

Process and device for recycling and decontaminating pockets
such as disposable gloves for clean rooms

The present invention generally relates to the decontamination of pockets made of a natural material (latex) or of plastic materials such as polyethylene or polypropylene, or again, non-porous or micro-porous polymers, which are usually disposable after use, and which are used more specifically in controlled atmosphere environments.

More precisely, the invention relates to a process and to a device for recycling and decontaminating said disposable pockets for clean rooms.

The items concerned can thus be both plastic bags and gloves of natural or synthetic latex, vinyl or any other polymer. Also included are all articles in the form of pockets and the water permeability of which is very low, or even nil.

The only exceptions, in practice, are thus water permeable articles such as textile articles or any other article commonly capable of being washed and dried efficiently in domestic or industrial washing machines and dryers.

It is difficult to dry non-porous pockets as the water introduced into them at the time of washing is very hard to eliminate. There are, indeed, major factors preventing drying, in particular the surface tensions between the two thin inner layers that "trap" the water and the inability of steam to pass through the pocket owing to the non-porosity of the materials concerned.

This is true of the gloves presently used in clean rooms, and which are discarded each time the wearers leave the room, that is to say approximately every two hours.

Document DE1 642 128 describes a process for recycling and decontaminating pockets such as disposable gloves.

The process according to the invention enables the gloves to be recycled several times and they can thus be re-used as new, non-

downgraded gloves, for secondary uses, thus reducing their average cost and the proportion of articles scrapped.

It will be noted that the process and device according to the invention relate to products intended more especially for areas with controlled atmospheres and that, for this reason, the characteristics of the decontamination bath, as well as of the detergents used, are very important. Some decontaminating liquids are, indeed, liable to cause damage to the material, and detergents can be the cause of residual pollution on the articles, which is incompatible with their use in processes taking place in controlled atmosphere areas.

To date, decontamination has been conducted in industrial machines with de-ionised, filtered water as well as a detergent containing non-ionic, cationic or anionic surfactants. Washing parameters, such as time, temperature, spin drying speed and the number of cycles are variable, as are the volumes of water and amounts of detergent used.

In addition, to prevent water from entering the pockets, which subsequently poses drying problems, the pockets are tied round in bundles to make them hermetic.

Drying, for its part, is carried out in conventional industrial type dryers. The only factors governing the drying time are temperature and the volume of material loaded into the drum.

Such treatments are directly derived from the decontamination of textiles intended for controlled atmosphere areas and it will be readily appreciated that they permit only decontamination of the outer faces of the pockets.

Now, in the case of gloves or pockets already used in controlled atmosphere areas, it is not sufficient to wash only one face as, from one of the two faces, it is necessary to remove the user's perspiration and, from the other, the soiling elements due to the operation performed, since the glove has to be restored to its original configuration both physically and with respect to the absence of particles and bacteria.

The invention enables these drawbacks to be avoided by providing a process and a device by means of which a pocket or a glove can be washed on both faces, inner and outer, and a recycled and/or decontaminated product can thus be obtained, at a lesser cost than that of the same product when new, which makes it possible, at the same time, to limit industrial scrapping of the materials concerned.

A first object of the invention is thus a process for recycling and decontaminating pockets such as disposable gloves for clean rooms, a process which consists:

- 10 - in providing for the sorting of the pockets, indelibly marked, as well as their counting and the implementing of a computerised follow-up;
- in carrying out the washing and decontamination of the pockets using washing and rinsing waters, as well as equipment, that are
- 15 treated so as to be non-pollutant;
- in transferring the washed pockets, inside a sealed, conditioned enclosure, to a drying unit equipped with devices limiting the contamination of the products;
- in transferring the dried pockets to a packaging station located
- 20 inside the sealed enclosure, where they are introduced into bags;
- in directing the packaged pockets out of the sealed enclosure.

Another main object of the invention is a device for recycling and decontaminating pockets such as disposable gloves for clean rooms, to implement the process, a device wherein a washer, disposed downstream of a sorting station, has an exit door opening inside a sealed enclosure, the air of which is conditioned and in which the pockets are displaced in the direction of a dryer, likewise placed in the sealed enclosure.

Further particular features and advantages of the invention will emerge from the following description of an exemplary embodiment wherein reference is made to the annexed drawing, which is a schematic representation of the recycling and decontaminating device according to the invention.

Figure 1 schematically represents a glove recycling and decontaminating device.

The gloves, bearing markings indelible to water and solvents, are gathered in a sorting station 1. The gloves are turned right side out and sorted by hand or automatically according to size, in the case of those considered not to have indelible stains, or cuts or tears. Those considered as non-recyclable are scrapped. Thanks to the use of computerised follow-up of said marks, the numbers of articles per size, the number of articles scrapped and the number of times of recycling of the articles sorted and considered satisfactory are counted.

Computerised monitoring also makes it possible to ascertain, on a real time basis, who the user clients are and how the sizes used evolve, enabling the manufacturer to tailor its production campaigns to actual consumption. In addition, it makes it possible to process the documents of the sales chain, as well as to readjust new articles automatically for each client, thus meeting its industrial requirements, and to monitor in the module, whether fixed or mobile, all the parameters required for, and essential to, the correct operation of the module, allowing all operations to be halted when one of the parameters no longer meets the specifications permitting decontamination that responds to the industrial needs of the destination of the recycled products.

At the exit from sorting station 1, gloves 2 are directed (dotted line arrow) towards a washer 3, into which they are introduced via a door 4. The washer, disposed downstream of the sorting station, is supplied by an ultra-pure water producing unit 5. This water is obtained by filtration on activated charcoal to at least 5 microns. To the washing water is added a washing agent with at least one non-ionic or cationic surfactant of the quaternary ammonium type or a mixture of these surfactants. There is also added at least one disinfectant having bactericidal, viricidal, fungicidal and oxidising properties. The water is de-ionised or osmosed.

The rinsing water introduced into the washer is preferably filtered to at least one micron. Decontamination water is de-ionised and filtered to at least 0.45 microns.

Washer 3 is equipped with a non-return valve 6 on waste water discharge valve 7, as well as with at least one cartridge, not shown, for filtering to at least one micron, located on the vents of the machine. All of the elements designed for fluid circulation are of a non-pollutant material, that is to say one that permits only a minimal release of metallic ions or particles in water due to the different pieces in contact with the water.

10 The washer is provided with an exit door 8 opening inside a sealed enclosure 9, which thus limits the particulate contamination generated by the ambient air.

The gloves placed in the washer undergo at least one washing operation, at least one rinsing operation, at least one decontamination operation and at least one spin drying operation.

After the gloves have been recovered via door 8, they are displaced through enclosure 9, as shown by the solid line arrow, towards a dryer 10, the access door 11 of which is inside the enclosure.

In dryer 10 is placed a hermetic device permitting mechanical agitation of the products. Therein is also provided circulation of clean hot air, filtered to at least 1 μm , from a supply source 12, a negative pressure of at least 50 mbar being created. The drying of pockets of zero or very low porosity is thus made possible in a time that makes it possible to keep the products obtained competitive. There is also provided a complementary device for air ionisation making it possible, according to the industrial requirements indicated, to reduce the residual particulate contamination present on the pockets or the gloves and, in particular, to reduce significantly the number of particles with dimensions of less than 1 μm , or to modify potentially the electrostatic charges of the pockets or gloves.

30 After this drying operation, the gloves are directed (dotted line arrow), still in sealed enclosure 9, towards a packaging station 13 internal to said enclosure, downstream of dryer 10. The pockets or gloves are introduced

therein into bags or blister packs, for example of polyethylene or polypropylene, which are clean with respect to particles and made in the form single or double packages, with tight welds and under partial vacuum.

Once packaged, the articles are directed out of sealed enclosure 9.

- 5 Inside this enclosure, in which the operations of washing, drying and packaging and transfers between stations consequently take place, and in which are located the equipment and personnel required to perform the different manual operations and tasks, the air is conditioned and controlled with a supply of clean, fresh air at an hourly renewal rate at least equal to 10.
- 10 This environment, commonly known as a "clean room", is necessary to ensure the cleanliness with respect to particles essential for the products treated by the device. Consequently, the operators in charge of these operations wear at least gloves, special headgear and one-piece garments with features similar to those of the ones used in clean rooms according to
- 15 the rules in force. If certain operations are carried out by automatic systems, these should be adapted so as not to be pollutant.

The process according to the invention thus provides a technical and industrially competitive solution to the recycling of pockets or gloves of zero or low porosity.

- 20 It makes it possible, in fact, by comparison with the processes used hitherto, to wash efficiently both faces of the products concerned by means, in particular, of the specific drying technique that permits evaporation of the liquid phase present inside the pockets or gloves while, at the same time, reducing, thanks to the recycling operation, the cost price of the product in
- 25 relation to that of a new product.

- The process also reduces the waste from the products concerned sent to the dumping ground or the incinerator, permitting their recycling, hence their re-use, at a low cost price, something that is presently carried out on an industrial scale in the case of highly porous materials, of the textile type, but
- 30 very little, and non-profitably, in that of the products concerned by said process.



CLAIMS

1. Process for recycling and decontaminating pockets (2) such as disposable gloves for clean rooms, characterised in that it consists:
 - 5 - in providing for the sorting of the pockets, indelibly marked, as well as their counting and the implementing of a computerised follow-up;
 - in carrying out the washing and decontamination of the pockets using washing and rinsing waters, as well as equipment, that are treated so as to be non-pollutant;
 - 10 - in transferring the washed pockets, inside a sealed, conditioned enclosure (9), to a drying unit equipped with devices(11) limiting the contamination of the products;
 - in transferring the dried pockets to a packaging station (13) located inside the sealed enclosure, where they are introduced into bags;
 - 15 - in directing the packaged pockets out of the sealed enclosure (9).
2. Recycling and decontaminating process according to claim 1, characterised in that the pockets (2) are turned right side out and sorted according to size after being marked individually and so as to be indelible to water and to solvents.
- 20 3. Recycling and decontaminating process according to claim 1, characterised in that there is added to the washing water a washing agent with at least one non-ionic, or cationic, surfactant or a mixture of these surfactants, and at least one disinfectant having bactericidal, viricidal, fungicidal and oxidising properties.
- 25 4. Recycling and decontaminating process according to claims 1 and 3, characterised in that the pockets (2) undergo at least one washing, at least one rinsing, at least one decontaminating and at least one spin drying operation.
- 30 5. Recycling and decontaminating process according to claim 1, characterised in that, in the drying unit (10) there is provided circulation of hot air filtered to at least 1 μ m and a negative pressure of at least 50 mbar.



6. Recycling and decontaminating process according to claims 1 and 5, characterised in that particulate contamination of the pockets (2) is reduced by potentially modifying their electrostatic charges.
- 5 7. Recycling and decontaminating process according to claim 1, characterised in that the pockets (2) are introduced into bags made in the form of single or double packages with tight welds and under a partial vacuum.
- 10 8. Device for recycling and decontaminating pockets such as disposable gloves for clean rooms, for implementing the process according to claims to 1 to 7, characterised in that a washer (3) disposed downstream of a sorting station (1) has an exit door (8) opening inside a sealed enclosure (9) the air of which is conditioned, and in which the pockets (2) are displaced in the direction of a dryer (10), and in that a packaging station (13),
- 15 downstream of the dryer, is also placed in the sealed enclosure.
- 20 9. Recycling and decontaminating device according to claim (8), characterised in that the washer (3) is equipped with a non-return valve (6) on the waste water discharge valve (7), as well as with at least one cartridge for filtering to at least one micron located on the vents of the drum of the machine.
10. Recycling and decontaminating device according to claim 9, characterised in that the circulation of clean hot air through the dryer (10) comes from a supply source (12) external to the sealed enclosure (9).