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Description

The present invention relates to a method and a device for removing undesirable odours from various materials, particularly smoke odour.

The common traditional method of removing undesirable odours is to ventilate the affected object. This method is based on the fact that, in order to perceive that a substance has an odour, it must have a certain volatility at normal temperatures and thus be able to pass from solid or liquid form into gas form and then through air circulation finally end up in the nose of the person sensing the smell. Solid substances which do not have such volatility therefore do not smell.

Even if a substance has vapour pressure (which is the same as volatility), this does not, however, mean that it will be perceived as smelling by the human sense of smell. Pure water has high volatility but is not considered to have any smell. No explanation has been forthcoming as to why certain substances smell and others do not despite a measurable volatility.

The amount of a gas required to produce a smell sensation varies considerably from one substance to another. Aceton, a common solvent, has a characteristic and rather pleasant smell. Its threshold value, i.e. the content in the air at which the smell is just perceivable, lies at a level of about 100 mg aceton per m³ air. A chemically similar substance but with an entirely smell is butyric acid, having a threshold value of 0.001 mg butyric acid gas per m³ air. The nose is thus 100,000 times more sensitive to this gas, and no one knows why.

One of the more common odour problems is caused by smoke. In a fire, the actual damage from fire is often considerably less than the value of the smoke-damaged textile materials, which in fires in carpet stores and fashion shops can reach enormous sums.

By airing and ventilation, the smell-producing substance is continually transferred from the textile material to the surrounding air, and gradually the smell-producing substance is completely absorbed and the smell ceases. This method, however, takes a very long time if the threshold value for the smoke odour is very low and if the smoke gases adhere to the textile material. Such smoke-damaged textile materials are therefore treated with air with ozone (see DE—A—2215269), whereby the odorous substances are oxidized to other less odouriferous compounds. It is true that this method produces good results, but ozone is firstly a particularly toxic gas, and secondly is quite aggressive and can easily damage colours and materials if too much is used. The present invention constitutes a significant improvement over previous methods and will be described in detail with reference to the accompanying drawing which shows the application of the invention to a smoke-damaged jacket.

The smoke-damaged jacket 1 is enclosed in a sealed container 2 which can be connected via a

pipe connection 3 to a vacuum. When the box is evacuated to a pressure of several torrs, which can be done with a simple vacuum pump, the smell-producing components which have adhered to the outer and inner surfaces of the textile material are vapourized to a greater or lesser degree. The vapourization takes place more quickly in a vacuum than at atmospheric pressure since air molecules no longer obstruct or retard the evaporation of the smell-producing components. An equilibrium is quickly achieved between the remaining adsorbed substance and the evaporated substance.

The air which is smell-saturated, which was in the textile material surrounding its fibers, will now expand because of the vacuum and completely fill the entire volume of the container. Continuous pumping during this phase, with a simultaneous leaking in of small amounts of fresh air, will remove the odorous air contained in the container.

After this step, the container is pressurized to atmospheric pressure with clean air. This air will now be drawn even into the pores of the textile material and there absorb additional vapourized, odouriferous material from the surfaces of the textile fibers. By alternating in this manner between evacuation and pressurization with such periodicity as to allow the expanding and smell-carrying air to be pumped out before fresh air is allowed into the pores of the textile material, a stage is reached, after 3—5 cycles, where the remaining smell-producing substance in the jacket has practically disappeared or is in any case below the odour threshold level. A heat loop 4 can be added in the vicinity of the textile material to accelerate the evaporation by heating. The temperature increase is of course adapted so that the textile material is not damaged by the heat.

A cooling loop 5 is also mounted in the container, and its surface temperature is kept suitably at -10—-20°C. Thus the evacuation can be shut off or kept at low capacity, since the gases freed from the textile material, the odour substances, water vapour etc., will condense on the surface of the cooling loop in accordance with the cold wall principle. This also produces a lower pressure than what a simple vacuum pump normally produces.

In order to prevent the textile material from coming into contact with the heat loop or the cooling loop, bars 6 can be mounted inside the container.

The unit according to the invention can be made both for stationary and portable use and thus can be quickly implemented for cleaning operations at out-of-the-way locations. The only requirement is that the container must be airtight and sufficiently strong to withstand the external air pressure when evacuated.

The method according to the invention produces a much more rapid and effective odour removal than what was previously possible. The method has also in certain cases been improved upon further, by using various chemicals at the

same time. When removing odours from smoke-damaged material, it is possible to add small amounts of ozone to the air left into the container. Likewise, if there are acidic compounds, small amounts of ammonia can be added to neutralize the odour-producing substances and thus facilitate cleaning.

The invention has been studied experimentally with regard to the removal of aggressive hydrochloric acid gas from textile materials. In fires with combustion of plastics of polyvinyl chloride (PVC) type, hydrochloric acid gas is produced from the heated plastic. This gas is eagerly absorbed on both metal surfaces and in porous material. In order to study the effectiveness of removing hydrochloric acid from textile materials, the following experiment was carried out.

Four balls of cotton, No. 1, 2, 3 and 4, were subjected in a glass chamber to gas from heated PVC. No. 1 was used as a reference. No. 2 was placed in a small evacuation chamber from which all the air was drawn out two times, and was pressurized therebetween with fresh air. No. 3 was subjected to the same treatment as No. 2 but with the difference that the last pressurization was done with air in which small amounts of moist gaseous ammonia were present. After the last pressurization, No. 3 was placed in fresh air for a few minutes until the smell of ammonia had disappeared. Finally, No. 4 was placed in fresh air for two hours, and a certain amount of air circulation was maintained around the cotton. After completed exposure, each of the balls was placed in a beaker with 100 ml of distilled water, and the chloride content and pH-value were determined by known analytical techniques.

The following results were obtained: Mere ventilation at normal pressure (No. 4) produced a reduction of the amount of chloride to 80% of the original value. Evacuation and pressurization (No. 2), however, caused a reduction in residual chloride to less than 2%. The pH-value was changed very little in No. 4 in comparison to the reference No. 1; both values were at about 2.2. The pH-value in No. 2, however, had risen to 4.0 and in No. 3 was as high as 8.2. The total time taken for two evacuations and two pressurizations was 10 minutes. The experiment demonstrates that the suggested method makes it possible to, on the one hand, remove most of the odouriferous and aggressive hydrochloric acid gas, and, on the other hand, neutralize residual acid by chemical manipulation.

A second experiment was carried out with two balls of cotton, No. 5 and 6. A drop of butyric acid was placed in each. No. 5 was a reference and No. 6 was moistened with water and placed in an evacuation chamber, which was first evacuated and then pressurized with air containing a small amount of ammonia, and after 10 minutes it was again evacuated. A small amount of methyl iodide was then introduced into the chamber which was left for an additional 10 minutes. The chamber was then pressurized. Finally, the ball of cotton was left for an additional 10 minutes in fresh air and a comparison was then made for odour intensity

between the two balls. A markedly lower odour intensity was observed in No. 6 compared with the reference.

The results are explained as follows. The major portion of the butyric acid can be evacuated as a gaseous mixture of water and butyric acid. The remaining butyric acid which still produces odour must, however, be removed by chemical means, in this case by conversion, with the aid of ammonia, of butyric acid to ionogenic form, whereafter it can be converted by methylation to a butyric acid derivative of considerably lower odour intensity. The suggested evacuation technique in combination with pressurization with specific chemicals thus makes it possible to eliminate difficult odour problems.

The invention has been used in practice in connection with a fire in a carpet store, where a number of valuable carpets were smoke-damaged so as to be unsalable. Odour-cleaning according to the invention, where the temperature of the heat loop was kept at 40°C, and of the cooling loop at -20°C, and small amounts of ammonia gas were added, made the carpet practically odour-free in a few hours.

In order to study the combined effect of the invention described here and conventional ozone treatment, the following experiment was carried out. A smoke-damaged leather coat was placed in an evacuation chamber, and the pressure was then reduced to 0.01 atmosphere. The pumping was continued for 5 minutes at this underpressure. The chamber was then pressurized to 1 atmosphere with air containing 3 ppm (= parts per million) of ozone. The unit was then left for 10 minutes, and evacuation was then done to 0.01 atmosphere, and was immediately thereafter pressurized with clean air without any ozone additive. The chamber was opened and the garment was removed. All the odours had now disappeared, both the smoke odour and the ozone odour.

What had happened was that during the first evacuation, the major portion of the odour producing substances were able to vaporize and be pumped out from the object. In the subsequent pressurization with ozone-containing air, the ozone was allowed to penetrate deep into the previously air-filled pores of the leather and there exert its oxidizing and odour-removing effect on the odour-producing substances. The subsequent evacuation served to remove the residual amounts of the toxic ozone gas.

The entire procedure took 0.5 hours. This can be compared with 24 hours which conventional ozone techniques usually take for the same type of object.

The smell of solvent from dry-cleaning can be removed in the same manner from textile materials. By adding various substances producing desirable odours to the air in the last pressurization, the material can be perfumed in various ways, e.g. plastic material can be made to smell of leather.

Claims

1. Method of freeing sensitive material of odours, particularly removing odours from textile materials after smoke damage from fires, characterized in that the material is subjected to alternating vacuum and atmospheric pressure.

2. Method according to Claim 1, characterized in that the material is heated.

3. Method according to Claim 1 or 2, characterized in that the evacuation effect is amplified by arranging a cooling loop in the vicinity of the material.

4. Method according any one of Claims 1—3, characterized in that when the material is subjected to atmospheric pressure after evacuation, the air supply has at the same time a chemical which is reactive with one of the odour-producing substances.

5. Device for removing odours from sensitive materials, characterized in that it consists of an airtight container (2), in which the material is placed, means (3) for evacuating the container, heat loops (4) for heating the air in the container, cooling loops (5) for condensing the odour-producing substances, water vapour, etc. and possibly one or more protective bars (6) for keeping the sensitive material in place and preventing contact with the cooling and/or heating loops.

Patentansprüche

1. Verfahren zum Befreien von empfindlichem Material von Gerüchen, insbesondere zum Entfernen von Gerüchen von textilen Materialien nach einer Rauchschädigung durch Brände, dadurch gekennzeichnet, daß das Material wechselweise Vakuum und atmosphärischem Druck ausgesetzt wird.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß das Material erwärmt wird.

3. Verfahren nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Evakuierungswirkung durch Anbringung einer Kühlschleife in der Nähe des Materials verstärkt wird.

4. Verfahren nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß dann, wenn das Material nach der Evakuierung atmosphärischem Druck ausgesetzt wird, die zugeführte Luft gleichzeitig eine Chemikalie enthält, welche mit einer

der geruchserzeugenden Substanzen reaktionsfähig ist.

5. Vorrichtung zum Entfernen von Gerüchen von empfindlichen Materialien, dadurch gekennzeichnet, daß sie aus einem luftdichten Behälter (2), in den das Material eingebracht wird, Mitteln (3) zum Evakuieren des Behälters, Heizschleifen (4) zur Erhitzung der Luft im Behälter, Kühlschleifen (5) zum Kondensieren der geruchserzeugenden Substanzen, des Wasserdampfes od. dgl. und gegebenenfalls einer oder mehrerer Schutzschranken (6) besteht, mit deren Hilfe das empfindliche Material an Ort und Stelle gehalten und sein Kontakt mit den Kühl- und/oder Heizschleifen verhindert wird.

Revendications

1. Procédé pour débarrasser d'odeurs un produit sensible, particulièrement pour débarrasser des produits textiles des odeurs de fumée résultant d'incendies, caractérisé en ce que le produit est soumis à des alternances de vide et de pression atmosphérique.

2. Procédé selon la revendication 1, caractérisé en ce que le produit est chauffé.

3. Procédé selon la revendications 1 ou 2, caractérisé en ce que l'effet de l'évacuation d'air est amplifié en disposant un serpentin de refroidissement au voisinage du produit.

4. Procédé selon l'une quelconque des revendications 1 à 3, caractérisé en ce que, lorsque le produit est soumis à la pression atmosphérique après une évacuation d'air, l'air qui arrive contient en même temps un produit chimique qui réagit avec l'une des substances provoquant les odeurs.

5. Dispositif pour débarrasser d'odeurs des produits sensibles, caractérisé en ce qu'il comporte une enceinte étanche à l'air (2) dans laquelle est placé le produit, des moyens (3) pour évacuer l'air de l'enceinte, un serpentin chauffant (4) pour chauffer l'air dans l'enceinte, un serpentin de refroidissement (5) pour condenser les substances provoquant les odeurs, la vapeur d'eau, etc. ..., et éventuellement un ou plusieurs barreaux de protection (6) pour maintenir en place le produit sensible et empêcher tout contact avec le serpentin de refroidissement et/ou le serpentin chauffant.

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