product being transported. The temperature and other data also remain in the memory of each transport package, which can be utilized in the self-monitoring of a temperature controlled transport. In Fig. 2, besides a truck 20, the means of transport are an intermodal container 21 and an aircraft 22. However, the system can be applied in connection with any means of transportation whatever. Vehicle-based terminals are part of the condition monitoring apparatus, as are modern mobile devices, such as mobile communicators 23.

Temperature monitoring and history information are significant advantages in temperature controlled transport. The sensor preferably 17 includes processing means 25, recording means 26, and communications means 24 for recording data on the product 11 and creating and sending an alarm from the transport package 12 to the condition monitoring apparatus 16. The sensor is completely watertight and otherwise enclosed, so that it can be placed next to, or even inside the product (Fig. 36).

An alarm limit can also be set in the sensor, above which or below which the driver of the transport means or the central control room receives an alarm. This permits rapid reaction and thus minimizes the extent of possible damage. Transportation is also simplified by independence from the means of transport, even though the product may demand a precise temperature range. In addition to transportation, the products can also be stored in the transport packages without external energy. Thus, short-term cold stores, for example, can be reduced in size, or at least allow a clearly longer time for arranging the transportation of the products. The applications of the method and system are particularly the transportation of foodstuffs, pharmaceuticals and samples, health care related transport, and generally global transportation, in which reliable temperature controlled transport is required.

Fig. 3a shows schematically an application of the system according to the invention. Product data is also preferably contained in the sensor. Such data are, for example, the product's type, manufacturer, date of manufacture, consignor, and consignee. Based on the data, transport documents 27 and/or temperature reports 28 can then be created. In Fig. 3a, a forwarding agent is moving transport packages through an access opening 29. On both sides of the access opening 29 there are transceivers 30, through which the sensors communicate with the condition monitoring apparatus 16. The condition monitoring apparatus can be part of the warehouse management apparatus, or the warehouse management apparatus can be part of the condition monitoring apparatus, or the warehouse management apparatus can be connected to the condition monitoring apparatus, for example, over the internet. The situation in Fig. 3a can be, for example, a departing or arriving transport. In the case of a departing transport, when the products are taken out, the system identifies the products and prints the transport documents 27 automatically. The product data can also be entered in the system manually, or reader devices can be used. In the case of an arriving transport, the products are identified and are entered directly into the warehouse management apparatus. At the right-hand side of Fig. 3a is a second apparatus, which can be, for example, controlled by public officials. The temperature data of transportable products, and the temperature reports 28 created from them can be sent automatically to an official.

According to the invention, the transport package is arranged to form a foodstuffs apartment. For its part this permits continuous monitoring, because data is demanded from the foodstuffs apartment concerning transport, transport means, the foodstuffs being transported, and the transport temperatures and methods of ascertaining the temperatures. Thanks to the system, the monitoring is real-time and reliable. In addition, history data and reports can be obtained from the system easily and quickly. In Fig. 3b, two transport packages 12 are placed on top of each other and a castor pallet 31 is placed under them. Roller cages with side walls are then unnecessary. Fig. 3b also shows an enlargement of the sensor 17.

The method also takes logistics in its entirety into account. Thus, in the method, multi-part transport packages are used, the parts of which are detached from each other after
transport and the return transport of the parts without products takes place in a smaller volume than previously. Thus, the return transport can be made as efficiently and cheaply as possible. FIGS. 4a and 4b show a transport package 12 according to the invention, which is formed of several parts 32. The parts 32 are fitted detachably to each other and are arranged in such a way that the volume of the parts 32 is less than the volume of the transport package. In this case, the transport package is formed of six panel-like parts, from which the base 33, lid 34, and four side walls 35 of the transport package are formed. The parts are held together by openable catches 39. FIG. 4b uses a broken line to show an application, in which each side wall is formed from three pieces. Thus, the capacity of the transport package can be easily altered by changing the number of pieces. In this case, the size of the transport package is 940*1020*1340 mm (width*height*length). Thus, the parts of four transport packages can fit on an Euro pallet, for example. In practice, the space taken up is about half a cubic metre, whereas in the prior art the space taken up would be from one to two cubic metres.

System 34. System according to claim 29, characterized in that the transport package is formed from several parts, which are

Method according to claim 19, characterized in that the temperature is monitored using a condition monitoring apparatus, the separate and independent sensor belonging to which is fitted inside the transport package.

Method according to claim 22, characterized in that the sensor is remotely read during transport and/or after transport.

Method according to claim 22, characterized in that on the data on the product, on the basis of which transport documents and/or temperature reports are created, are contained in the sensor.

Method according to claim 19, characterized in that the product is removed from the transport package at the premises of the end user.

Method according to claim 19, characterized in that a non-disposable transport package manufactured from a recyclable material is used in the method.

Method according to claim 19, characterized in that, in the method, a multi-part transport package is used, the parts of which are detached from each other after transportation, and the parts are transported back without a product, in a volume less than before.

Method according to claim 19, characterized in that each transport package is arranged to form its own foodstuffs apartment.

System for temperature controlled transport, which system includes a means of transport for transporting a temperature controlled product, characterized in that the system further includes an essentially energy tight transport package, and a thermal element, by means of which the internal temperature of the transport package is maintained as desired without external energy, is placed in the transport package, and the temperature in the transport package is monitored wirelessly essentially continuously.

Method according to claim 19, characterized in that the products are transported in a non-temperature controlled means of transport.

Method according to claim 19, characterized in that products with different temperature ranges are transported in the same non-temperature controlled means of transport.

Method according to claims 19, characterized in that the temperature is monitored using a condition monitoring apparatus, the separate and independent sensor belonging to which is fitted inside the transport package.

Method according to claim 22, characterized in that the sensor is remotely read during transport and/or after transport.

Method according to claim 22, characterized in that on the data on the product, on the basis of which transport documents and/or temperature reports are created, are contained in the sensor.

Method according to claim 19, characterized in that the product is removed from the transport package at the premises of the end user.

Method according to claim 19, characterized in that a non-disposable transport package manufactured from a recyclable material is used in the method.

Method according to claim 19, characterized in that, in the method, a multi-part transport package is used, the parts of which are detached from each other after transportation, and the parts are transported back without a product, in a volume less than before.

Method according to claim 19, characterized in that each transport package is arranged to form its own foodstuffs apartment.

System for temperature controlled transport, which system includes a means of transport for transporting a temperature controlled product, characterized in that the system further includes an essentially energy tight transport package, and a thermal element, by means of which the internal temperature of the transport package is maintained as desired without external energy, is placed in the transport package, and the temperature in the transport package is monitored wirelessly essentially continuously.

Method according to claim 29, characterized in that the means of transport is non-temperature controlled.

Method according to claim 29, characterized in that the condition monitoring apparatus includes a separate, independent, and remotely readable sensor, which is arranged to be placed inside the transport package.

System according to claim 31, characterized in that the sensor includes processing means, recording means, and communications means for recording the data of the product and creating and transmitting an alarm from the transport package to the condition monitoring apparatus.

System according to claim 29, characterized in that the transport package is non-disposable and manufactured from a recyclable material.
arranged to be detachably attached to each other, and the parts are arranged in such a way that the volume of the parts is less than the volume of the transport package.

35. System according to claims 29, characterized in that the transport package is formed of two mutually similar pieces.

36. System according to claim 35, characterized in that a piece includes three walls arranged at right angles to each other, which have a single common connection point.

* * * * *