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(54) Title: MANUFACTURED PRODUCT DIFFUSING VOLATILE INGREDIENTS

(57) Abstract: The present invention relates to the field of diffusion of volatile ingredients in the environment. It relates more particularly to a manufactured product comprising an absorbent material for volatile substances containing biochar used as a carrier for active volatile ingredients, which allows for an effective and prolonged evaporation of said ingredients.



MANUFACTURED PRODUCT DIFFUSING VOLATILE INGREDIENTS

Technical field

5 The present invention relates to the field of airborne delivery of volatile materials. It relates more particularly to a manufactured product that provides an effective and prolonged release of active volatile ingredients in the environment, such as a perfume composition. The product of the present invention contains an absorbent material of volatile ingredients which
10 comprises a carrier essentially made of a biological material, namely biochar.

Prior art

15 The use of various articles for the diffusion of volatile compounds, for example perfumes, sanitizing agents, insect repellents and the like, has become more and more current in the recent years. Air-freshening devices or deodorizers are currently used in practically all households to mask bad odors and/or to diffuse fragrances or other volatile active ingredients to the air surrounding the device, in particular in rooms such as bathrooms, toilets, kitchens and cupboards, litter containers, and other closed environments.

20 Amongst the various types of compositions that can be used to diffuse fragrances and other air modifying substances such as purifying or sanitizing agents, one class of systems capable of diffusing active volatile ingredients are solid state devices consisting of solid materials or carriers impregnated with active ingredients. Such devices may be formed of various materials which are capable of absorbing the active ingredient and subsequently releasing it in a more or less controlled manner. Examples of such known materials include gels, synthetic
25 polymer resins, or blocks of mineral material, e.g. plaster or silica or clays.

30 Materials that are able to absorb undesirable scents present in the air while serving at the same time as a carrier for aromas, fragrances or other active ingredients have also been described in the prior art. US6635344 for example discloses a product described as having this dual functionality, which consists of particles obtained from the milling, separation, air wash and classification of the different fractions obtained from corncobs.

Use of absorbent substances or products for eliminating unpleasant smells from the air which are characterized by the fact that they retain the malodor molecules inside their molecular structure have also been described by prior arts. Those substances include charcoal, alkaline compounds such as sodium bicarbonate, aluminum silicates and Zeolite. However, those material
5 are not necessarily performing in releasing volatile ingredients in the airborne.

There is still a need to find systems which can absorb volatile materials and subsequently release them without “interacting” with such materials, i.e. systems being able to restore such materials in the airborne in a performing way, both in terms of quantity and quality, without altering their properties.

10 It has now been found that biochar can be used in that context and provide a performing carrier for volatile ingredients absorbed therein, capable of diffusing said ingredients, such as a perfume over time with an intact profile. Biochar has been the object of many publications in the recent years in particular in the context of efforts made to valorize organic materials prepared without production of CO₂. Main applications described so far include trapping of heaving
15 metals, fertilizers, recovering urea from sludge, absorbent of organic pollutants like halogenated compounds. However, the use of biochar as a carrier or reservoir for active volatile ingredients has never been described or suggested heretofore.

Summary of the Invention

20 The invention relates to a manufactured product for the diffusion of active volatile ingredients in the airborne, containing an absorbent material of volatile substances, said material comprising a carrier based on biochar, which turned out to demonstrate excellent release properties over time of volatile active ingredients absorbed therein. In particular, said product can be very advantageously used for the diffusion of perfume in the airborne, preserving an
25 excellent perfume profile over time and providing a long lasting effect which are both benefits of high interest to the perfumery industry. The product of the invention can also be used to diffuse other types of volatile ingredients in the environment including close spaces such as, but not limited to, an insect repellent, insect attractant, insecticide, a pesticide, a fungicide or a sanitizing or air-purifying material, a malodour counteractant, or an antimicrobial ingredient.

A first object of the present invention is therefore a manufactured product for the diffusion of active volatile ingredients in the airborne comprising:

- a composition of matter containing an absorbent material comprising a carrier consisting essentially of biochar, and
- dispensing means to dispense at least partly in the airborne active volatile ingredients.

A second object of the invention consists of a process for the preparation of a manufactured product as defined above, comprising the step processing the absorbent material into a manufactured product and loading said material with active volatile ingredients.

The use of biochar, in particular biochar derived from human solid waste as a delivery system for active volatile ingredients constitutes another object of the invention.

Also, a composition of matter containing an absorbent material comprising a carrier consisting essentially of biochar loaded with volatile active ingredients is part of the invention.

Finally a method to modulate, enhance or modify the evaporation of active volatile ingredients comprising the step of loading a manufactured product as defined above with volatile ingredients is also an object of the present invention.

Brief Description of the Drawings

Figure 1 is a schematic representation of a process for the preparation of biochar derived from human solid waste.

Figure 2 represents the release pattern of biochar A & biochar B described in example 1.

Figure 3 represents the release of volatiles by functional groups for biochar B described in example 1) compared to cellulosic material and active charcoal.

Figure 4 is an extraction pattern of volatile compounds from biochar compared to cellulosic material and active charcoal.

Figure 5 represents the loss weight monitored in climate chambers with controlled humidity and temperature.

Figure 6 shows the results obtained from a sensory panel comparing the performance of cellulosic material vs Biochar B for an aldehyde mixture.

Description of the invention

It has been found that biochar material had a micro-porous structure which makes it very useful to act as a reservoir for volatile active ingredients and which is capable to provide a very efficient delivery system for those ingredients, for example in the form of a perfume composition. Compared to existing plastics or non-biodegradable existing systems for diffusing perfume in the air, the solution according to the invention is advantageously environmental friendly. Also it is a great way to bring value to biochar, a new generation of waste organic material treatment consisting in burning organic material under inert atmosphere. In the context of the present invention, biochar is preferably derived from solid human waste.

A first object of the present invention therefore consists of a manufactured product for the diffusion of active volatile ingredients in the airborne comprising:

- a composition of matter containing an absorbent material comprising a carrier consisting essentially of biochar, and
- dispensing means to dispense at least partly in the airborne active volatile ingredients.

Biochar is used to describe a material resulting from the pyrolysis i.e. heat treatment in the absence of oxygen, of any biological material. It has been usually dedicated to agricultural purposes. Transformation by pyrolysis of organic waste materials such as rice hulks, spoiled vegetables or manure is thus widely investigated. It has now been surprisingly found that biochar was performing as a delivery system for active volatile ingredients, including perfume. In the latter case, the product according to the invention presents an additional advantage compared to other biodegradable materials which can be used as solid delivery system, namely cellulosic pads. In particular, the problem of those prior art systems is that if they are used to diffuse a perfume containing aldehydes, the latter chemicals are oxidized to their corresponding acids, which provides on a longer term, off notes like rancid waxy odors are building up. Perfumes used with those systems therefore need special design, without aldehydes. The product of the invention is advantageously totally inert *vis-à-vis* aldehydes and therefore opens new avenues for creation of perfumes to be diffused in the airborne.

It has been found that biochar has a micro-porous structure with a certain kind of polarity that makes the material suitable for use as a reservoir for volatile active ingredients.

Advantageously the system of the invention allows modifying the release pattern over time of the

volatile active ingredients absorbed therein compared to prior solutions. Also, it has been found that active ingredients of different volatility are released in a way that the overall profile of the composition is not altered.

According to an embodiment, the composition of matter comprises active volatile
5 ingredients.

According to a particular embodiment, the biochar is loaded with the active volatile ingredients.

In all embodiments of the invention, the composition of matter preferably comprises from 50 to 99%, preferably from 70 to 90% by weight of biochar based on the total weight of the
10 composition of matter.

In all embodiments of the invention, the composition of matter preferably comprises from 1 to 50%, preferably from 10 to 30% by weight of active volatile ingredients based on the total weight of the composition of matter.

According to an embodiment, the composition of matter further comprises a binder
15 chosen in the group consisting of polyethyleneglycol, latex, polyvinylacetate, modified cellulose (e.g. carboxymethylcellulose), starch, modified starches (e.g. carboxymethylstarch), clays, gums (e.g. gum Arabic), lignin, sodium lignosulfonate, magnesium stearate, and mixtures thereof.

Typically, the binder is used in an amount comprised between 5 and 25% by weight based on the total weight of the composition of matter.

According to a particular embodiment, the composition of matter consists of biochar
20 and active volatile ingredients.

According to the invention, the manufactured product comprises dispensing means to dispense at least partly in the airborne active volatile ingredients.

According to the invention, "dispensing means" should be understood as any means
25 suitable to dispense at least partly in the airborne active volatile ingredients.

According to a particular embodiment, dispensing means are the biochar itself.

However, the manufactured product can comprise other dispensing means.

Indeed, the manufactured product can comprise simple dispensing means such as opening(s) (for example in bags, boxes, containers), or more complex dispensing means such as mechanical
30 systems (pump, pressurized spray system) or electrical systems.

According to a preferred embodiment the biochar component used in the manufactured product according to the invention results from a pyrolysis of human solid waste material. The human solid waste consists of human fecal material optionally mixed with sawdust. Sawdust has typically a density of 0.3-0.48g/cm³ and can be sourced from untreated cypress, pine, or cedar. It is in the form of powder. Figure 1 represents schematically how biochar from human solid waste can be prepared. The toilet system is urine diverted system, which implies that urine and fecal material are separated. The fecal material is collected in a drum placed underneath the pit. The drum is collected and replaced every afternoon. The fecal plus sawdust heat treatment starts after one day to maximum 7 days.

Preferred temperatures for said process are comprised between 200 and 650°C, more preferably between 200°C and 300°C. Optionally, the biochar component of the invention can be blended with other natural waste products including but not limited to cellulose, lignin, chitin.

According to a particular embodiment, the manufactured product according to the invention comprises active volatile ingredients selected from the group consisting of perfuming ingredients, insect attractants and insect repellants, insecticides, pesticides, fungicides, sanitizing and air-purifying materials, malodour counteracting, antibacterial ingredients and mixtures thereof.

According to a particular embodiment, the active volatile ingredients comprise a perfume. As mentioned above, the product of the invention is particularly advantageous over prior art systems using cellulosic pads for releasing perfume, as contrary to such materials, biochar turned to be “inert” vis-à-vis perfuming ingredients, in particular aldehydes. As shown in comparative example below, cellulosic material oxidizes aldehydes which alter their olfactory profile. As “perfume” one may use any perfuming ingredient or a mixture thereof. A “perfuming ingredient” is meant here to designate a compound which is of current use in the perfumery industry, i.e. a compound which is used as active ingredient in perfuming compositions or in perfumed products in order to impart a hedonic effect into its surroundings. In other words, such an ingredient or mixture, to be considered as being a perfuming one, must be recognized by a person skilled in the art of perfumery as being at least able to impart or modify, preferably in a positive or pleasant way, the odor of a composition or product, and not just as having an odor. Moreover, this definition is also meant to include compounds that do not necessarily have an odor but are

capable of modulating the odor of a perfuming composition or of a perfumed product and, as a result, of modifying the perception by a user of the odor of such a composition or product.

The nature and type of these perfuming ingredients do not warrant a more detailed description here, which in any case would not be exhaustive, the skilled person being able to select them on the basis of his general knowledge, the intended use or application and the desired organoleptic effect. In general terms, these perfuming ingredients belong to chemical classes as varied as alcohols, aldehydes, ketones, esters, ethers, acetates, nitriles, terpene hydrocarbons, nitrogenous or sulphurous heterocyclic compounds and essential oils. Said perfuming ingredients can be of natural or synthetic origin. Many of these ingredients are in any case listed in reference texts such as the book by S. Arctander, *Perfume and Flavor Chemicals*, 1969, Montclair, New Jersey, USA, or its more recent versions, or in other works of a similar nature, as well as in the abundant patent literature in the field of perfumery. It is also understood that said ingredients may also be compounds known to release in a controlled manner various types of perfuming compounds. According to a preferred embodiment, the perfume contains aldehydes.

Typically, the perfume may also contain a carrier of current use in perfumery such as a solvent. The amount and nature of such current perfume additives can be selected and its amount adjusted by the skilled person so as to not adversely affect the properties of the carrier according to the invention. Perfume ingredients or mixtures of ingredients may also be carried in an encapsulated form, enclosed in encapsulating carriers of current use in perfumery. Fragrance microcapsules may be advantageous to protect particularly fragile perfuming ingredients, or yet to delay the release of certain perfume components and thus create a slow release impact. The same applies when so-called pro-fragrances (i.e. chemical substances of high molecular weight, generally not odorant as such but able to generate an odorant by chemical or photochemical reaction under use conditions) are used according to the invention.

The product of the invention can benefit to other active volatile ingredients used separately or in combination with a perfume and including insect attractant and insect repellent insecticides, pesticides, fungicides, sanitizing and air-purifying materials, malodour counteracting and mixtures thereof. By the term "malodor counteractant" or "malodor counteracting ingredient" we mean here compounds which are capable of reducing the perception of malodor, i.e. of an odor that is unpleasant or offensive to the human nose, by

counteracting and/or masking malodors. In particular embodiments, these compounds have the ability to react with key compounds which are known or suspected to be the cause of the malodor. The reactions result in reduction of the malodor materials' airborne levels and consequent reduction in the perception of the malodor.

5 The active volatile ingredient may also be an insect repellent. Non-limiting examples of suitable insect repellents include citronella, dimethyl phthalate and n,n-dimethyl-m-toluidide, but any other insect repellent agent can be used according to the invention.

10 The active volatile can be dissolved in any suitable solvent. According to a preferred embodiment of the invention, the solvent is free of VOC compounds. By "VOC" we mean here the Volatile Organic Compounds as defined by the Environmental Protection Agency, and in particular we mean C₁-C₅ alkanols, such as ethanol, or C₁-C₅ alkanediols, such as ethylene glycol.

15 Examples of particularly appreciated VOC free solvents are methoxylated siloxanes (for example those sold under the Dow Corning[®] Fluid trade-names), mineral oils and vegetable oils such as for example olive oil, castor oil and sunflower oil.

In all embodiments of the invention, the amount of active volatile ingredients is preferably comprised between 1 to 50%, more preferably between 10% and 30% by weight of the composition of matter.

20 The manufactured product according to the invention can take several format holding powders. According to a preferred embodiment said product is in the form of a compressed tablet, a sheet, a tea bag, or a diffusing stick air freshener, or a perfumed powder.

25 The preparation of a product according to the present invention is another object of the invention and includes the step of processing the absorbent material into a manufactured product, and loading said material with active volatile ingredients. In a particular embodiment the absorbent material consists of biochar which is compressed into tablets for instance using a hydraulic press (Perkin-Elmer) applying 10 T/cm².

According to another embodiment, the absorbent material further comprises cellulose or wood and the biochar carrier is plated on the other absorbent material.

30 There are then several options to add the volatile ingredients to the carrier. According to one embodiment, the biochar is compressed to form tablets and the volatile compositions, e.g. a

perfume is then simply absorbed on tablets or the perfume is dry blended with biochar and presented in a teabag.

The use of biochar used as a delivery system or reservoir for releasing volatile active ingredients, is also an object of the present invention. According to a specific embodiment the biochar is derived from solid human waste. According to a specific embodiment the volatile active ingredients comprise a perfume composition. All the other embodiments relating to the biochar and the volatile active ingredients described for the manufactured product also apply for this object of the invention.

As illustrated in the examples below, the delivery of a perfume over time is very advantageous with the system of the present invention, in particular in terms of perfume profile which is maintained and extended up to 72 hours without alteration of the perfume.

Another object of the invention is a composition of matter containing an absorbent material comprising a carrier consisting essentially of biochar loaded with active volatile ingredients.

The composition of matter can be used for the diffusion of active volatile ingredients in the airborne.

According to a particular embodiment, active volatile ingredients are selected from the group consisting of perfuming ingredients, insect attractants and insect repellants, insecticides, pesticides, fungicides, sanitizing and air-purifying materials, malodour counteracting, antibacterial ingredients and mixtures thereof.

According to a particular embodiment, the active volatile ingredients comprise a perfume. According to a preferred embodiment, the perfume contains aldehydes.

All the other embodiments relating to the composition of matter described for the manufactured product also apply for this object of the invention.

A method to modulate, enhance or modify the evaporation of active volatile ingredients comprising the step of loading a manufactured product as defined above with volatile ingredients, preferably a perfume is another object of the invention.

The invention will now be described in further detail by way of the following examples wherein the amounts are indicated in % by weight, relative to the weight of the carrier composition, and the temperatures are indicated in degrees centigrade.

Example 1

Preparation of Biochar carrier

A typical process for the preparation of such biochar includes the following steps:

5 A charcolator was designed to process Human Solid Waste (HSW) into Biochar using pyrolysis. The charcolator unit consists of a 316-grade stainless steel pyrolysis chamber equipped with a mixing paddle, a cooling coil, a motor and a fan. The chamber sits directly on the hard firebrick. This hard brick is placed on the floor of the furnace, atop the soft firebrick & heating element, with the corrugations facing downward.

10 A fire brick spacer to maintain proper depth of the charcolator inside the furnace is included at the back of the furnace. This should be placed between the nuts on the back of the charcolator, and rest on the hard fire brick floor. The three tubing sections fit into the slots at the top of the furnace opening.

The charcolator has a cooling coil which needs to be connected to a water supply. The coiling
15 coil serves to cool the chamber at a faster rate during biochar runs. This is a desirable means of operation but it is not necessary. Cooling can also be achieved by turning off the furnace and letting the chamber cool naturally. This will take a longer period of time though. The other end of the cooling coil should convey the hot steam away from the charcolator and operators without creating excessive back pressure.

20 The charcolator also has a sweep gas connection. This sweep gas is to flush out air to enable an oxygen-free environment for pyrolysis. Argon or Nitrogen can be used as a sweep gas. The fitting is a ¼" stainless tubing stub. Use a section of ¼" ID flexible tubing to connect this to a flow meter, in turn connected to a pressure regulator. 1 L/min of sweep gas is normally used.

The furnace requires 240 VAC, 20A service at a minimum. The electric motor for the paddle
25 requires 120 VAC. It does not matter how the wires are connected. The furnace chassis is grounded, and so the motor is grounded when it is attached to the furnace.

There is a #8-32 bolt fastening the drive adapter to the motor output shaft. This was designed as a shear bolt to protect the motor in the event that the paddle becomes jammed. Several spares have been included, and anything that fits that is not hardened steel would be suitable.

During the first few runs liberally apply anti-seize to every interface during assembly. The more sensitive locations are the interfaces between the rotating paddle and the stationary can, and the nuts that hold the pyrolysis chamber door in place. This can be done for the first few pyrolysis runs. After that, there should be a carbon patina that will prevent any problems in the future.

- 5 The copper content of the anti-seize could interfere with science (anti-microbial, etc.) and so judicious use is encouraged.

Samples:

- 10 Samples were prepared using as starting material a mixture of human solid waste with following composition: Feces with sawdust (ratio about 1:2).

Biochar A to F were prepared starting from said samples heated according to different profiles as reported in Table 1:

- 15 Table 1: Heating profile of fecal material and sawdust.

Biochar Name	Overshoot ¹⁾ (°C)	Target HHT (°C)	Soak (min)	Ramp Rate (°C/min)
A	252	200	30	2.5
B	347	300	30	2.5
C	442	400	30	2.5
D	516	500	30	2.5
E	600	600	30	2.5
F	650	650	30	2.5

- 1) Temperature set on the furnace in order to achieve the target temperature inside the charcolator

- 20 The ramp increases up to specific target temperature and then soaks at the target temperature for 30 min, then cooling stage begins.

Example 2

Preparation of compressed tablets comprising Biochar

Biochar A, B and C were prepared by heat treatment of organic compost as described in Example 1. The pH was measured after the suspension on biochar (10%) in water. The pH was 7.8 for biochar A and pH = 8.0 for biochar B and pH 9.65 for biochar C.

Two different mechanical presses were used to prepare the tablets, depending of the desired size of the tablets. For small tablets the mechanical press Mark Specac (Portmann Instruments AG), 13mm ID, 10 tons maximum load, was used. For bigger tablets, mechanical press Elmer-Perkin, 38.5mm ID, 15 tons maximum load, was used. A defined amount of biochar was put into a cylindrical mold. Then a smaller cylinder was introduced into the mold in order to press the biochar and form a tablet. A force of 10 tons was applied on the biochar. Once the pressure was released, the tablet could be taken out of the mold and used as a perfume carrier. Perfume was added drop wise on the tablet.

Water absorption of Biochar A, B and C was measured in a climate chamber where humidity and temperatures can be precisely controlled.

The biochar tablets were placed on an analytical scale Mettler Toledo EW 11334-54, connected to a PC via Mettler Toledo Balance Link software to record masses change automatically every 5 minutes. A cellulosic material (origin: Orlandi) was used as benchmark.

The results are summarized in Table 2.

Table 2: Properties of various biochar qualities

Carrier		Dimensions d:diameter t:thickness m:mass	Water uptake (35°C & 70% humidity over 72h) [g water/g support]	pH	Maximum fragrance absorption (% masse)
Biochar A		d:13mm,32mm t: 2mm, 7mm m: ~ 300mg, ~ 5g	0.098 [g/g] 0.093 [g/g]	7.8	33%
Biochar B		d:13mm,32mm t: 2mm, 7mm m: ~ 300mg, ~ 5g	0.081 [g/g] 0.067 [g/g]	8	32%
Biochar C		d:13mm,32mm t: 2mm, 7mm m: ~ 300mg, ~ 5g	0.109 [g/g] 0.095 [g/g]	9.65	33%
Cellulosic material		d:13mm t: 2mm m: ~ 100mg	0.036 [g/g]	7.36	33%

To measure the perfume release it was important to understand the water intake. In fact the biochar can absorb about 9% of their weight of water without influencing their physical aspect. Therefore the product according to the invention could advantageously be used in high humidity environments without e.g. becoming soft.

Example 3

Perfume headspace analysis out of products according to the invention

10 Biochar samples A and B as described in example 1 were compressed into tablets (diameter 13 mm, thickness 3.1 mm; 2.55; 2.0 mm, weight 443; 386; 301 mg). Said tablets were then loaded with different perfume compositions (see table 3 below) (10 µl, 10%).

Table 3: perfume compositions

Compound	Perfume model (g)	Aldehydes model (g)	Alcools model (g)	Hydrocarbon Model (g)
Octanal	2	2.5		
2,4-Dimethyl-3-cyclohexene-1-carbaldehyde ¹⁾	1			
Terpinolene	5			2
Citronellol	2		2.5	
Decanal		2.5		
Citral		2.5		
Lilial ^{® 2)}		2.5		
1-octanol			2.5	
Phenylethanol			2.5	
p-Cresol			2.5	
Caryophyllene				2
Octane				2
Decane				2
Dodecane				2
TOTAL (g)	10	10	10	10

1) Origin : Firmenich SA, Geneva, Switzerland

2) 3-(4-tert-butylphenyl)-2-methylpropanal; Origin and trademark: Givaudan SA, Vernier, Switzerland

- 5 The tablets loaded with perfume were then wrapped in an aluminum foil for 10 min. These tablets were placed in headspace cells. A constant flow of air (200 ml/min (+/- 0.5) at 50% humidity was pumped through the cells (3 cells). As soon as the delivery system was placed in the headspace cell, the air was pumped through a tenax cartridge during 10 min. Then air was pumped through the cell for 60 min. Then a new tenax cartridge was plugged and the air was
- 10 sampled for 10 min. This was repeated after 3 hours and 18 hours or 72 hours. The peak areas of each individual compound were plotted versus time. Results are shown in Figures 2A & 2B.

These charts display the slow release of perfume compounds over time from compressed biochar in tablets. The evaporation is faster on cellulosic material for volatile compounds compared to biochar A&B.

Example 4

5

Preparation of Compositions according to the invention – Headspace analysis-(teabag model)

Biochar B prepared according to example 1 was pulverized in a mortar. About exactly 10 g of these powders were placed in a container (volume 10 mL, size diameter 2 cm and 4 cm high). To these powders 340 µl of the perfume models described in example 3 were added and then the
10 container was vigorously shaken using a Vortex. After 24 hours the powders were placed in a disc with a fine mesh stainless steel. This device was placed in a headspace cell. The release of volatile was monitored by pumping immediately (time = 0), after 1, 3, 18 hours on tenax cartridge. The pumps worked at a constant flow of 200 mL/min. The air was pumped through a salty solution to guaranty 50% humidity. These experiments were repeated three times. From
15 calibration curves established by injecting each individual compounds on tenax, it was possible to express the results in weight by volume at a certain time.

Cellulosic material and active charcoal were used in the same way to allow comparison, Results are represented on Figure 3.

Contrary to the benchmarks, the composition according to the invention provides a releasing
20 pattern very homogeneous over time, meaning that there is no alteration of the perfume profile. This also translates that advantageously and contrary to many solutions from the prior art, there is no interaction between perfume components and the biochar carrier. In particular aldehydes are not transformed in acids, leaving therefore more room for creation. The biochar is also different from active charcoal which absorbs all volatiles. Active charcoal is very efficient in
25 trapping volatiles, therefore not performing as delivery system in this format.

When the solid supports are extracted with an organic solvent after 24 hours storage, the loss of aldehydes and the formation in acids was confirmed for cellulosic material. The oxidation capacity is 0.4 mEq peroxide/g cellulosic material. For active charcoal all compounds are recovered, only terpinolene was not recovered from active charcoal. Figure 4 display the
30 extraction pattern.

Example 4 demonstrates that hydrocarbon evaporate much faster from cellulosic material. When the remaining volatiles are extracted with a solvent, acids corresponding to aldehydes are extracted only from cellulose (figure 4). The active charcoal is a good absorbent and volatiles can be extracted back.

5

Example 5

Perfume retention in the carrier over time

Monitoring the weight loss was performed in a climate chamber. The biochar A tablets prepared as described in example 2 (4 g) were impregnated with perfume model described in example 3 at 10% (1 g) and placed on a scale. The weight change was automatically monitored over time. At 25°C and 50% humidity, slow release of perfume was observed. After 2 days in the climate chamber, a nice citrus smell was still perceived.

At 35°C and 70% humidity, the biochar absorbs the same amount of humidity (up to 10%) and surprisingly we can still load the perfume and this does not affect the perfume release (figure 5A).

Description of Figure 5:

A: Experiment conducted at 35°C and 70% humidity with Biochar300. Water uptake (1st step) and perfume release (2nd step). B: Experiment conducted at 25°C and 50% humidity. Perfume release from Biochar200 when compared to cellulose pad.

Example 5 demonstrates that water do not influence the release properties of biochar. When we compare biochar with cellulosic material (figure 5B), we can see that biochar releases the volatile slower but 20% stay on the matrix.

Example 6

Comparative sensory analysis between cellulosic material and biochar B (from example 2) using aldehydes perfume model system (described in example 3).

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The method used is a Difference-from-control test. The test objective is to determine whether a difference exists between one or more samples and a control (or reference, or standard) and to estimate the size of any such differences. The samples were evaluated with respect to “how different each is from that control”.

A panel of 29 subjects was presented for each support, namely cellulosic material and Biochar B the following:

- Control, the mixture of aldehydes applied onto one support after 1h of deposit*,
- Sample, the mixture of aldehydes applied onto one support after 24h** of deposit at 30°C.
- Blind Control, the mixture of aldehydes applied onto one support after 1h of deposit* to obtain a measure of the placebo effect.

This estimate represents the numerical effects of simply asking the difference question, when in fact no difference exists.

Each subject rates onto a linear scale the size of the difference between blind control and sample vs. the control (see Fizz questionnaire below) (0=no difference; 10=very different). Then they were asked using a choice between attributes to describe the type of the difference: intensity, quality or both.

* Control and Blind Control= the product was applied 1h before the panel evaluation

**Sample = the product was applied 24h before the panel evaluation and stayed at 30°C.

The panel duration is estimated to 1h and 28 internal panelists took part to this panel.

The two blind controls have about a score of 2 on a scale of 10, demonstrating an important placebo effect. This could be explained by the fact it was not mentioned to panelists that the products could be not systematically different from the reference. Nevertheless, the two placebos effects are not different from each other (two-tailed paired student test which is not significant). Furthermore the comments related to the type of the differences is quite balanced between the three choices (quality, intensity and both) except that few panelists found the difference type for the cellulosic material blind control vs. control is more due to intensity than to quality.

The sample on cellulosic is very significantly different from the blind control (two-tailed paired student test which is significant at 99.9%) (figure 6). The type of the difference is clearly due to the quality but also to both intensity and quality, but not to the intensity only. This demonstrates a very significant perceived difference between the aldehyde mixtures after 1h vs. 24h of deposit when it is applied onto this support, which is mainly due to quality degradation.

The sample on Biochar B is not significantly different from the blind control (two-tailed paired student test which is not significant) and again the comments on the type of differences is quite balanced. This demonstrates that there is no perceived difference between the aldehyde mixtures after 1h vs. 24h of deposit when it is applied onto this support.

By consequence, the differences between control and sample for Biochar B vs. Cellulosic material from Orlandi are significantly different (two-tailed paired student test which is significant at 99.9%) (figure 6).

The sensory results obtained for Cellulosic material support demonstrate that there is a very significant perceived difference between the aldehyde mixtures after 1h vs. 24h of deposit. This difference seems to be mainly due to perceived qualitative degradation of the mixture over time applied on this support.

The sensory results obtained for Biochar B demonstrate that there is no perceived significant difference between the aldehyde mixtures after 1h vs. 24h of deposit. It shows a high stability for these chemicals onto this support.

Biochar support seems to be a more efficient support than cellulosic material for the stability of aldehydes over time. So, the major advantage of biochar B on cellulose is that aldehydes are preserved.

The sensory evaluation of active charcoal was not performed simply because the active charcoal absorb all volatiles and doesn't smell.

Claims

1. A manufactured product for the diffusion of active volatile ingredients in the airborne comprising:
 - 5 - a composition of matter containing an absorbent material comprising a carrier consisting essentially of biochar, and
 - dispensing means to dispense at least partly in the airborne active volatile ingredients.
- 10 2. The manufactured product according to claim 1, characterized in that the composition of matter comprises from 50 to 99% by weight of biochar based on the total weight of the composition of matter.
- 15 3. The manufactured product according to claim 1 or 2, characterized in that the biochar results from a pyrolysis of human solid waste material, optionally mixed with sawdust.
4. The manufactured product according to claim 3, characterized in that the pyrolysis is performed at temperatures comprised 200 and 650°C, preferably between 200 and 300°C.
- 20 5. The manufactured product according to any one of the preceding claims, characterized in that it comprises active volatile ingredients selected from the group consisting of perfuming ingredients, insect attractants and insect repellants, insecticides, pesticides, fungicides, sanitizing and air-purifying materials, malodour counteracting, antibacterial ingredients and mixtures thereof.
- 25 6. The manufactured product according to claim 5, wherein the active volatile ingredients comprise a perfume.
7. The manufactured product according to claim 6, wherein the perfume contains aldehydes.

8. The manufactured product according to any one of claims 1 to 7 in the form of a compressed tablet, a sheet, a tea bag, or a diffusing stick air freshener or a perfumed powder.

5 9. A process for the preparation of a product as defined in any one of claims 1 to 7, said process comprising the step of processing the absorbent material into a manufactured product, and loading said material with active volatile ingredients.

10. Use of biochar as a reservoir for releasing active volatile ingredients in the airborne.

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11. Use according to claim 10, characterized in that the active volatile ingredients comprise a perfume.

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12. Use according to claim 10 or 11, characterized in that the biochar is derived from human solid waste.

13. Composition of matter containing an absorbent material comprising a carrier consisting essentially of biochar loaded with active volatile ingredients.

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14. Composition of matter according to claim 13, characterized in that active volatile ingredients comprise perfume.

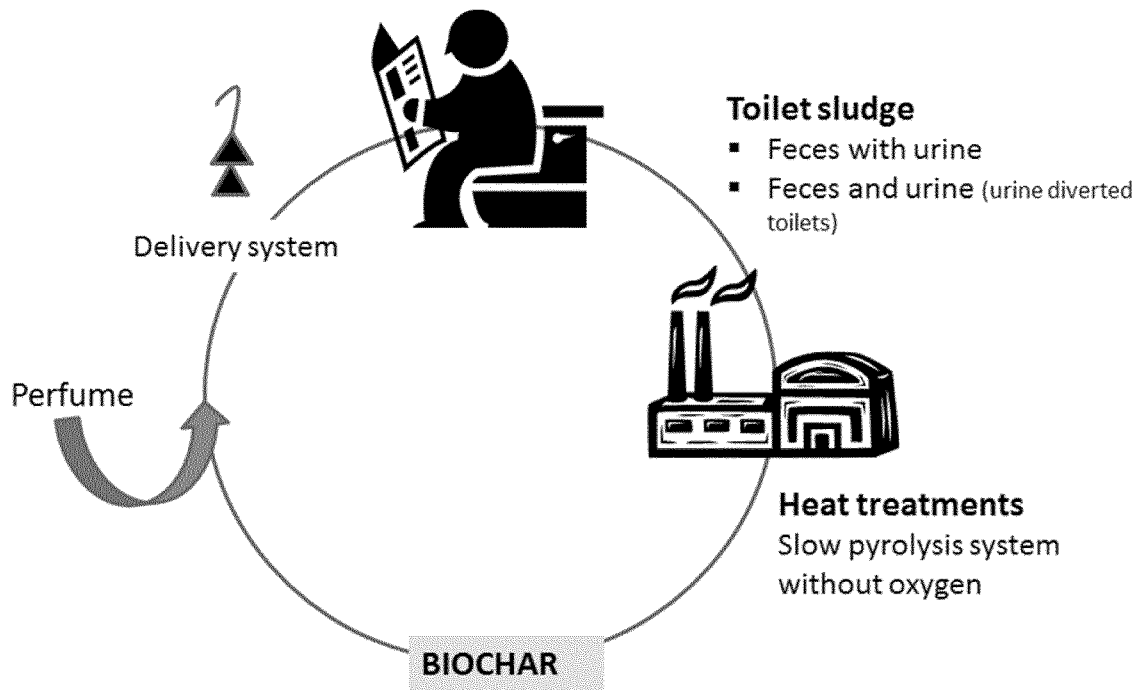
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15. A method to modulate, enhance or modify the evaporation of active volatile ingredients over time comprising the step of loading a manufactured article as defined in claim 1 with volatile ingredients.

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1/6

Figure 1



2/6

Figure 2a & 2b

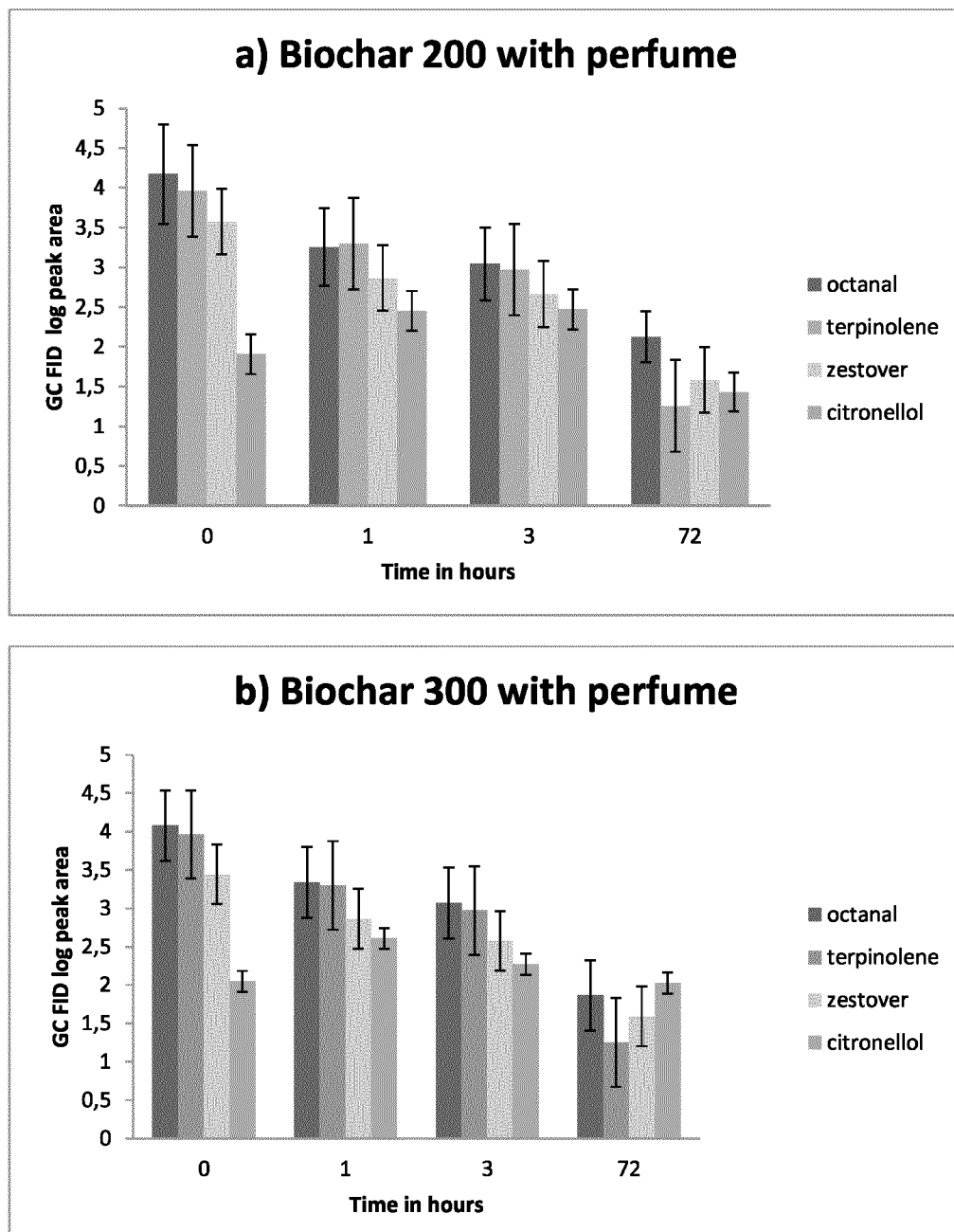


Figure 3

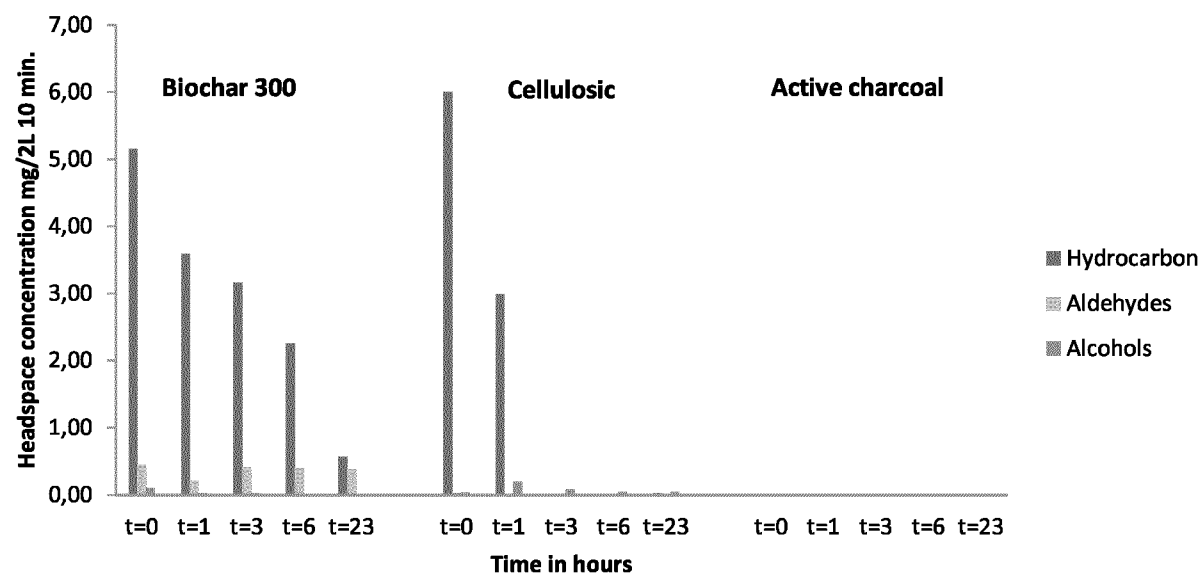


Figure 4

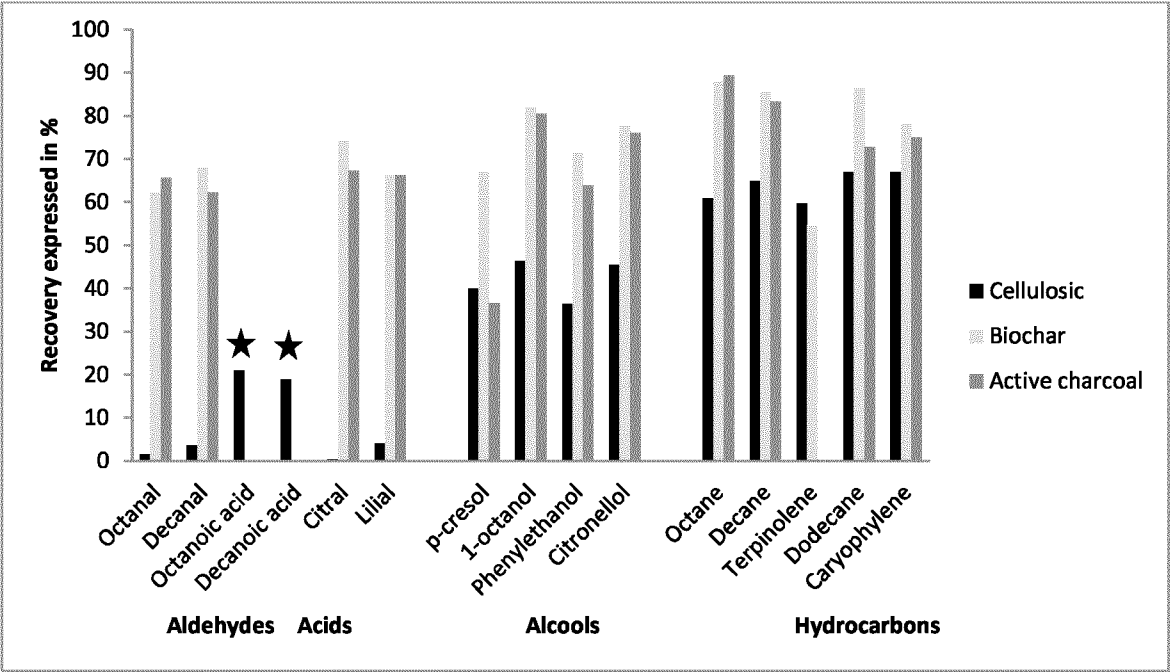


Figure 5A & 5B

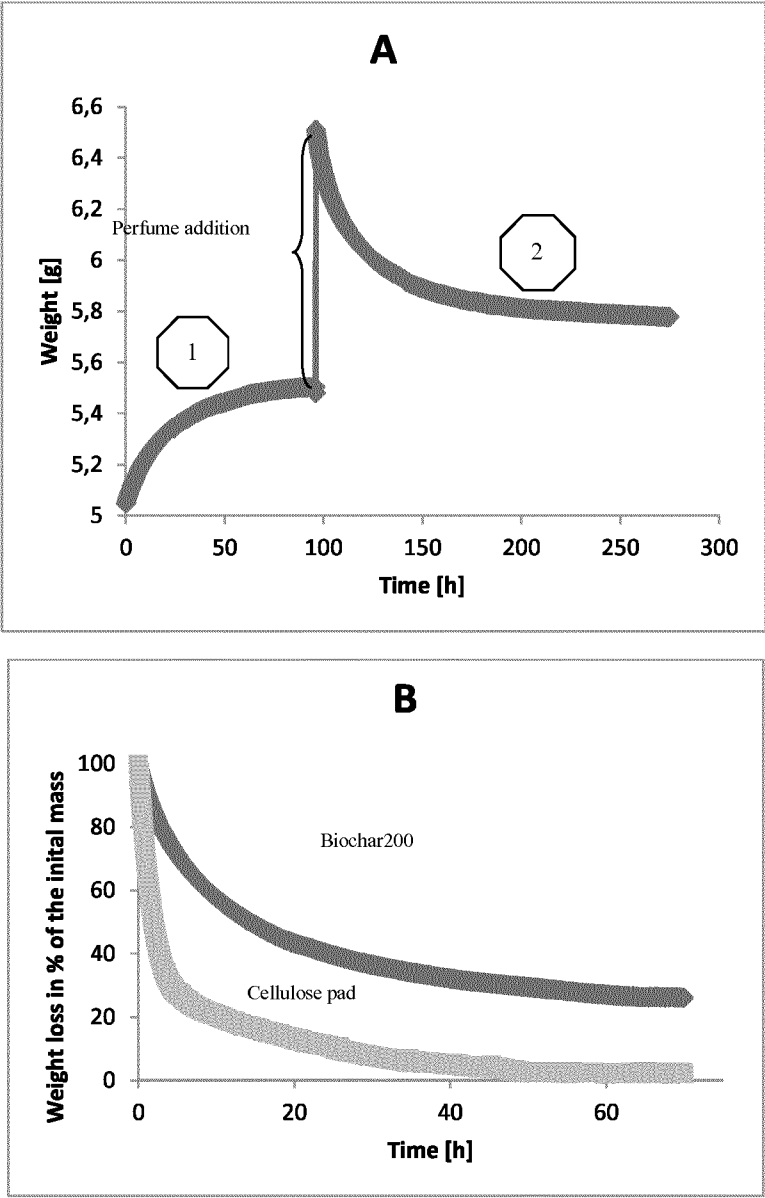


Figure 6

