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明細書

環境浄化材

技術分野

本発明は、空気、水、土壌等に含まれる、悪臭・汚染・汚濁等の原因となる有害物質等を吸着、分解して空気、水、土壌等を清浄化する環境浄化材に関する。

背景技術

空気や排気ガス等の気体中に含まれる、悪臭・有害物質等を吸着、分解して、これを清浄化する方法としては、酸、アルカリ、硫酸アルミニウム等の化学薬品によって化学反応を起こさせ除く方法、活性炭やゼオライト等の吸着剤に吸着させ除く方法、芳香剤によってマスキングする方法、あるいは金属もしくは金属酸化物の触媒粒子を用いて酸化・燃焼させる方法等がある。また、河川や池、排水等の水中に含まれる悪臭、汚染、汚濁等の原因物質を吸着、分解して、これを清浄化する方法としては、活性炭やゼオライト等の吸着剤に吸着させる方法、オゾン等の化学薬品によって酸化分解する方法、微生物によって分解する方法等が知られている。

活性炭やゼオライト等の吸着材粒子、又は反応触媒能(catalytic activity)をもつ金属もしくは金属酸化物の粒子

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を含む多孔性構造体の製法は、従来、次のような方法が知られている。

一つは、金属もしくは金属酸化物粒子等の粒子を混合し、加圧成形する方法（加圧成形法といわれる。）で、例えば、特開昭50-30795号公報には二酸化マンガン40重量部、酸化第二銅20重量部及びγアルミナ40重量部を混合したタブレット状に成形する方法が開示されている。

別の方法は、多孔性担体又は多孔性構造体にマンガンや銅等の金属塩の水溶液を含浸した後、焼成する方法（焼成法、あるいは焼結法といわれる。）で、この方法によるものとしては、例えば、A型ゼオライトにマンガン酸化物及び銅酸化物を含有させた脱臭剤（特開平1-151938号公報）、二酸化マンガン及び酸化銅をハニカム状多孔性担体に担持させた脱臭剤（特開平4-156854号公報）等がある。

その他の方法として、活性炭やゼオライト等の吸着材粒子及び／又は金属もしくは金属酸化物の触媒粒子を、バインダーと共に混合し、これを押出し機で押し出して一定の形状物としたのち、加熱・活性化し、多孔性の粒状物とする方法（バインダーと共に押出し成形する方法）、発泡性の熱可塑性樹脂に活性炭、金属酸化物等の粒子を練り込み、加熱して発泡させ、これを脱臭用の多孔性構造体とする方法（発泡法）、等も知られている。

またシート状脱臭剤の製造法としては、紙等の基材シー

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ト上に脱臭剤粉末及び熱可塑性樹脂粉末を散布し、これを加熱して一体化する方法（特開昭61-119269号公報）や、少なくとも一方が通気性シートである二層のシート間にガス処理用脱臭粉末と熱可塑性樹脂粉末の混合物を挟み、圧着して一体化する方法（特開平5-49850号公報）等が知られている。

脱臭用の多孔性構造体を上記の加圧成形法により製造する場合、金属もしくは金属酸化物等の粒子は密に充填されて成形物の比表面積は低下し、通気性が悪くなる。また、活性炭やゼオライトのように崩壊しやすい粒子では成形できない問題がある。

焼成法により製造する場合、形成させた酸化物層や用いたバインダー等に起因する焼成時の不純物が多孔性担体の微細孔を塞ぎ、多孔性構造体の比表面積が低下する問題がある。また、焼成法では活性炭の表面に金属もしくは金属酸化物粒子を焼結させることは困難である。

また、バインダーと共に押出し成形する方法や発泡法では、脱臭剤粉末がバインダーや発泡性樹脂に被覆されるため、臭気成分と脱臭剤粉末の接触が直接的とはならず、脱臭剤粉末本来の性能を発揮できない問題がある。

発明の開示

本発明の課題は、金属及び／又は金属酸化物粒子、吸着材粒子及び熱可塑性樹脂粒子からなる環境浄化材、又はこ

れら粒子と通気性シートの繊維状基材からなる環境浄化材であって、金属及び／又は金属酸化物粒子及び吸着材粒子は、各々の本来の性能及び表面積が有効に保たれ、多孔性構造体として一体化された環境浄化材を提供することである。

本発明は先ず、次の環境浄化材、すなわち、

- (a) 金属及び／又は金属酸化物粒子、
- (b) 吸着材粒子、及び
- (c) 熱可塑性樹脂粒子を含み、

金属及び／又は金属酸化物粒子(a)と吸着材粒子(b)は、熱可塑性樹脂粒子(c)表面に、それぞれ粒子どうしの接触部分で結合(bind)し、かつ、熱可塑性樹脂粒子(c)どうしはそれらの接触部分で結合(join)している環境浄化材である。なお、本明細書ではケイ素などの半金属も「金属」に含める。

本態様の環境浄化材を図により説明する。図1は本発明の環境浄化材における粒子(a)～(c)の結合状態の一例の模式図であり、図2は本発明の環境浄化材における粒子(a)～(c)の結合状態の他の例の模式図で、図1及び図2中、a1は金属酸化物粒子1、a2は金属酸化物粒子2、bは吸着材粒子、cは熱可塑性樹脂粒子をそれぞれ示す。2種類の金属及び／又は金属酸化物粒子(a1とa2)、及び1種類の吸着材粒子(b)が、その形状(図では球形で示されている。)を保ったまま、熱可塑性樹脂粒

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子(c)表面に粒子どうしの接触部分で結合し、熱可塑性樹脂粒子(c)どうしはそれぞれの接触部分で結合して3次元の広がりをもつ多孔性構造体を形成している。

本発明の環境浄化材においては、その比表面積は $200 \text{ m}^2/\text{g}$ 以上の大きなものも得られる。そのため、本発明の環境浄化材は悪臭・有害物質との接触頻度が高く、良好な環境浄化能を発揮する。

本発明で用いる金属及び／又は金属酸化物粒子(a)としては、マンガン、銅、亜鉛、鉄、バナジウム、ニッケル、マグネシウム、アルミニウム、チタン、パラジウム、白金、セリウム、ケイ素、及びそれらの酸化物の粒子がある。

マンガン酸化物としては、 MnO_2 、 MnO 、 Mn_2O_3 、 Mn_3O_4 及び Mn_2O_7 等があり、中でも MnO_2 が好ましく用いられる。

銅酸化物としては、 CuO 、 Cu_2O 及び Cu_3O 等があり、中でも CuO が好ましく用いられる。

これらの金属及び／又は金属酸化物粒子は1種を用いることもできるが、多種の有害物質を浄化する機能をもたせるために2種以上を用いてもよい。2種以上を混合する場合の好ましい例としては、二酸化マンガン粒子と酸化第二銅粒子を含むものが用いられる。その場合、マンガンと銅の量比は、好ましくは元素重量比で Mn/Cu は約4:1前後、又は約2:3前後とする。そのような場合に硫黄系悪臭ガスを効果的に除去できる。

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本発明で用いる吸着材粒子（b）としては、活性炭、ゼオライト、シリカゲル、セピオライト、活性アルミナ及び活性白土等がある。これら吸着材粒子に硫酸アルミニウム、ヨウ素、硫酸第一鉄、燐酸カルシウム、炭酸ナトリウム、珪酸マグネシウム、ほう酸、リン酸、アスコルビン酸、酒石酸、シュウ酸、タンニン酸、没食子酸等を担持させたものも用いることができる。吸着材粒子は1種を用いても、又は2種以上を用いてもよい。

活性炭には、植物性炭素質（ヤシ殻、アーモンド殻等）、木炭、瀝青炭等のほか、合成樹脂炭素質（フェノール樹脂他）等があり、いずれも使用できる。

本発明で用いられる熱可塑性樹脂粒子（c）としては、超高分子量ポリエチレン、ポリエチレン、ポリカーボネート、ポリアミドABS（Acrylonitrile-Butadiene-Styrene）樹脂、ポリイミド、ポリ塩化ビニル、ポリスルホン、ポリスチレンフタレート、ポリプロピレン、酢酸セルローズ等から選ばれる粒子である。夏場での70～100℃の雰囲気温度に耐える高温の融点が必要である。これら熱可塑性樹脂粒子は、金属及び／又は金属酸化物粒子（a）と吸着材粒子（b）を、熱可塑性樹脂層で被覆されることなく熱可塑性樹脂粒子（c）表面に、粒子どうしの接触部分で結合させる結合剤としての役割をもつ。また、熱可塑性樹脂粒子（c）どうしはそれぞれの接触部分で結合し、全体として3次元的に広がりをもつ多孔性構造体を形成する。

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熱可塑性樹脂粒子のうち、特に平均分子量（粘度法による測定値）100万～900万の超高分子量ポリエチレンが好ましく用いられる。残留モノマー成分が少なく、酸、アルカリ、有機薬品に対して高い安定性があり、かつ、金属及び／又は金属酸化物粒子（a）と吸着材粒子（b）の表面を損傷させず、優れた環境浄化機能と適度な強度をもった多孔性構造体を得られるからである。

本発明で用いる金属及び／又は金属酸化物粒子（a）の大きさは、平均粒径で0.1～10 μ mが好ましい。0.1 μ m未満であると、粒子が凝集し均一に分散させることが難しく、10 μ mを越えると比表面積が小さくなり、反応触媒能が低下する。

これらの金属及び／又は金属酸化物粒子（a）の比表面積は、金属又は金属酸化物の種類、その粒径、表面粗さ等に左右される。

本発明で用いる吸着材粒子（b）は、ふるい目開き48メッシュ（粒径としては300 μ m）を通過する粒子を有し、吸着材粒子（b）の全量に対して、この大きさの粒子を好ましくは50重量／重量％以上、更に好ましくは70重量／重量％以上を含む。ふるい目開き48メッシュを通過する粒子が50重量／重量％未満では（すなわち、ふるい目開き48メッシュを通過しない粒子が50重量／重量％を越えると）比表面積が小さくなり、吸着能が低下する。吸着材粒子（b）の比表面積は、好ましくは350 m^2 ／

g 以上である。

本発明で用いる熱可塑性樹脂粒子 (c) の大きさは、平均粒径で好ましくは $20 \sim 150 \mu\text{m}$ 、更に好ましくは $20 \sim 50 \mu\text{m}$ である。 $20 \mu\text{m}$ 未満の大きさの熱可塑性樹脂粒子は製造が難しく高価であり、 $150 \mu\text{m}$ を越えると得られる構造体の強度が低下傾向となる。

なお、ここで金属及び／又は金属酸化物粒子の平均粒径は、数基準で表した平均値である。

また、熱可塑性樹脂粒子の平均粒径は、重量基準で表した粒度分布の中心値 (50% 値 = D_{50}) である。

各粒子 (a、b 及び c) 間の相対的な大きさの比較では、金属及び／又は金属酸化物粒子 (a) の平均粒径は熱可塑性樹脂粒子 (c) の平均粒径の $0.01 \sim 0.5$ 倍が好ましく、また、吸着材粒子 (b) の平均粒径は熱可塑性樹脂粒子 (c) の平均粒径の $0.01 \sim 2$ 倍が好ましい。このようにときに、金属及び／又は金属酸化物粒子と吸着材粒子の表面積は有効に維持され、反応触媒能や吸着能等の環境浄化能は高く、かつ、それぞれの粒子はその構造体から容易に脱落しない多孔性の環境浄化材が得られる。

用いる熱可塑性樹脂粒子 (c) の量は、金属及び／又は金属酸化物粒子 (a) と吸着材粒子 (b) との合計 100 重量部に対し、 $10 \sim 80$ 重量部、好ましくは $20 \sim 50$ 重量部である。 10 重量部未満では、熱可塑性樹脂粒子 (c) を介した金属及び／又は金属酸化物粒子 (a) と吸

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着材粒子 (b) の結合力もしくは構造体の強度が不十分となりやすく、80重量部を越えると、単位重量当たりの環境浄化能が低下する傾向となり、経済的ともいえない。

上記環境浄化材は、

(a) 金属及び／又は金属酸化物粒子、

(b) 吸着材粒子、及び

(c) 熱可塑性樹脂粒子、

を混合し、用いた熱可塑性樹脂 (粒子) の融点以上ないしは熱分解温度以下の温度で加熱して、製造できる。必要に応じて、加熱の際に適当な圧力で加圧する。

加熱の温度は熱可塑性樹脂の融点ないしは熱分解温度以下、好ましくは熱可塑性樹脂の融点以上ないしはその融点 + 50℃以下とする。熱可塑性樹脂粒子として、超高分子量ポリエチレン粒子を用いる場合、加熱温度は130℃～200℃、好ましくは160℃～180℃で行う。130℃未満では、超高分子量ポリエチレン粒子への、金属及び／又は金属酸化物粒子 (a) 及び吸着材粒子 (b) の結合が不十分となり、得られる多孔性構造体の強度が不足となりやすい。200℃を越えると、超高分子量ポリエチレン粒子が溶け、溶融体が金属及び／又は金属酸化物粒子、及び吸着材粒子の表面を覆って、環境浄化能が低下する。

加熱と共に圧力を加える場合、その圧力は好ましくは490～2940 kPa (5～30 kg/cm²)、更に好ましくは490～2450 kPa (5～25 kg/cm²)

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とする。2940 KPa (30 kg/cm²) を越えると、超高分子量ポリエチレン粒子等の熱可塑性樹脂粒子がつぶれ、通気性が得られにくくなる。

加熱（又は加熱・加圧）の時間は、熱可塑性樹脂粒子がその球形を保ったままで表層が軟化し結合力をもつに至る時間とする。熱可塑性樹脂が溶けて液体状になるまで過熱されないようにすることが肝要である。また、得られる構造体が適度な強度をもち、かつ、金属及び／又は金属酸化物粒子、及び吸着材粒子のそれぞれの粒子はその表面積を有効に保つことができる時間を選ぶ。熱可塑性樹脂粒子として、超高分子量ポリエチレン粒子を用いた場合は、通常、5～60分である。

加熱（又は加熱・加圧）により成形される構造体の形状は、型枠の形状等を適当に選べば、粒状、ペレット状、ボール状、タブレット状、板状等、種々の形状にすることができる。

本発明はまた、次のシート状環境浄化材、すなわち、

- (a) 金属及び／又は金属酸化物粒子、
- (b) 吸着材粒子、
- (c) 熱可塑性樹脂粒子、及び
- (d) 通気性シートをなす繊維状基材を含み、

金属及び／又は金属酸化物粒子 (a) と吸着材粒子 (b) は、熱可塑性樹脂粒子 (c) 表面に、粒子どうしの接触部分で結合し、

熱可塑性樹脂粒子（c）は通気性シートの繊維状基材（d）に結合している、シート状環境浄化材、に関する。

図により説明する。図3は、本発明のシート状環境浄化材における金属及び／又は金属酸化物粒子（a1、a2）、吸着材粒子（b）、熱可塑性樹脂粒子（c）及び繊維状基材（d）の結合を示した概略模式図であり、図中、a1は金属酸化物粒子1（例えば、二酸化マンガン）、a2は金属酸化物粒子2（酸化第二銅）、bは吸着材粒子（例えば、活性炭）、cは熱可塑性樹脂粒子、dは繊維状基材の繊維をそれぞれ示す。2種類の金属及び／又は金属酸化物粒子（a1とa2）、及び1種類の吸着材粒子（b）が、その形状（図では球形で示されている。）を保ったまま、熱可塑性樹脂粒子（c）表面に粒子どうしの接触部分で結合し、熱可塑性樹脂粒子（c）どうしはそれぞれの接触部分で結合するとともに繊維状基材（d）の繊維に結合し、これらが3次元的広がりをもつ多孔性構造体を形成している。

本発明のシート状環境浄化材において、使用できる金属及び／又は金属酸化物粒子（a）、吸着材粒子（b）及び熱可塑性樹脂粒子（c）の種類及びそれぞれの粒子の絶対的又は相対的大きさは、前記と同様である。

本発明のシート状環境浄化材において、その比表面積は通常、 $20 \text{ m}^2/\text{g}$ 以上、更に高いものでは $30 \text{ m}^2/\text{g}$ 以上となり、空隙率は通常、50%以上、更に高いもので80%以上となる。そのため、本発明の環境浄化材は、悪臭・

有害物質を効率よく除去し、通気性が高く、良好な環境浄化能を発揮する。

通気性シートの繊維状基材（d）としては、空隙率が60%～99%、更に好ましくは70%～98%の繊維状基材で、例えば、ガラス織布・不織布、ポリエチレン、ポリプロピレン、ポリアミド、ポリエステル等のプラスチック織布・不織布、紙等がある。中でも、ガラス繊維をベースとしてつくられた空隙率70%～98%のガラス不織布は、耐熱性及び通気性の点から好ましく用いられる。

使用する基材の厚みは、塗布、含浸等の作業時に断裂しない程度の厚みがあれば特に制限するものではない。厚みのある基材を用いれば板状の多孔性構造体を得られ、厚みの薄い基材を用いればシート状の多孔性構造体を得られる。

通気性シートの繊維状基材（d）に保持させる金属及び／又は金属酸化物粒子（a）の量と、吸着材粒子（b）の量と熱可塑性樹脂粒子（c）の量との合計、すなわち、

（a）＋（b）＋（c）の量は、通気性シートの繊維状基材（d）100重量部に対して、40～200重量部、好ましくは70～150重量部である。40重量部未満では、環境浄化能が低くなり、また、200重量部を越えて保持させることは困難である。

上記シート状環境浄化材は、

（a）金属及び／又は金属酸化物粒子、

（b）吸着材粒子、

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(c) 熱可塑性樹脂粒子、

(e) 吸水性樹脂、及び

(f) 水、

を混ぜて均一に分散された懸濁液をつくり、この懸濁液の所定量を、

(d) 通気性シートをなす繊維状基材、に保持させ、

前記熱可塑性樹脂の融点以上ないしは熱分解温度以下の温度で加熱し、水分を除去しながら、金属及び／又は金属酸化物粒子(a)、及び吸着材粒子(b)を熱可塑性樹脂粒子(c)を介して繊維状基材(d)に結合させて、製造することができる。

ここで、吸水性樹脂(e)を加える理由は、金属及び／又は金属酸化物粒子(a)、吸着材粒子(b)及び熱可塑性樹脂粒子(c)の混合粒子の水懸濁液を均一に分散させるためである。吸水性樹脂を加えると、吸水性樹脂は吸水して粘度が上昇し、混合粒子の懸濁液は均一に分散された状態となり、しかも、その均一分散の状態は安定に長時間維持される。そのため、次の工程、すなわち、この懸濁液の一定量を通気性シートの繊維状基材(d)に保持させる工程を容易に行うことができる。

用いられる吸水性樹脂(e)としては、自重の何十倍～何千倍の重量の水を吸収する樹脂が好ましい。アクリル酸-酢酸ビニル共重合体ケン化物、ポリビニルアルコール架橋重合体、ポリアクリロニトリル系重合体ケン化物、ポリ

アクリル酸塩架橋重合体、デンプン-アクリロニトリルグラフト共重合体、デンプン-アクリル酸グラフト共重合体、デンプン-ビニルスルホン酸グラフト共重合体、デンプン-スチレンスルホン酸グラフト共重合体、セルロース-アクリロニトリルグラフト共重合体、セルロース-スチレンスルホン酸グラフト共重合体、カルボキシメチルセルロース架橋重合体、ポリエチレングリコールジアクリレート架橋重合体、ポリビニルピロリドン系架橋重合体、等がある。

これらの吸水性樹脂は、前述したように数種の混合粒子を均一に、しかも長時間分散・懸濁させる目的で使われるが、最終の多孔性構造体となったのちは積極的な役目をもっていない。そのため、少量であっても懸濁液の粘度を上げることができ、乾燥（脱水）後は金属及び／又は金属酸化物粒子（a）又は吸着材粒子（b）の機能を阻害しない樹脂が好ましい。吸水倍率の高い吸水性樹脂はこの目的に適合している。前記吸水性樹脂のうち吸水倍率の高い樹脂としては、アクリル酸-酢酸ビニル共重合体ケン化物、ポリアクリル酸塩架橋重合体、デンプン-アクリロニトリルグラフト共重合体、デンプン-アクリル酸グラフト共重合体、デンプン-ビニルスルホン酸グラフト共重合体、デンプン-スチレンスルホン酸グラフト共重合体等で、これらが特に好ましく用いられる。

用いる吸水性樹脂の量は、吸水性樹脂の種類によって変動する。それぞれについて適宜、決定すればよい。このと

き、吸水性樹脂使用量を決定する指標となる性質は、混合粒子懸濁液の粘度である。25℃における測定値で10～500cp、好ましくは、50～200cpとなるように予めその量を決めておくとよい。通常は、水100重量部に対しておおむね0.01～1.0重量部である。

溶媒として水を使用するのは、各々の粒子の特性を維持できること、環境汚染が無いこと、静電気による火災防止上で安全性が高いこと、等である。

金属及び／又は金属酸化物粒子(a)、吸着材粒子(b)、熱可塑性樹脂粒子(c)、吸水性樹脂(e)及び水(f)を混ぜて均一に分散された懸濁液をつくる方法は、吸水性樹脂と水を混ぜた後に攪拌しながら粒子(a、b、c)を少量ずつ加えるか、あるいは、水に攪拌しながら粒子(a、b、c)を少量ずつ加え、次いで吸水性樹脂(e)を加える方法などにより行うことができる。ただし、これらの方法に限定されるものではない。

通気性シートの繊維状基材(d)に、前記した(a)及び(b)、(c)及び(e)の水懸濁液の一定量を保持させる方法としては、ディップ含浸法、グラビアコート法、ダイヘッドコーター法等の慣用される塗工法を用いて、繊維状基材に一定量の懸濁液を塗布もしくは保持させることができる。温度は、室温で行うことができる。

懸濁液の一定量が繊維状基材に保持された後、これを熱可塑性樹脂の融点以上その熱分解温度以下の温度、更に好

ましくは、熱可塑性樹脂の融点以上その融点+50℃以下の温度で、所定時間加熱する。この加熱処理により、水分は蒸発・除去され、熱可塑性樹脂粒子は表層部が軟化し結合力をもつようになる。表層部が軟化し結合力をもつようになった熱可塑性樹脂粒子はその球形の粒子形状を保ったまま、その表面に粒子(a)及び(b)を捕捉・結合し、熱可塑性樹脂粒子(c)どうしは、相互間で接触部分で結合しながら繊維状基材に結合する。

加熱の時間は、水分が蒸発・除去され、熱可塑性樹脂粒子がその球形を保ったまま表層が軟化し、結合力をもつ時間である。実験等により予め決めておく。熱可塑性樹脂が溶けて液状になるまで過熱されないようにすることが肝要である。用いる熱可塑性樹脂が超高分子量ポリエチレンである場合の加熱温度は、通常、130～200℃、更に好ましくは140～180℃で行う。

上記のシート状環境浄化材は、これを複数枚積ねて、加熱・加圧して多層シート状環境浄化材とすることができる。加熱・加圧の条件は、用いる熱可塑性樹脂により変動するが、超高分子量ポリエチレンである場合には、130～200℃、490～4900kPa(5～50kg/cm²)で5～120分間、更に好ましくは140～170℃、980～2940kPa(10～30kg/cm²)で10～60分間、処理して行う。

上記多層シート状環境浄化材は、これを構成する層のう

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ちの少なくとも2層について、環境浄化材を構成する金属及び／又は金属酸化物粒子（a）又は吸着材粒子（b）が各々異なる種類のものを使用することができる。例えば、層1については、aとして二酸化マンガン粒子（bは活性炭粒子、cは超高分子量ポリエチレン粒子、dはガラス不織布）を使用し、層2については、aとして酸化第二銅粒子（bは活性炭粒子、cは超高分子量ポリエチレン粒子、dはガラス不織布）を用いるような場合である。

本発明は、また上記シート状環境浄化材又は積層されたシート状環境浄化材の少なくとも一方の面が、通気性表面保護材で覆われた表面保護材付きシート状環境浄化材にも関する。

通気性表面保護材は、シート状環境浄化材又は積層されたシート状環境浄化材から少量の粒子が脱落するのを防止する目的で貼り合わせる。

通気性表面保護材としては、通気性があり、金属及び／又は金属酸化物粒子又は吸着材粒子等の粒子が通過しない程度の目の細かいシートであればよく、特に限定するものではない。そのような通気性表面保護材としては、例えば、紙、不織布、織布等があり、紙としてはパルプ紙、合成紙、濾紙等があり、不織布としてはポリエチレン、ポリプロピレン、ポリアミド、ポリエステル等の単体不織布又はこれらの混紡不織布、ガラス不織布等があり、織布として綿、ポリエステル等の天然もしくは合成繊維がある。

表面保護材付きシート状環境浄化材は、シート状環境浄化材もしくは積層されたシート状環境浄化材の片面又は表裏両面に、前記通気性表面保護材を重ね合わせ、加熱・加圧して製造できる。この際の、加熱・加圧の条件は、シート状環境浄化材の製造に用いた熱可塑性樹脂により変動するが、超高分子量ポリエチレンである場合には、 $130 \sim 200^{\circ}\text{C}$ 、 $490 \sim 4900 \text{ kPa}$ ($5 \sim 50 \text{ kg/cm}^2$) で $5 \sim 120$ 分間、更に好ましくは $140 \sim 170^{\circ}\text{C}$ 、 $980 \sim 2940 \text{ kPa}$ ($10 \sim 30 \text{ kg/cm}^2$) で $10 \sim 60$ 分間、処理して行う。

本発明はまた、シート状環境浄化材を3次元に加工して得られるハニカム構造の環境浄化材にも関する。

シートからハニカム構造の環境浄化材を製造する方法は、特に限定するものではないが、例えば、次のような方法により行うことができる。

〔方法1〕

段ボール作製装置を用い、シート状環境浄化材の2枚を図6のAのように片側で結合させる。この際両者の結合剤は、シート状環境浄化材中の熱可塑性樹脂粒子（例えば、超高分子量ポリエチレン）を利用する。加熱・加圧の条件は、用いる熱可塑性樹脂により変動するが、超高分子量ポリエチレンを用いる場合には、概ね、 $150 \sim 200^{\circ}\text{C}$ 、 $490 \sim 2940 \text{ kPa}$ ($5 \sim 30 \text{ kg/cm}^2$) で、供給速度 $2 \sim 5 \text{ m/分}$ 、 $2 \sim 10$ 分間の処理である。このようにして得られたものを、次に図6のBのように多段に重ね、再度、加熱・加圧する。この際の加熱・加圧の条件は、 $130 \sim 200^{\circ}\text{C}$ 、 $490 \sim 4900 \text{ kPa}$ ($5 \sim 50 \text{ kg/cm}^2$) で $5 \sim 120$ 分間、更に好ましくは $140 \sim 170^{\circ}\text{C}$ 、 $980 \sim 2940 \text{ kPa}$ ($10 \sim 30 \text{ kg/cm}^2$) で $10 \sim 60$ 分間とする。

〔方法2〕

シート状環境浄化材を一定の大きさに切断し、これを多段に重ね、図7のようにシート状環境浄化材の間に、スペーサ（紙等）を挟み、加熱しながら上下から加圧する。加

熱・加圧の条件は、超高分子量ポリエチレンを用いる場合には、 $130 \sim 200^{\circ}\text{C}$ 、 $490 \sim 4900 \text{ kPa}$ ($5 \sim 50 \text{ kg/cm}^2$) で $5 \sim 120$ 分間、更に好ましくは $140 \sim 170^{\circ}\text{C}$ 、 $980 \sim 2940 \text{ kPa}$ ($10 \sim 30 \text{ kg/cm}^2$) で $10 \sim 60$ 分間とする。

熱可塑性樹脂の一つの超高分子量ポリエチレンは、耐摩耗性、耐衝撃性、自己潤滑性及び耐薬品性に優れ、また、静電気を有してその静電気力で金属酸化物の粒子や活性炭の粒子をその表面に集める作用がある。二酸化マンガンの酸化銅等の金属及び／又は金属酸化物粒子、又は活性炭等の吸着材粒子及び超高分子量ポリエチレン粒子の混合物を、 $130^{\circ}\text{C} \sim 200^{\circ}\text{C}$ の温度で加熱すると、超高分子量ポリエチレン粒子の表面は軟化し始めて結合力をもつようになり、その表面に金属及び／又は金属酸化物粒子及び吸着材粒子が接着する。更に、超高分子量ポリエチレン粒子どうしの結合も起こり、粒子塊は3次元的に拡大する

(図1、図2)。この際、加圧すると粒子どうしの結合力は強められ、また種々の形状の型枠等を用いると多種の形状に成形することができる。これを常温、常圧に戻すと適度な堅さをもつ多孔性構造体、すなわち、金属及び／又は金属酸化物粒子、及び吸着材粒子の各々の特性及び表面積が有効に保たれた環境浄化材が得られる。

上記粒子の他に、粒子を懸濁させる水(媒体)に粒子を均一に分散させる吸水性樹脂を用いると、通気性シートの

繊維状基材に金属及び／又は金属酸化物粒子、及び吸着材粒子が、熱可塑性樹脂粒子を介して絡んだ多孔性構造体、すなわち、シート状環境浄化材が得られる。このシート状環境浄化材もまた金属及び／又は金属酸化物粒子、及び吸着材粒子の本来の性能と表面積は保たれており、良好な環境浄化材となる。

さらに、本発明では、本発明の環境浄化材に被浄化物を接触させることにより、被浄化物に含まれる汚染物質を除去する環境浄化方法も提供される。なお、ここで汚染物質とは、悪臭、汚染、汚濁などの原因物質である。また、被汚染物質とは、工業排水等の液体や排気ガス、空気等の気体、あるいは、土壌などの固体である。

本発明の環境浄化材（粒状、ペレット状、ボール状、板状、シート状、ハニカム構造状等のいずれも）は多孔性構造体であって、各構成粒子は本来の粒子がもっている特性及び表面積を有効に保持し、吸着能や反応触媒能等の機能性が高い。

本発明の環境浄化材は、大気に存在するアンモニア、硫化水素、メルカプタン類、等の悪臭ガスの脱臭用、オゾン、窒素酸化物、CO、等の有害ガスの除去、分解用、空気清浄機のフィルター、トンネル内のCO・窒素酸化物等の分解除去材として、また、水中のNH₃・P等の除去等の浄化材として、あるいは土壌中に存在する各種有害物質等の脱臭・吸着・除去材として利用できる。

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本発明の環境浄化材は、適度な強度をもち、構造体から粒子が容易には脱落せず、環境を汚さない。触っても手を汚さない。地球環境にやさしく、安全である。

本発明の環境浄化材を用いた脱臭剤は、硫黄系の悪臭ガスに対して高い脱臭効果を示すばかりでなく、アンモニア、トリメチルアミン等の窒素系悪臭ガスに対しても、高い脱臭効果を示す。

本発明の環境浄化材を用いた脱臭剤は、コンパクトで、寿命が長い。

本発明の製造法により、特殊な繊維状基材を選ばず、容易に各種環境浄化材を製造することができる。

図面の簡単な説明

図 1 は、本発明の環境浄化材における、金属及び／又は金属酸化物粒子（a1、a2）、吸着材粒子（b）及び熱可塑性樹脂粒子（c）の結合の様子を示した模式図である。

図 2 は、本発明の環境浄化材の他の例の模式図で、金属及び／又は金属酸化物粒子（a1、a2）、吸着材粒子（b）及び熱可塑性樹脂粒子（c）を拡大し示した図である。

図 3 は、本発明のシート状環境浄化材における、金属及び／又は金属酸化物粒子（a1、a2）、吸着材粒子（b）、熱可塑性樹脂粒子（c）及び繊維状基材（d）の結合の様子を示した模式図である。

図 4 は、目の細かいシートで両面を覆ったシート状環境

浄化材の断面を示す模式図である。

図 5 は、二酸化マンガン及び酸化銅の混合粉の元素 (Mn : Cu) 重量比とメチルメルカプタン除去率の関係を示すグラフである。

図 6 A, 6 B は、本発明のハニカム構造の環境浄化材の一例を示す断面模式図である。6 A は、段ボール作製装置を用いて 2 枚のシート状環境浄化材を結合させた図、6 B は A を 4 段に結合させた図である。

図 7 は、本発明のハニカム構造の環境浄化材の他の例を示す断面模式図である。

発明を実施するための最良の形態

先ず、二酸化マンガンと酸化第二銅の混合比と脱臭能の関係についての実験例を示す。

〔実験例〕

二酸化マンガンと酸化第二銅を各々、5 : 0、4 : 1、3 : 1、1 : 1、2 : 3、1 : 4 及び 1 : 5 の元素 (Mn : Cu) 重量比で配合し、これをメノウ製のボールミルで混合し、脱臭用金属酸化物混合粉とした。この脱臭用金属酸化物混合粉の粒径を顕微鏡で観察するとおよそ $5\mu\text{m}$ 以下の微粉末であった。1 L のポリプロピレン製の密閉式ビーカーに、室温で、悪臭源としての 25 % メチルメルカプタンナトリウム水溶液 $10\mu\text{l}$ をとり、これに上記脱臭用金属酸化物混合粉 2 g を加えた場合及び加えない場合につい

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て、それぞれ30分後にメチルメルカプタン濃度を測定し、比較した。濃度は検知管で測定した。図5にその結果を示した。横軸は混合粉のマンガンと銅の元素重量比、縦軸はメチルメルカプタン除去率である。

図5から分かるようにメチルメルカプタンの除去率とMn : Cu比率の関係は2峰性を示し、Mn : Cuが4 : 1及び2 : 3で最大値を示した。

以下、実施例で本発明を更に詳細に説明する。なお、以下の実施例において、金属及び／又は金属酸化物粒子の平均粒径は、レーザー回折散乱法による粒度分布測定器LMS-24型（セイシン企業（株）製）により測定し、ポリエチレン粒子の平均粒径は、体積法による粒度分布測定器コールターマルチサイザーII（コールター社製）によりD₅₀を測定した。

また、比表面積は、BET比表面積測定装置「マイクロメリティクス アキソープ2100型」（島津製作所製）を用いて測定し、密度（空隙率）の測定はオートピクノメータ1320型（島津製作所製）により測定した。

実施例 1

二酸化マンガン（平均粒径：2.0 μm 、比表面積：60 m^2/g ）20g、酸化第二銅（平均粒径：1.9 μm 、比表面積：60 m^2/g ）25g及び活性炭（粒径：48メッシュ（300 μm ）パス、比表面積：510 m^2/g ）55gをボールミル内で混合した。これに超高分子量ポリ

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エチレン粒子〔（粘度法による分子量：2,000 K、粒径：20～150 μm （平均粒径：35 μm ）〕20 gを加えて更によく混合し、混合粒子の一部を、100 mm×100 mm×2.0 mm（縦×横×厚み）の型枠内に移し、上下から2.0 mmの鏡板で挟み、成形温度160℃、圧力1960 kPa（20 kg/cm²）で、40分間処理し、厚さ2.0 mmの多孔性板を得た。

得られた多孔性板を10 g切り取り、200 ppmのアンモニアを含む密閉された2 L容器中に吊るして静置させ、30分後にその濃度を測定すると5 ppm以下に減じていた。

得られた多孔性板2.7 gを切り取り、1000 ppmのアンモニアを含む密閉された1 Lポリプロピレン製ビーカー中に吊るして静置させ、20分後にその濃度を測定すると130 ppmにまで減じていた。

得られた多孔性板を2.7 g切り取り、これを310 ppmのメチルメルカプタンを含む密閉された1 Lポリプロピレン製ビーカー中に吊るして静置し、20分後にその濃度を測定すると29 ppmにまで減じていた。

得られた多孔性板を別に2.7 g切り取り、340 ppmのトリメチルアミンを含む密閉された1 Lポリプロピレン製ビーカー中に吊るして静置し、20分後にその濃度を測定すると81 ppmにまで減じていた。測定は検知管（ガステック社製）を用いた。

実施例 2

二酸化マンガン（平均粒径：2.0 μm ）50 g、酸化第二銅（平均粒径：1.9 μm ）50 g 及び活性炭（粒径：48メッシュ（300 μm ）パス）160 g をボールミル内で混合した。これに超高分子量ポリエチレン粒子〔粘度法による分子量：2,000 K、粒径：20～40 μm （平均粒径：30 μm ）〕70 g を加えて更によく混合した。

この混合粒子を角バット(vat)に10 mm 以下になるように均等に広げ、150℃で40分間加熱した。これを、室温に冷却後、粗粉碎機で粉碎し、およそ3～10 mm の大きさの粒状物を得た。

この粒状物20 g を2 L の密閉容器に入れ、容器内に硫化水素ガス100 ppm を供給した。10分後に硫化水素ガス検知管で測定したところ、硫化水素ガス濃度はゼロであった。

実施例 3

二酸化マンガン（平均粒径：2.0 μm ）50 g、酸化第二銅（平均粒径：1.9 μm ）50 g 及び活性炭（粒径：48メッシュ（300 μm ）パス）160 g をボールミル内で混合した。これに超高分子量ポリエチレン粒子〔粘度法による分子量：2,000 K、粒径：20～40 μm （平均粒径：30 μm ）〕70 g を加えて更によく混合した。この混合粒子をスクリー式造粒機に入れ、150℃

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で25分間、攪拌・混合した。およそ2～5mmの大きさの粒状物が得られた。

この粒状物10gを2Lの密閉容器に入れ、容器内に硫化水素ガス100ppmを供給した。10分後に硫化水素ガス検知管で測定したところ、硫化水素ガス濃度はゼロであった。

実施例4

二酸化マンガン（平均粒径：2.0 μ m）20g、酸化第二銅（平均粒径：1.9 μ m）25g及び活性炭（粒径：48メッシュ（300 μ m）パス）55gを予め、ボールミル内で混合した。

2Lの容器に水1Lを入れ、吸水性樹脂「スミカゲル」（住友化学（株）製、酢酸ビニル-アクリル酸エステル共重合ケン化物の商品名）2gを加え、よく攪拌した後、前記混合粒子の全量と超高分子量ポリエチレン粒子〔粘度法による分子量：2,000K、粒径：20～150 μ m（平均粒径は35 μ m）〕20gを加えて更によく混合し、粒子懸濁液を調製した。

この粒子懸濁液を厚さ0.3mm（40g/m²）のガラス不織布にディップ浸漬法で塗布含浸した後、175℃に加熱・乾燥し、シート状物を得た。このシート状物の比表面積は33m²/g、空隙率は91%であった。

得られたシート状物10gを、アンモニアガス濃度200ppmが入った2L密閉容器内に投入し、20分間に測定

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するとアンモニアガス濃度は5 ppm以下であった。

実施例 5

二酸化マンガン（平均粒径：2.0 μm ）50 g、酸化第二銅（平均粒径：1.9 μm ）50 g 及び活性炭（粒径：100メッシュ（150 μm ）パス）160 gをボールミル内で混ぜ、これに超高分子量ポリエチレン粒子〔粒径：20～40 μm （平均粒径：30 μm ）〕70 gを加えて更によく混ぜた。

別に3 Lポリエチレン容器に水2 Lを入れ、先にボールミル内で混ぜた粒子混合物を攪拌しながら少しずつ加え、次いで「スミカゲル」（住友化学（株）製）3 gを加え（粘度：150 c p）、更によく混ぜ、均一な分散状態の懸濁液とした。

得られたこの懸濁液を35 g/m²（厚みは約0.2 mm）のガラス不織布に、ディップ含浸法（縦型塗工機）で塗工し、加熱・乾燥した。塗工速度は1 m/分で、加熱・乾燥温度は170℃で行った。このようにして得られたシート状物は、単位面積あたり50 wt %が基材のガラス不織布であり、他の50 wt %は、活性炭、マンガンと銅酸化物粒子及び超高分子量ポリエチレン粒子であった。

得られたシート状物を100 mm×100 mmの大きさに切断し、2 Lの密閉容器に入れ、容器内に硫化水素ガス100 ppmを供給した。10分後に硫化水素ガス検知管で測定したところ、硫化水素ガス濃度はゼロであった。

実施例 6

実施例 4 の前半にて調製した粒子懸濁液と同じ粒子懸濁液を、 70 g/m^2 （厚みは約 0.2 mm ）のポリエステル不織布にグラビアコーター法（横型塗工機）で塗工し、加熱・乾燥した。塗工速度は 1 m/分 で、加熱・乾燥温度は 160°C で行った。このようにして得られたシート状物は、単位面積あたり $45 \text{ wt}\%$ が基材のポリエステル不織布であり、他の $55 \text{ wt}\%$ は、活性炭、マンガン酸化物、銅酸化物及び超高分子量ポリエチレンの各粒子であった。

得られたシート状物を $100 \text{ mm} \times 100 \text{ mm}$ の大きさに切断し、 2 L の密閉容器に入れ、容器内にアンモニアガス 100 ppm を供給した。30 分後にアンモニアガス検知管で測定したところ、アンモニアガス濃度はゼロであった。

実施例 7

実施例 4 の前半にて調製した粒子懸濁液と同じ粒子懸濁液を、 30 g/m^2 （厚みは約 0.2 mm ）ポリエステル・パルプ混抄不織布にダイヘッドコーター法（横型塗工機）で塗工し、加熱・乾燥した。塗工速度は 2 m/分 で、加熱・乾燥温度は 160°C で行った。このようにして得られたシート状物は、単位面積あたり $45 \text{ wt}\%$ が基材のポリエステル・パルプ混抄不織布、他の $55 \text{ wt}\%$ は、活性炭、マンガン酸化物、銅酸化物及び超高分子量ポリエチレンの各粒子であった。

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得られたシート状物を $100\text{ mm} \times 100\text{ mm}$ の大きさに切断し、 2 L の密閉容器に入れ、容器内にアンモニアガス 100 ppm を供給した。30分後にアンモニアガス検知管で測定したところ、アンモニアガス濃度はゼロであった。

実施例 8

二酸化マンガン（平均粒径： $2.0\text{ }\mu\text{ m}$ ） 50 g 、酸化第二銅（平均粒径： $1.9\text{ }\mu\text{ m}$ ） 50 g 、酸化マグネシウム（平均粒径： $1.5\text{ }\mu\text{ m}$ ） 50 g 及び活性炭（粒径： $48\text{ }\mu\text{ m}$ メッシュ（ $300\text{ }\mu\text{ m}$ ）パス） 110 g をボールミル内で混ぜたのち、超高分子量ポリエチレン粒子（粒径： $20\sim 40\text{ }\mu\text{ m}$ 、平均粒径： $30\text{ }\mu\text{ m}$ ） 70 g を加え、更に混合した。

別に 3 L ポリエチレン容器に水 2 L を入れ、これに先にボールミル内で混ぜた粒子混合物を少しずつ加え攪拌し、更に「スミカゲル」（住友化学（株）製） 3 g を加えて混ぜ、均一な分散状態の懸濁液とした。

得られたこの懸濁液を $35\text{ g}/\text{m}^2$ （厚みは約 0.2 mm ）のガラス不織布にディップ含浸法（縦型塗工機）で塗工、乾燥した。塗工速度は $1\text{ m}/\text{分}$ 、乾燥温度は 170°C で行った。得られたシート状物は、単位面積あたり $50\text{ wt}\%$ が基材のガラス不織布、他の $50\text{ wt}\%$ は活性炭、マンガン・銅・ Mg 酸化物粒子及び超高分子量ポリエチレン粒子であった。

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得られたシート状物を $100\text{ mm} \times 100\text{ mm}$ の大きさに切断し、 2 L の密閉容器に入れ、容器内に硫化水素ガス 100 ppm を供給した。10分後に硫化水素ガス検知管で測定したところ、硫化水素ガス濃度はゼロであった。

実施例 9

実施例 4 で得たシート状物を 5 枚重ねて 2 枚の鏡板に挟み、温度 170°C 、圧力 1470 KPa (15 kg/cm^2) で 60 分間処理した。厚さ 1.2 mm の多層シート状物が得られた。実施例 4 のシート状物より密となった。

この多層シート状物 10 g を、アンモニアガス濃度 200 ppm が入った 2 L 密閉容器内に投入し、30分間後に測定するとアンモニアガス濃度は、 5 ppm 以下であった。

実施例 10

実施例 5 で得たシート状物 1 枚と実施例 8 で得たシート状物 1 枚を重ね、これを 2 枚の鏡板に挟み、温度 160°C 、圧力 1960 KPa (20 kg/cm^2) で 30 分間処理した。

この重層シート状物を $100\text{ mm} \times 100\text{ mm}$ の大きさに切断し、 2 L の密閉容器に入れ、容器内に硫化水素ガス 100 ppm を供給し、5分後に測定すると硫化水素ガス濃度はゼロであった。

また、この重層シート状物を $100\text{ mm} \times 100\text{ mm}$ の大きさに切断し、 2 L の密閉容器に入れ、容器内に酢酸 150 ppm を供給し、20分後に測定すると酢酸濃度は 10 p

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p m以下であった。

実施例 11

2 Lの容器に水 1 Lを入れ、吸水性樹脂「スミカゲル」(住友化学(株)製、酢酸ビニル-アクリル酸エステル共重合ケン化物の商品名) 1 gを加え、攪拌した後に、二酸化マンガ(平均粒径: $2.0 \mu\text{m}$) 20 g、酸化第二銅(平均粒径: $1.9 \mu\text{m}$) 25 g、及び活性炭(粒子径: 100メッシュ($150 \mu\text{m}$)パス) 55 gをボールミル内に入れ、一定時間混合してから更に、超高分子量ポリエチレン粒子(粒径: $20 \sim 150 \mu\text{m}$ 、平均粒径: $35 \mu\text{m}$) 20 gを加え、更に混合し、 30 g/m^2 のガラス不織布に、前記粒子の総量が 37 g/m^2 となるように塗布し(粒子の塗布量はシート状物全体の55重量%)、 160°C で乾燥し、シート状物を得た。

次に、このシート状物の上下両面に厚さ $65 \mu\text{m}$ のガラス不織布(30 g/m^2)を重ね、2枚の鏡板の間にはさみ、温度 170°C 、圧力 1960 kPa (20 kg/cm^2)で30分間、加熱・加圧し、積層一体化したものを得た(図4)。図4中、1は重ねた2枚のシート状物、2はガラス不織布を示す。

積層一体化されたシート状物を $100 \text{ mm} \times 150 \text{ mm}$ の大きさに切断し、アンモニアガス濃度200 ppmが入った2 L密閉容器内に投入し、30分間後に測定するとアンモニアガス濃度は、5 ppm以下であった。

実施例 1 2

実施例 1 1 の前半において得られたシート状物の 2 枚を重ね、その後は実施例 1 1 と同様に操作し、積層一体化された表面保護材付シート状物を作製した。

積層一体化されたシート状物を $100\text{ mm} \times 150\text{ mm}$ の大きさに切断し、アンモニアガス濃度 200 ppm が入った 2 L 密閉容器内に投入し、 15 分間後に測定するとアンモニアガス濃度は、 10 ppm 以下であった。

実施例 1 3

二酸化マンガン（平均粒径： $2.0\text{ }\mu\text{ m}$ ） 50 g 、酸化第二銅（平均粒径： $1.9\text{ }\mu\text{ m}$ ） 50 g 及び活性炭（粒径： 48 メッシュ（ $300\text{ }\mu\text{ m}$ ）パス） 160 g をボールミル内で混合した。これに超高分子量ポリエチレン粒子（粒径： $20 \sim 40\text{ }\mu\text{ m}$ （平均粒径： $30\text{ }\mu\text{ m}$ ） 70 g を加えて更によく混合して混合粒子を得た。水 2 L を 3 L 容器に入れて前記混合粒子を攪拌しながら少しずつ加え、次いで、吸水性樹脂「スミカゲル」 3 g を加え、よく攪拌して均一に分散された粒子懸濁液とした。

これを 35 g/m^2 のガラス不織布に、縦型塗工機を用いディップ含浸法にて塗工し、乾燥し、第一のシート状物を得た。塗工速度は 1 m/分 、乾燥温度は 170°C 、前記粒子の塗布量は 35 g/m^2 （粒子の塗布量はシート状物全体の 50 重量%）とした。

別に、活性炭（粒径： 48 メッシュ（ $300\text{ }\mu\text{ m}$ ）パス）

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260 g と超高分子量ポリエチレン粒子（粒径：20～40 μm （平均粒径：30 μm ）85 g をボールミル内で混合して混合粒子を得た。3 L 容器に水 2 L を入れて、前記混合粒子を攪拌しながら少しずつ加え、更に吸水性樹脂「スミカゲル」3 g を加え、よく攪拌し均一に分散された粒子懸濁液とした。これを前記と同様にして、35 g/m² のガラス不織布に、縦型塗工機を用いディップ含浸法にて塗工し、乾燥し、第二のシート状物を得た。

第一のシート状物の上下両面に第二のシート状物を重ねて3層とし、更にこの上下にの両面に40 g/m² のレーヨン不織布を重ね、これを2枚の鏡板の間にはさみ、温度160℃、圧力1960 kPa（20 kg/cm²）で30分間、加熱・加圧し、積層一体化した。

積層一体化された表面保護材付シート状物を100 mm×100 mmの大きさに切断し、2 Lの密閉容器に入れ、容器内に硫化水素ガス100 ppmを供給した。5分後に硫化水素ガス検知管で測定したところ、硫化水素ガス濃度はゼロであった。



請求の範囲

1. (a) 金属及び金属酸化物の少なくともいずれかの粒子、

(b) 吸着材粒子、及び

(c) 熱可塑性樹脂粒子を含み、

金属及び金属酸化物の少なくともいずれかの粒子 (a) と吸着材粒子 (b) とは、熱可塑性樹脂粒子 (c) 表面に、それぞれ粒子どうしの接触部分で結合し、かつ、熱可塑性樹脂粒子 (c) どうしはそれらの接触部分で結合している環境浄化材。

2. 金属及び金属酸化物の少なくともいずれかの粒子

(a) が、マンガン、銅、亜鉛、鉄、バナジウム、ニッケル、マグネシウム、アルミニウム、チタン、パラジウム、白金、セリウム、ならびにケイ素、及びそれらの酸化物のうちから選ばれる一種以上であり、

吸着材粒子 (b) が、活性炭、ゼオライト、シリカゲル、セピオライト、活性アルミナ及び活性白土のうちから選ばれる1種以上であり、

熱可塑性樹脂粒子 (c) が、超高分子量ポリエチレン、ポリエチレン、ポリカーボネート、ポリアミドABS (Acrylonitrile-Butadiene-Styrene) 樹脂、ポリイミド、ポリ塩化ビニル、酢酸セルローズ、ポリスルホン、ポリスチレンフタレート、およびポリプロピレンから選ばれる一種以



上である請求項 1 の環境浄化材。

3. 金属及び金属酸化物の少なくともいずれかの粒子

(a) が、二酸化マンガン及び酸化第二銅であり、

吸着材粒子 (b) が、活性炭であり、

熱可塑性樹脂粒子 (c) が、平均分子量 (粘度法) 100 万～900 万の超高分子量ポリエチレンである、請求項 2 の環境浄化材。

4. 金属及び金属酸化物の少なくともいずれかの粒子

(a) は平均粒径 0.1～10 μm の大きさであり、

吸着材粒子 (b) はふるい目開き 48 メッシュ (300 μm) を通過する粒子を上記吸着材粒子全量の 50 重量/重量% 以上を含み、

熱可塑性樹脂粒子 (c) は平均粒径 20～50 μm の大きさである、請求項 1～3 のいずれかの環境浄化材。

5. (a) 金属及び金属酸化物のうちの少なくともいずれかの粒子 90～100 重量部、と

(b) 吸着材粒子 10～90 重量部との合計 100 重量部に對し、

(c) 熱可塑性樹脂粒子が 10～80 重量部である、請求項 1～4 のいずれかの環境浄化材。



6. 環境浄化材が、粒状、ペレット状、ボール状又は板状のいずれかの形状に成形された、請求項1～5のいずれかの環境浄化材。

7. (a) 金属及び金属酸化物の少なくともいずれかの粒子、

(b) 吸着材粒子、及び

(c) 熱可塑性樹脂粒子、

を混合し、前記熱可塑性樹脂の融点以上熱分解温度以下の温度で加熱する、請求項1～6のいずれかの環境浄化材の製造法。

8. 加熱が加圧を伴うものである、請求項7の製造法。

9. (a) 金属及び金属酸化物の少なくともいずれかの粒子、

(b) 吸着材粒子、

(c) 熱可塑性樹脂粒子、及び

(d) 通気性シートの繊維状基材を含み、

金属及び金属酸化物の少なくともいずれかの粒子(a)と吸着材粒子(b)とは、熱可塑性樹脂粒子(c)表面に、それぞれ粒子どうしの接触部分で結合し、

熱可塑性樹脂粒子(c)は通気性シートの繊維状基材(d)に結合している、シート状環境浄化材。



10. 金属及び金属酸化物のうち少なくともいずれかの粒子(a)が、マンガン、銅、亜鉛、鉄、バナジウム、ニッケル、マグネシウム、アルミニウム、チタン、パラジウム、白金、セリウム、ならびにケイ素、及びそれらの酸化物のうちから選ばれる一種以上であり、

吸着材粒子(b)が、活性炭、ゼオライト、シリカゲル、セピオライト、活性アルミナ及び活性白土のうちから選ばれる一種以上であり、

熱可塑性樹脂粒子(c)が、超高分子量ポリエチレン、ポリエチレン、ポリカーボネート、ポリアミドABS樹脂、ポリイミド、ポリ塩化ビニル、酢酸セルローズ、ポリスルホン、ポリスチレンフタレート、およびポリプロピレンのうちから選ばれる1種以上であり、

通気性シートの繊維状基材(d)が、空隙率60～98%の繊維状基材である、請求項9のシート状環境浄化材。

11. 金属及び金属酸化物のうちの少なくともいずれかの粒子(a)が、二酸化マンガン及び酸化第二銅であり、

吸着材粒子(b)が、活性炭であり、

熱可塑性樹脂粒子(c)が、平均分子量(粘度法)100万～900万の超高分子量ポリエチレンであり、

通気性シートの繊維状基材(d)が空隙率60～98%のガラス不織布である、請求項9のシート状環境浄化材。



12. 金属及び金属酸化物のうちの少なくともいずれかの粒子 (a) は平均粒径 $0.1 \sim 10 \mu\text{m}$ の大きさであり、

吸着材粒子 (b) はふるい目開き 48 メッシュ ($300 \mu\text{m}$) を通過する粒子を上記吸着材粒子全量の 50 重量 / 重量 % 以上を含み、

熱可塑性樹脂粒子 (c) は平均粒径 $20 \sim 50 \mu\text{m}$ の大きさである、

請求項 9 ～ 11 のいずれかのシート状環境浄化材。

13. 重量比率が、通気性シートの繊維状基材 (d) 100 重量部に対して、混合粒子 (a + b + c) 量が 40 ～ 200 重量部である、請求項 9 ～ 12 のいずれかのシート状環境浄化材。

14. 請求項 9 ～ 13 のいずれかのシート状環境浄化材を複数枚積層してなる、多層シート状環境浄化材。

15. 請求項 14 の多層シート状環境浄化材であって、そのうちの少なくとも 2 層はシート状環境浄化材を構成する金属及び金属酸化物のうちの少なくともいずれかの粒子 (a) 又は吸着材粒子 (b) が異なる、多層シート状環境浄化材。



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16. 請求項9～15のいずれかのシート状環境浄化材の少なくとも一方の面が、通気性表面保護材で覆われた表面保護材付シート状環境浄化材。

17. 請求項9～13のいずれかのシート状環境浄化材を立体的に加工してなる、ハニカム状環境浄化材。

18. (1) (a) 金属及び金属酸化物の少なくともいずれかの粒子、

(b) 吸着材粒子、

(c) 熱可塑性樹脂粒子、

(e) 吸水性樹脂、及び

(f) 水、

を混ぜて均一に分散された懸濁液をつくり、

(2) 上記懸濁液の所定量を、(d) 通気性シートの繊維状基材に保持させ、

(3) 前記熱可塑性樹脂の融点以上熱分解温度以下の温度で加熱し、水分を除去しながら、金属および金属酸化物の少なくともいずれかの粒子(a)および吸着材粒子(b)を、それぞれ熱可塑性樹脂粒子(c)を介して繊維状基材(d)に結合させる、請求項9～13のいずれかのシート状環境浄化材の製造法。

19. 吸水性樹脂が、アクリル酸－酢酸ビニル共重合体



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ケン化物、ポリアクリル酸塩架橋重合体、デンプン-アクリロニトリルグラフト共重合体、デンプン-アクリル酸グラフト共重合体、デンプン-ビニルスルホン酸グラフト共重合体及びデンプン-スチレンスルホン酸グラフト共重合体から選ばれる少なくとも一種の樹脂である、請求項 18 の製造法。

20. 請求項 9 ～ 13 のいずれかのシート状環境浄化材を複数枚重ねて、加圧とともに加熱する、請求項 14 又は請求項 15 のいずれかの多層シート状環境浄化材の製造法。

21. 請求項 9 ～ 15 のいずれかのシート状環境浄化材の少なくとも一方の面を通気性表面保護シート材で覆い、両面を加熱とともに加圧する、表面保護材付シート状環境浄化材の製造法。

22. 請求項 1 または 9 記載の環境浄化材に被浄化物を接触させることにより、被浄化物に含まれる汚染物質を除去する環境浄化方法。

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図 1

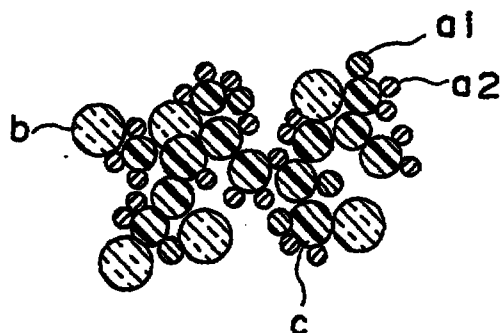
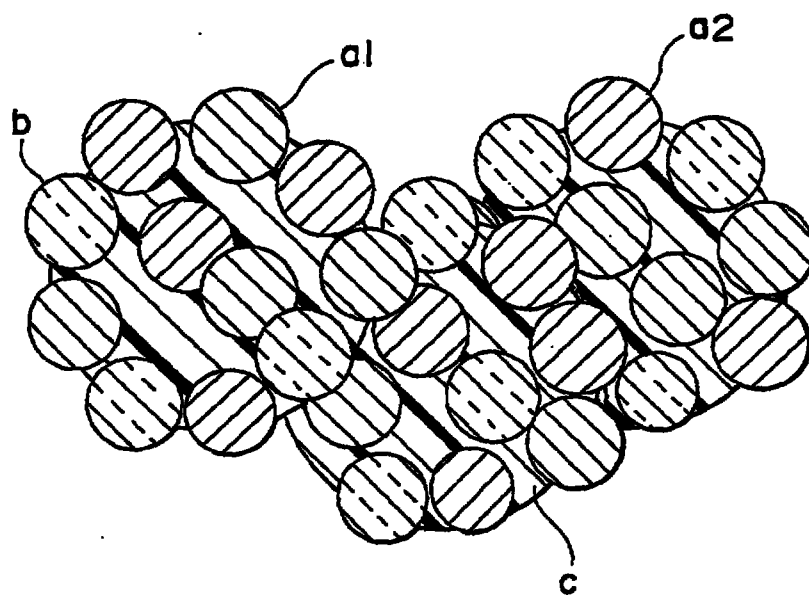


図 2



2/4

図3

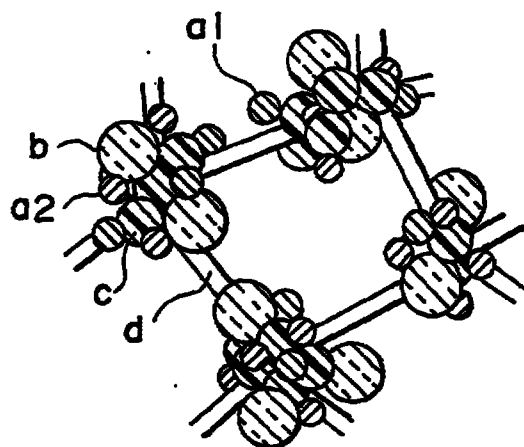
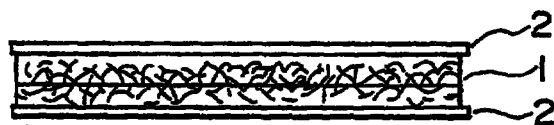


図4



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図5

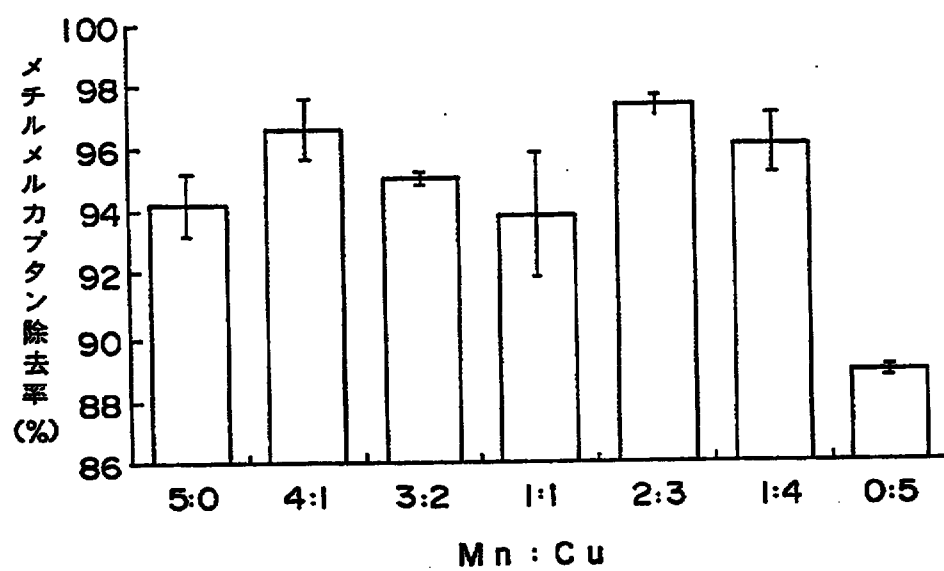
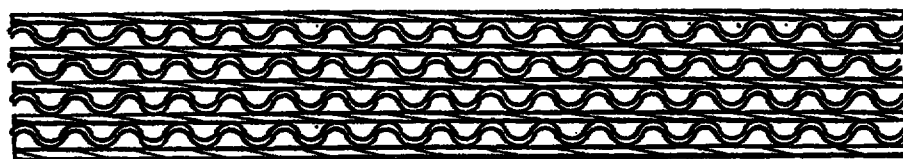


図6A

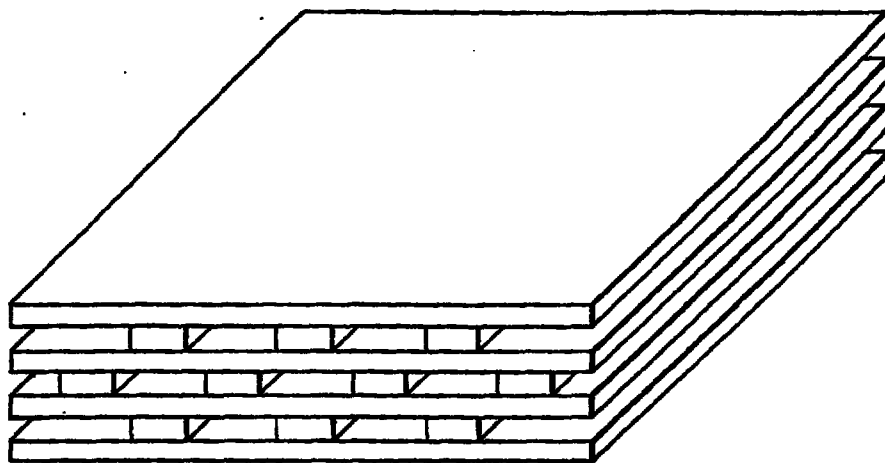


図6B



4/4

図7



SPECIFICATION

ENVIRONMENT PURIFYING MATERIAL

5

TECHNICAL FIELD

This invention relates to an environment purifying material that adsorbs and decomposes harmful substances causing rank odors, pollution, turbidity and so forth, contained in air, water, soil and so forth, and with which the air, water, soil and so forth can be made pure.

TECHNICAL BACKGROUND

15 Methods by which harmful substances, rank odors and so forth, contained in gases such as air and exhaust gases are adsorbed and decomposed to make the gases pure are known to include a method in which they are caused to chemically react with chemicals such as acid, alkali and aluminum sulfate to
20 remove them, a method in which they are adsorbed on adsorbents such as activated carbon and zeolite to remove them, a method in which they are masked with aromatics, and a method in which they are oxidized or burnt using catalytic particles of metals or metal oxides. Methods by which substances causing rank odors,
25 pollution, turbidity and so forth, contained in water such as river water, pond water and waste water are adsorbed and decomposed

to make the water pure are also known to include a method in which they are adsorbed on adsorbents such as activated carbon and zeolite, a method in which they are oxidized and decomposed using chemicals such as ozone, and a method in which they are
5 decomposed by microorganisms.

As methods for producing porous structural materials containing adsorbent particles such as activated carbon and zeolite or particles of metals or metal oxides having a reactivity as catalyst (catalytic activity), the following methods are
10 conventionally known.

One of them is a method in which particles such as particles of metals or metal oxides are mixed and the mixture is press-molded (a method called press molding). For example, Japanese Patent Application Laid-open (KOKAI) No. 50-30795 discloses a
15 method in which 40 parts by weight of manganese dioxide, 20 parts by weight of cupric oxide and 40 parts by weight of gamma alumina are mixed and the mixture is formed into tablets.

Another method is a method in which a porous carrier or a porous structural material is impregnated with an aqueous
20 solution of salts of metals such as manganese and copper, followed by baking (a method called baking or sintering). Materials used in such a method include, for example, a deodorizer comprising A-type zeolite incorporated with manganese oxide and copper oxide (Japanese Patent Application Laid-open (KOKAI) No.
25 1-151938), and a deodorizer comprising a honeycomb porous carrier supported with manganese dioxide and cupric oxide

(Japanese Patent Application Laid-open (KOKAI) No. 4-156854).

Other methods are also known to include a method in which the adsorbent particles such as activated carbon and zeolite and/or particles of metals or metal oxides are mixed together
5 with a binder and the mixture obtained is extruded by means of an extruder into stated shapes, followed by heating and activation to obtain porous particulate products (a method of extrusion molding with a binder), and a method in which the particles of metal
oxides or the like are kneaded into a foamable thermoplastic
10 resin, followed by heating to blow the resin into foams, which are used as deodorizing porous structural materials (a method of foaming), and so forth.

Methods for producing sheet-like deodorizers are also known to include a method in which a deodorizer powder and a
15 thermoplastic resin powder are sprayed onto a substrate sheet made of paper or the like, followed by heating to bring them into an integral form (Japanese Patent Application Laid-open (KOKAI) No. 61-119269), and a method in which a mixture of a deodorizing powder for gas treatment and a thermoplastic resin powder is
20 held between two layers of sheets at least one of which is an air-permeable sheet, followed by contact bonding to bring them into an integral form (Japanese Patent Application Laid-open (KOKAI) No. 5-49850), and so forth.

In the case when deodorizing porous structural materials
25 are produced by the above pressure molding, the particles of metals or metal oxides are so closely packed that the molded

products have a low specific surface area and a poor air permeability. There is another problem that particles that tend to collapse, as in the case of activated carbon and zeolite, cannot be molded.

5 In the case when they are produced by baking, there is a problem that oxide layers formed and impurities formed at the time of baking because of the binder used may block up the micropores of porous carriers, resulting in a decrease in specific surface area of the porous structural materials. In the case when
10 they are produced by sintering, it is difficult to cause metal or metal oxide particles to join to the surface of activated carbon.

 In the case when they are produced by extrusion molding with a binder or foaming, particles of the deodorizer powder are covered with the binder or the foamable resin, and hence odor
15 components cannot come into direct contact with the deodorizer powder, to cause a problem that the performance inherent in the deodorizer powder cannot be exhibited.

DISCLOSURE OF THE INVENTION

20

 An object of the present invention is to provide an environment purifying material comprising particles of a metal and/or a metal oxide, adsorbent particles, and thermoplastic resin particles, or an environment purifying material comprising
25 these particles and an air-permeable sheet fibrous substrate, where the particles of a metal and a metal oxide and/or the

adsorbent particles keep the original performance and specific surface area effectively retained, and are brought into an integral form as a porous structural material.

In an embodiment of the present invention, the environment
5 purifying material comprises;

- (a) particles of a metal and/or a metal oxide;
- (b) adsorbent particles; and
- (c) thermoplastic resin particles.

In this embodiment, the component-(a) particles of a metal
10 and/or a metal oxide and the component-(b) particles of adsorbent particles respectively stand bound to the surfaces of the component-(c) thermoplastic resin particles at their mutual contact portions, and the component-(c) thermoplastic resin particles stand joined to each other at their contact portions.

15 In this specification, semi-metals like silicon, are included in metals.

The environment purifying material of the present embodiment will be described below with reference to accompanying drawings. Fig. 1 diagrammatically illustrates an
20 example of how the component-(a) to (c) particles stand bound or joined in the environment purifying material of the present invention, and Fig. 2 diagrammatically illustrates another example of how the particles (a) to (c) stand bound or joined in the environment purifying material of the present invention. In
25 Figs. 1 and 2, reference symbol a1 denotes metal oxide particles 1; a2, metal oxide particles 2; b, adsorbent particles; and c,

thermoplastic resin particles. Two kinds of metal and/or metal oxide particles (a1 and a2) and one kind of adsorbent particles (b) stand bound to the surfaces of the thermoplastic resin particles (c) at their mutual contact portions while keeping their shapes (shown as spherical shapes in the drawings), and the particles of the thermoplastic resin particles stand joined to each other at their contact portions. Thus, a porous structural material having a three dimensional shape is formed.

In the environment purifying material of the present invention, materials having a specific surface area of 200 m²/g or larger can also be obtained. Hence, the environment purifying material of the present invention has a high rate of contact with rank odors and harmful substances, and shows a good environment purifying performance.

The metal and/or metal oxide particles (a) include particles of manganese, copper, zinc, iron, vanadium, nickel, magnesium, aluminum, titanium, palladium, platinum, cerium or silicon, and oxides thereof.

Manganese oxides includes MnO₂, MnO, Mn₃O₄, Mn₂O₃ and Mn₂O₇ or the like. In particular, MnO₂ may preferably be used.

Copper oxides includes CuO, Cu₂O and Cu₄O. In particular, CuO may preferably be used.

Any of these metal and/or metal oxide particles may be used alone, or may be used in combination of two or more kinds so that the function to purify many kinds of harmful substances can be imparted. When two or more kinds of particles are used in

combination, it is preferable to use a material containing, for example, manganese dioxide particles and cupric oxide particles. In such a case, manganese and copper may preferably be in a weight ratio of Mn/Cu of about 4:1 or so, or about 2:3 or so, in terms of element weight ratio. Their use in such a ratio enables effective removal of sulfur-containing odor gases.

The adsorbent particles (b) used in the present invention include particles of activated carbon, zeolite, silica gel, sepiolite, activated alumina and activated clay and so forth. Any of these adsorbent particles supported with aluminum sulfate, iodine, ferrous sulfide, calcium phosphate, sodium carbonate, magnesium silicate, boric acid, phosphoric acid, ascorbic acid, tartaric acid, oxalic acid, tannic acid, gallic acid or the like may also be used. Any of these adsorbent particles may be used alone, or may be used in combination of two or more kinds.

The activated carbon includes vegetable carbonaceous materials such as coconut shells and almond shells, charcoal, and bituminous coal, as well as synthetic resin carbonaceous materials such as phenol resin, any of which may be used.

The thermoplastic resin particles (c) used in the present invention include particles selected from particles of ultrahigh-molecular weight polyethylene, polyethylene, polycarbonate, polyamide ABS (acrylonitrile-butadiene-styrene) resins, polyimide, polyvinyl chloride, polysulfone, polystyrene phthalate, polypropylene, and cellulose acetate or the like. The particles must have a melting point high enough to endure atmospheric



temperatures of 70 to 100 °C in the summer season. These thermoplastic resin particles play a role as a binder that binds the metal and/or metal oxide particles (a) and the adsorbent particles (b) to the surfaces of the thermoplastic resin particles (c) at their mutual contact portions without being covered with thermoplastic resin layers. Also, the thermoplastic resin particles (c) stand joined to each other at their contact portions. Thus, as a whole, a porous structural material having a three dimensional shape is formed.

Of the various kinds of thermoplastic resin particles, ultrahigh-molecular weight polyethylene having an average molecular weight of from 1,000,000 to 9,000,000 as measured by viscometry may preferably be used, because they have less residual monomer components, a high stability to acid, alkali and organic chemicals, and also do not damage the surfaces of the metal and/or metal oxide particles (a) and adsorbent particles (b), making it possible to obtain a porous structural material having a superior environment purifying performance and an appropriate strength.

The metal and/or metal oxide particles (a) used in the present invention may preferably have a size of from 0.1 to 10 μm in terms of average particle diameter. If the particles have a size smaller than 0.1 μm , they may agglomerate to make it difficult to be uniformly dispersed. In a size larger than 10 μm , the particles may have a small specific surface area, resulting in a lowering of reactivity as catalyst.

The specific surface area of the metal and/or metal oxide particles (a) depends on the type of metal or metal oxide particles, the particle diameter thereof and the surface roughness.

5 The adsorbent particles (b) used in the present invention may have particles having such a size that they pass a sieve of 48 meshes (corresponding to particle diameter of 300 μm), and may preferably contain the particles with such a size in an amount not less than 50% by weight, and more preferably not less than 70%
10 by weight, based on the total weight of the adsorbent particles (b). If the particles passing a sieve of 48 meshes are in an amount less than 50% by weight (in other words, if particles not passing a sieve of 48 meshes are in an amount more than 50% by weight), the particles may have a small specific surface area,
15 resulting in a lowering of adsorptivity. The adsorbent particles (b) may preferably have a specific surface area of at least 350 m^2/g .

 The thermoplastic resin particles (c) used in the present invention may preferably have a size of from 20 to 150 μm , and
20 more preferably from 20 to 50 μm , in terms of average particle diameter. Thermoplastic resin particles having a size smaller than 20 μm can be produced with difficulty and are expensive. If the particles have a size larger than 150 μm , the structural material obtained tends to have a low strength.

25 Herein, the average particle diameter of the metal and/or metal oxide particles is in terms of a number-based average

value.

The average particle diameter of the thermoplastic resin particles is in terms of a central value (50% value, D50) of weight-based particle size distribution.

- 5 In comparison of relative size of the respective particles (a), (b) and (c), the metal and/or metal oxide particles (a) may preferably have an average particle diameter 0.01 to 0.5 times the average particle diameter of the thermoplastic resin particles (c), and the adsorbent particles (b) may preferably have
10 an average particle diameter 0.01 to 2 times the average particle diameter of the thermoplastic resin particles (c). When such conditions are satisfied, the surface area of the metal and/or metal oxide particles and that of the adsorbent particles can be effectively retained, promising a high grade of environment
15 purifying performance such as reactivity as catalyst and adsorptivity, and making it possible to obtain an environment purifying material with a porous structure from which the respective component-(a) to (c) particles do not easily come off.

- The thermoplastic resin particles (c) may be used in an
20 amount of from 10 to 80 parts by weight, and preferably from 20 to 50 parts by weight, based on 100 parts by weight as the total weight of the metal and/or metal oxide particles (a) and adsorbent particles (b). If in an amount less than 10 parts by weight, the binding force of the metal and/or metal oxide
25 particles (a) and the adsorbent particles (b) onto the thermoplastic resin particles (c) or the structure strength tends

to be insufficient. If in an amount more than 80 parts by weight, environment purifying performance per unit weight tends to lower, and also such an amount cannot be said to be economical.

The environment purifying material described above can be
5 produced by mixing;

- (a) the particles of a metal and/or a metal oxide;
- (b) the adsorbent particles; and
- (c) the thermoplastic resin particles;

and heating the mixture at a temperature not lower than the
10 melting point of the thermoplastic resin (particles) used and not higher than the thermal decomposition temperature thereof. If necessary, an appropriate pressure may be applied to the mixture when heated.

The mixture may be heated at a temperature of the melting
15 point of the thermoplastic resin up to a temperature not higher than its thermal decomposition temperature, and preferably at a temperature not lower than the melting point of the thermoplastic resin up to a temperature of the melting point plus 50 °C or below. In the case when the ultrahigh-molecular weight
20 polyethylene is used as the thermoplastic resin particles, the mixture may be heated at a temperature of from 130 °C to 200 °C, and preferably from 160 °C to 180 °C. If heated at a temperature lower than 130 °C, the binding of the metal and/or metal oxide particles (a) and adsorbent particles (b) to the ultrahigh-
25 molecular weight polyethylene particles may be insufficient, tending to result in an unsatisfactory strength of the porous



structural material obtained. If heated at a temperature higher than 200 °C, the ultrahigh-molecular weight polyethylene particles may melt, and the molten matter may cover the surfaces of the metal and/or metal oxide particles and adsorbent particles, resulting in a lowering of environment purifying performance.

In the case when pressure is applied at the time of heating, the pressure may preferably be in the range of from 490 to 2,940 kPa (5 to 30 kg/cm²), and more preferably from 490 to 2,450 kPa (5 to 25 kg/cm²). If the pressure is higher than 2,940 kPa (30 kg/cm²), the thermoplastic resin particles such as ultrahigh-molecular weight polyethylene particles may crush, making it difficult to achieve the desired air-permeability.

The heating (or heating and pressing) may be carried out for a time that is sufficient for the surface layers of the thermoplastic resin particles to become soft while keeping their spherical shape, until the particles have a binding power. It is important not to over-heat the thermoplastic resin so as not to melt and turn into liquid. Also, the heating time should be selected so that the respective particles of the metal and/or metal oxide particles and adsorbent particles can effectively keep their surface area. In the case when the ultrahigh-molecular weight polyethylene particles are used as the thermoplastic resin particles, the heating time may usually be in the range of from 5 to 60 minutes.

The structural material formed by heating (or heating and pressing) may have any form of various types such as grains,

pellets, balls, tablets and sheets or plates under, etc. appropriate selection of the shapes of frames or the like.

The present invention further relates to the environment purifying material which is a sheet-form environment purifying material which comprises;

- (a) particles of a metal and/or a metal oxide;
- (b) adsorbent particles;
- (c) thermoplastic resin particles; and
- (d) an air-permeable sheet of fibrous substrate;

the component-(a) particles of a metal and/or a metal oxide and the component-(b) adsorbent particles standing bound to the surfaces of the component-(c) thermoplastic resin particles at their mutual contact portions; and

the component-(c) particles standing joined to the component-(d) air-permeable sheet of fibrous substrate.

The environment purifying material of the present embodiment will be described below with reference to the figure. Fig. 3 diagrammatically illustrates how metal and/or metal oxide particles (a1, a2), adsorbent particles (b), thermoplastic resin particles (c) and a fibrous substrate (d) stand bound or joined in the environment purifying material of the present invention. In the figure, reference symbol a1 denotes metal oxide particles 1 (e.g., manganese dioxide); a2, metal oxide particles 2 (e.g., cupric oxide); b, adsorbent particles (e.g., activated carbon); c, thermoplastic resin particles; and d, fibers of the fibrous substrate. Two kinds of metal and/or metal oxide particles (a1

and a2) and one kind of adsorbent particles (b) stand bound to the surfaces of the thermoplastic resin particles (c) at their mutual contact portions while keeping their shapes (shown as spherical shapes in the drawing), and the particles of the thermoplastic resin particles stand joined to each other at their contact portions and also stand joined to the fibers of the fibrous substrate (d). Thus, these form a porous structural material having a three dimensional shape.

In the sheet-form environment purifying material of the present embodiment, the metal and/or metal oxide particles (a), the adsorbent particles (b) and the thermoplastic resin particles (c) have the same type and absolute or relative size as those previously described.

In the sheet-form environment purifying material of the present invention, it can have a specific surface area of 20 m²/g or larger in usual cases and a much larger specific surface area of 30 m²/g or larger in some cases, have a void volume of 50% or more in usual cases and a much larger void volume of 80% or more in some cases. Hence, the environment purifying material of the present invention can remove rank odors and harmful substances with good efficiency, has a high air-permeability, and exhibits a good environment purifying performance.

The air-permeable sheet fibrous substrate (d) may be a fibrous substrate having a void volume of from 60% to 99%, and preferably from 70% to 98%, including, for example, woven or nonwoven glass fabric, and woven or nonwoven plastic fabric

made of polyethylene, polypropylene, polyamide or polyester, and paper or the like. In particular, nonwoven glass fabric basically made of glass fiber and having a void volume of from 70% to 98% may preferably be used in view of thermal resistance and air-
5 permeability.

The fibrous substrate used may have any thickness without any particular limitations so long as it has a thickness large enough not to break when treated by impregnation or the like. When substrates having a large thickness are used, plate-form
10 porous structural materials can be obtained. When those having a small thickness are used, sheet-form porous structural materials can be obtained.

The metal and/or metal oxide particles (a), adsorbent particles (b) and thermoplastic resin particles (c) held on the air-
15 permeable sheet fibrous substrate (d) may be in a total weight, i.e., weight of (a)+(b)+(c), of from 40 to 200 parts by weight, and preferably from 70 to 150 parts by weight, based on 100 parts by weight of the air-permeable sheet fibrous substrate (d). If held in an amount less than 40 parts by weight, the environment
20 purifying performance may lower. Also, it is difficult for them to be held thereon in an amount more than 200 parts by weight.

The above sheet-form environment purifying material can be produced by mixing;

- (a) the particles of a metal and/or a metal oxide;
- 25 (b) the adsorbent particles;
- (c) the thermoplastic resin particles;

(e) a water-absorptive resin; and

(f) water;

to prepare a homogeneously dispersed suspension, and bringing
the suspension into contact with an air-permeable sheet of
5 fibrous substrate (d) in a stated quantity so as to be held thereon,
followed by heating at a temperature not lower than the melting
point of the thermoplastic resin and not higher than the thermal
decomposition temperature thereof, to cause the metal and/or
metal oxide particles (a) and the adsorbent particles (b) to join to
10 the fibrous substrate (d) via the thermoplastic resin particles (c)
while removing water content.

Here, the water-absorptive resin (e) is added in order to
homogeneously disperse the aqueous suspension of the
mixed particles of the metal and/or metal oxide particles (a),
15 adsorbent particles (b) and thermoplastic resin particles (c).
Upon addition of the water-absorptive resin, the water-
absorptive resin absorbs water to cause an increase in viscosity,
and the suspension of the mixed particles is brought into a state
of homogeneous dispersion and besides the state of homogeneous
20 dispersion is stably maintained for a long time. Hence, the
subsequent step, i.e., the step of bringing the suspension into
contact with an air-permeable sheet fibrous substrate in a stated
quantity so as to be held thereon, can be carried out with ease.

The water-absorptive resin (e) may preferably be resins
25 capable of absorbing water in a weight tens to thousands of times
its own weight, including acrylic acid-vinyl acetate copolymer

saponified products, polyvinyl alcohol cross-linked polymers, polyacrylonitrile polymer saponified products, polyacrylate cross-linked polymers, a starch-acrylonitrile graft copolymer, a starch-acrylate graft copolymer, a starch-vinylsulfonic acid
5 graft copolymer, a starch-styrenesulfonic acid graft copolymer, a cellulose-acrylonitrile graft copolymer, a cellulose-styrenesulfonic acid graft copolymer, carboxymethyl cellulose cross-linked polymers, polyethylene glycol diacrylate cross-linked polymers, and polyvinyl pyrrolidone cross-linked polymers
10 or the like.

Such water-absorptive resins are used for the purpose of dispersing and suspending the mixture of several kinds of particles homogeneously and also for a long time as described above, but have no positive role after the final porous structural
15 material has been formed. Hence, the water-absorptive resin may preferably be a resin that can increase the viscosity of the suspension even when used in a small quantity and does not inhibit the function of the metal and/or metal oxide particles (a) or the adsorbent particles (b) after drying (dehydration). Highly
20 water-absorptive resins are suited for such a purpose. Of the water-absorptive resins listed above, highly water-absorptive resins are acrylic acid-vinyl acetate copolymer saponified products, polyacrylate cross-linked polymers, a starch-acrylonitrile graft copolymer, a starch-acrylate graft copolymer,
25 a starch-vinylsulfonic acid graft copolymer and a starch-styrenesulfonic acid graft copolymer or the like, and these are

particularly preferably used.

The amount of the water-absorptive resin used may vary depending on the types of the water-absorptive resin. The amount may be determined appropriately according to the types. In such a case, the property serving as an index that determines the amount of the water-absorptive resin used is the viscosity of the suspension of the mixed particles. Accordingly, the water-absorptive resin may be used in an amount previously determined so as to provide a viscosity of from 10 to 500 cp, and preferably from 50 to 200 cp, as measured at 25 °C. Usually, it may be used in an amount of approximately from 0.01 to 1.0 part by weight based on 100 parts by weight of the water.

The reasons why the water is used as a solvent are that it can maintain the properties of the respective particles, that it causes no environmental pollution, that it has a high safety in view of the prevention of fires on account of static electricity, and so forth.

The homogeneously dispersed suspension comprising a mixture of the metal and/or metal oxide particles (a), the adsorbent particles (b), the thermoplastic resin particles (c), the water-absorptive resin (e) and the water (f) can be prepared by, for example, a method in which the water-absorptive resin and water are mixed, followed by stirring during which the component-(a), (b) and (c) particles are added little by little, or a method in which the component-(a), (b) and (c) particles are added little by little in the water with stirring and then the water-

absorptive resin (e) is added thereto. Methods are by no means limited to these.

As a method by which the aqueous suspension of the components (a), (b), (c) and (e) are held on the air-permeable
5 sheet of fibrous substrate (d) in a stated quantity, the suspension may be coated or held on the fibrous substrate by using a conventional coating process such as dip coating, gravure coating or die head coating. Temperature may be set at room temperature.

After a stated quantity of the suspension has been held on
10 the fibrous substrate, this substrate with the suspension is heated for a stated time at a temperature not lower than the melting point of the thermoplastic resin used and not higher than the thermal decomposition temperature thereof, more preferably, a temperature not lower than the melting point of the
15 thermoplastic resin used and up to a temperature of the melting point plus 50 °C or below of the thermoplastic resin. As a result of this heating, the water content is evaporated and removed, so that the thermoplastic resin particles become soft at their surface layers to have a binding power. The thermoplastic resin
20 particles having become soft at their surface layers so as to have a binding power, capture and bind on their surfaces the particles (a) and (b) while keeping their spherical particle shape, and the thermoplastic resin particles (c) join to the fibrous substrate while joining to each other at their contact portions.

25 The heating may be carried out for a time that is sufficient for the surface layers of the thermoplastic resin particles to

become soft while keeping their spherical shape, until the particles have a binding power. The time may be previously fixed after experiments or the like. It is important not to over-heat the thermoplastic resin so as not to melt and turn liquid. In the case when the thermoplastic resin particles used are the ultrahigh-molecular weight polyethylene particles, the heating may usually be carried at a temperature of from 130 to 200 °C, and preferably from 140 to 180 °C.

The sheet-form environment purifying material described above may be superposed a number of times, followed by heating and pressing to produce a multi-layer sheet-form environment purifying material. Conditions for the heating and pressing may vary depending on the thermoplastic resin used. When the ultrahigh-molecular weight polyethylene is used, the heating and pressing may be carried out at 130 to 200 °C, at 490 to 4,900 kPa (5 to 50 kg/cm²) and for 5 to 120 minutes, and preferably at 140 to 170 °C, at 980 to 2,940 kPa (10 to 30 kg/cm²) and for 10 to 60 minutes.

The multi-layer sheet-form environment purifying material may be used in such a form that at least two layers of the layers constituting the environment purifying material respectively contain the metal and/or metal oxide particles (a) or adsorbent particles (b) of different types. For example, it is possible regard to a layer 1, that manganese dioxide particles are used as the particles (a) ((b), activated carbon particles; (c), ultrahigh-molecular weight polyethylene particles; and (d), nonwoven glass

fabric), and with regard to a layer 2, cupric oxide particles are used as the particles (a) ((b), activated carbon particles; (c), ultrahigh-molecular weight polyethylene particles; and (d), nonwoven glass fabric).

5 The present invention is also concerned with a sheet-form environment purifying material provided with a protective layer, according to which at least one side of the sheet-form environment purifying material or multi-layer sheet-form environment purifying material is covered with an air-permeable
10 surface protective material.

 The air-permeable surface protective material is laminated so that even a small quantity of particles can be prevented from coming off from the sheet-form environment purifying material or laminated sheet-form environment purifying material.

15 The air-permeable surface protective material may be a sheet having an air-permeability and have meshes substantially fine enough not to pass the particles of the metal and/or metal oxide particles, adsorbent particles and so forth, and there are no particular limitations thereon. Such air-permeable surface
20 protective materials include, for example, paper, nonwoven fabric and woven fabric or the like. The paper includes pulp paper, synthetic paper and filter paper or the like. The nonwoven fabric includes nonwoven single-material fabric made of polyethylene, polypropylene, polyamide or polyester, or mixed nonwoven fabric
25 of some of these, and nonwoven glass fabric or the like. The woven fabric includes those made of natural or synthetic fiber

such as cotton or polyester fiber etc.

The sheet-form environment purifying material with the surface protective material can be produced by superposing the air-permeable surface protective material on one side or both
5 sides of the sheet-form environment purifying material or laminated sheet-form environment purifying material, followed by heating and pressing. Conditions for the heating and pressing carried out in this instance may vary depending on the thermoplastic resin used in the production of the sheet-form
10 environment purifying material. When the ultrahigh-molecular weight polyethylene is used, the heating and pressing may be carried out at 130 to 200 °C, at 490 to 4,900 kPa (5 to 50 kg/cm²) and for 5 to 120 minutes, and preferably at 140 to 170 °C, at 980 to 2,940 kPa (10 to 30 kg/cm²) and for 10 to 60
15 minutes.

The present invention is also concerned with a environment purifying material having a honeycomb structure obtained by three-dimensionally working the sheet-form environment purifying material.

20 There are no particular limitations on the method for producing, from the sheet, the environment purifying material having a honeycomb structure. For example, it can be produced by the following methods.

- Method 1 -

25 Using a corrugated board manufacturing machine, two sheets of the sheet-form environment purifying materials are

joined together on one side as shown in Fig. 6A. As a binder between the two, the thermoplastic resin particles (e.g., ultrahigh-molecular weight polyethylene) in the sheet-form environment purifying material are utilized. Conditions for the heating and pressing vary depending on the thermoplastic resin used. When the ultrahigh-molecular weight polyethylene is used, the heating and pressing may be carried out approximately at 150 to 200 °C, at 490 to 2,940 kPa (5 to 30 kg/cm²) and for 2 to 10 minutes at a feed rate of 2 to 5 m/min. Products thus obtained are superposed in multiple layers as shown in Fig. 6B, followed by heating and pressing again. The heating and pressing at this stage may be carried out at 130 to 200 °C, at 490 to 4,900 kPa (5 to 50 kg/cm²) and for 5 to 120 minutes, and preferably at 140 to 170 °C, at 980 to 2,940 kPa (10 to 30 kg/cm²) and for 10 to 60 minutes.

- Method 2 -

The sheet-form environment purifying material is cut into sheets with a given size, and the cut sheets are superposed in multiple layers. Spacers such as sheets of paper are inserted between the cut sheet-form environment purifying materials as shown in Fig. 7, followed by pressing from the top and bottom while heating. As to conditions for the heating and pressing, when the ultrahigh-molecular weight polyethylene is used, the heating and pressing may be carried out at 130 to 200 °C, at 490 to 4,900 kPa (5 to 50 kg/cm²) and for 5 to 120 minutes, and preferably at 140 to 170 °C, at 980 to 2,940 kPa (10 to 30

kg/cm²) and for 10 to 60 minutes.

The ultrahigh-molecular weight polyethylene, one of thermoplastic resins, has superior wear resistance, impact resistance, self-lubricating properties and chemical resistance.

5 It also generates static electricity, and has the action of gathering particles of metal oxides or particles of activated carbon to its surface on account of its electrostatic force. Upon the heating of particles of metal and/or metal oxides such as manganese dioxide and cupric oxide, or mixtures of adsorbent

10 particles such as activated carbon with ultrahigh-molecular weight polyethylene particles, at a temperature of 130 °C to 200 °C, the surfaces of ultrahigh-molecular weight polyethylene particles begin to become soft and have a binding power, so that the metal and/or metal oxide particles and the adsorbent

15 particles adhere to the surfaces. Also, the ultrahigh-molecular weight polyethylene particles are joined to each other, so that the mass of particles expands three dimensionally (see Fig. 1, Fig. 2). Here, when pressed, the power to join particles to particles can be strengthened. Also, when frames or the like of various

20 shapes are used, the products can be formed into various kinds of shapes. The temperature and pressure are the restored to ordinary temperature and ordinary pressure, whereupon a porous structural material having an appropriate rigidity can be obtained, that is, an environment purifying material in which the

25 properties and surface area of the respective metal and/or metal oxide particles and adsorbent particles are effectively retained.

When, in addition to the particles described above, the water-absorptive resin capable of homogeneously dispersing the particles in the water in which the particles are suspended is used, it is possible to obtain the porous structural material in which the metal and/or metal oxide particles and the adsorbent particles are entangled with the air-permeable surface protective material via the thermoplastic resin particles, i.e., the sheet-form environment purifying material. In this sheet-form environment purifying material, too, the performances and surface area inherent in the metal and/or metal oxide particles and adsorbent particles are retained, resulting in a good environment purifying material.

Further, according to the present invention, there is provided a method of purifying the environment with removing pollutive substances contained in objects to be purified, by contacting the objects with the environment purifying materials of the present invention. Here, the pollutive substance means substances causative of rank odors, pollution, turbidity and so forth, and the polluted substances means a liquid such as industrial waste water, a gas such as exhaust gas or air, or a solid such as soil.

As described above, the environment purifying materials of the present invention (any of those formed into grains, pellets, balls, plates, sheets or honeycomb structures) are porous structural materials, and the respective constituent particles effectively retain the properties and specific surface area



inherent in the original particles, and can be high in performances characteristics such as adsorption performance and catalytic reactivities.

5 The environment purifying materials of the present invention can be utilized as materials for deodorizing smelly gases such as ammonia, hydrogen sulfide and mercaptan etc. present in the air, materials for removing or decomposing harmful gases such as ozone, nitrogen oxide and CO etc., materials for decomposing and removing CO, nitrogen oxide and so forth in
10 tunnels or filters of air cleaners, and purifying materials for removing NH_3 , P and so forth in water, as well as materials for deodorizing, adsorbing and decomposing various harmful substances having caused pollution of soil.

The environment purifying materials of the present
15 invention have an appropriate strength, so that the particles do not easily come away from the structural materials, causing no environmental pollution by themselves. When touched, they do not contaminate hands. They are friendly to the global environment, and are safe.

20 Deodorizers making use of the environment purifying material of the present invention not only have a high deodorizing effect against sulfur type smelly gases, but also have a high deodorizing effect against nitrogen type smelly gases such as ammonia and trimethylamine.

25 Deodorizers making use of the environment purifying material of the present invention are compact, and have a long

lifetime.

The production processes of the present invention enable easy manufacture of various types of environment purifying materials without the need to select any special fibrous
5 substrates.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagrammatic view showing how metal and/or
10 metal oxide particles (a1, a2), adsorbent particles (b) and thermoplastic resin particles (c) stand bound or joined in the environment purifying material of the present invention.

Fig. 2 is diagrammatic view of another example of the environment purifying material of the present invention, and is an
15 enlarged view of the metal and/or metal oxide particles (a1, a2), the adsorbent particles (b) and the thermoplastic resin particles (c).

Fig. 3 is a diagrammatic view showing how metal and/or metal oxide particles (a1, a2), adsorbent particles (b),
20 thermoplastic resin particles (c) and a fibrous substrate (d) stand bound or joined in the sheet-form environment purifying material of the present invention.

Fig. 4 is a diagrammatic view showing a cross section of a sheet-form environment purifying material covered with fine-
25 weave sheets on both sides thereof.

Fig. 5 is a graph showing the relationship between weight

ratio of elements (Mn:Cu) in a powdery mixture of manganese dioxide and cupric oxide, and removal rate of methyl mercaptan.

Figs. 6A and 6B are diagrammatic cross-sectional views showing examples of an environment purifying material with a honeycomb structure according to the present invention. Fig. 6A is a view where two sheet-like environment purifying materials are put together using a corrugated board manufacturing machine. Fig. 6B is a view where the materials shown in Fig. 6A are put together in four layers.

Fig. 7 is a diagrammatic cross-sectional view showing another example of the honeycomb structure.

MOST PREFERRED EMBODIMENT OF THE INVENTION

An experimental example will be shown first, concerning the relationship between the mixing ratio of manganese dioxide and cupric oxide, and the deodorizing ability.

Experimental Example

Manganese dioxide and cupric oxide were mixed in a weight ratio of elements (Mn:Cu), of 5:0, 4:1, 3:1, 1:1, 2:3, 1:4 or 1:5. The mixture obtained was blended using a ball mill made of agate to form a deodorizing metal oxide powdery mixture. This deodorizing metal oxide powdery mixture was observed with a microscope to examine its particle diameters, to find that it was a fine powder with particle diameters of about 5 μm or smaller. In a hermetically enclosed 1 liter beaker made of polypropylene, 10 μl of an aqueous 25% methyl mercaptan sodium salt solution



was taken at room temperature, the methyl mercaptan being a rank-odor source. To this solution, 2 g of the above deodorizing metal oxide powdery mixture was added or not added. For both the cases, methyl mercaptan concentration was measured after
5 30 minutes to make a comparison. The concentration was measured using an indicator tube. Results obtained are shown in Fig. 5. The abscissa indicates element weight ratio of manganese to copper in the powdery mixture, and the ordinate, methyl mercaptan removal rate.

10 As can be seen from Fig. 5, the methyl mercaptan removal rate and the Mn:Cu ratio are in the relationship of a double-peak fashion, showing maximum values when Mn:Cu is 4:1 and 2:3.

The present invention will be described below in greater detail by giving Examples. In the following Examples, the average
15 particle diameter of the metal and/or metal oxide particles was measured using Model LMS-24 (manufactured by Seishin Kigyo K.K.), a device for measuring particle size distribution by laser diffraction scattering. The average particle diameter of polyethylene particles was examined by measuring D50 using a
20 Coulter Multisizer II (manufactured by Coulter Electronics Co.), a device for measuring particle size distribution by volumetry.

The specific surface area was measured using a BET specific surface area measuring unit MICROMERITIX AQUISOBE Model 2100 (manufactured by Shimazu Corporation). The density
25 (void volume) was measured using Autopcnometer Model 1320 (manufactured by Shimazu Corporation).

Example 1

In a ball mill, 20 g of manganese dioxide (average particle diameter: 2.0 μm ; specific surface area: 60 m^2/g), 25 g of cupric oxide (average particle diameter: 1.9 μm ; specific surface area: 60 m^2/g) and 55 g of activated carbon (particle diameter: 48 mesh(300 μm)-pass; specific surface area: 510 m^2/g) were mixed. To the mixture obtained, 20 g of ultrahigh-molecular weight polyethylene particles (molecular weight as measured by viscometry: 2,000 K; particle diameters: 20 to 150 μm (average particle diameter: 35 μm)) were added, followed by further thorough mixing. A portion of the mixed particles obtained was moved into a frame of 100 mm $\times$ 100 mm $\times$ 2.0 mm (length $\times$ width $\times$ thickness), which was then held between mirror plates of 2.0 mm thick from the top and bottom, followed by treatment for 40 minutes at a molding temperature of 160 $^{\circ}\text{C}$ and a pressure of 1,960 kPa (20 kg/cm^2) to obtain a 2.0 mm thick porous plate.

The porous plate obtained was cut out to a weight of 10 g, and then hung in a hermetically enclosed 2 liter container containing 200 ppm of ammonia, leaving it to stand. After 30 minutes, the ammonia concentration was measured to reveal that it had decreased to 5 ppm.

The porous plate obtained was cut out to a weight of 2.7 g, and then hung in a hermetically enclosed 1 liter polypropylene beaker containing 1,000 ppm of ammonia, leaving it to stand. After 20 minutes, its concentration was measured to reveal that it had decreased to as low as 130 ppm.

The porous plate obtained was cut out to a weight of 2.7 g, and then hung in a hermetically enclosed 1 liter polypropylene beaker containing 310 ppm of methyl mercaptan, leaving it to stand. After 20 minutes, its concentration was measured to
5 reveal that it had decreased to as low as 29 ppm.

The porous plate obtained was further cut out to a weight of 2.7 g, and then hung in a hermetically enclosed 1 liter polypropylene beaker containing 340 ppm of trimethylamine, leaving it to stand. After 20 minutes, its concentration was
10 measured to reveal that it was decreased to as low as 81 ppm. The concentration was measured using an indicator tube (manufactured by Gastech Co.)

Example 2

In a ball mill, 50 g of manganese dioxide (average particle
15 diameter: 2.0 μm), 50 g of cupric oxide (average particle diameter: 1.9 μm) and 160 g of activated carbon (particle diameter: 48 mesh(300 μm)-pass) were mixed. To the mixture obtained, 70 g of ultrahigh-molecular weight polyethylene particles (molecular weight as measured by viscometry: 2,000 K; particle diameters:
20 20 to 40 μm (average particle diameter: 30 μm)) were added, followed by further thorough mixing.

The mixed particles obtained were evenly spread over a square tray so as to be 10 mm thick or less, followed by heating at 150 °C for 40 minutes. The particles thus treated were cooled
25 to room temperature, and thereafter crushed using a primary crusher to obtain a granular product with a size of about 3 to 10

mm.

This granular product (20 g) was put in a hermetically enclosed 2 liter container, and hydrogen sulfide gas was fed into the container in a concentration of 100 ppm. After 10 minutes, the concentration of hydrogen sulfide gas was measured using a hydrogen sulfide gas indicator tube. As a result, the concentration of hydrogen sulfide gas was zero.

Example 3

In a ball mill, 50 g of manganese dioxide (average particle diameter: 2.0 μm), 50 g of cupric oxide (average particle diameter: 1.9 μm) and 160 g of activated carbon (particle diameter: 48 mesh(300 μm)-pass) were mixed. To the mixture obtained, 70 g of ultrahigh-molecular weight polyethylene particles (molecular weight as measured by viscometry: 2,000 K; particle diameters: 20 to 40 μm (average particle diameter: 30 μm)) were added, followed by further thorough mixing. The mixed particles obtained were put into a screw type granulator, followed by agitation and mixing at 150 °C for 25 minutes. A granular product with a size of about 2 to 5 mm was obtained.

This granular product (10 g) was put in a hermetically enclosed 2 liter container, and hydrogen sulfide gas was fed into the container in a concentration of 100 ppm. After 10 minutes, the concentration of hydrogen sulfide gas was measured using a hydrogen sulfide gas indicator tube. As a result, the concentration of hydrogen sulfide gas was zero.

Example 4

In a ball mill, 20 g of manganese dioxide (average particle diameter: 2.0 μm), 25 g of cupric oxide (average particle diameter: 1.9 μm) and 55 g of activated carbon (particle diameter: 48 mesh(300 μm)-pass) were mixed.

5 One liter of water was put into a 2 liter container, and 2 g of a water-absorptive resin SUMICAGEL (trade name of a vinyl acetate-acrylate copolymer saponified product; available from Sumitomo Chemical Co., Ltd.) was added thereto, followed by thorough stirring. Thereafter, the whole of the above mixed
10 particles and 20 g of ultrahigh-molecular weight polyethylene particles (molecular weight as measured by viscometry: 2,000 K; particle diameters: 20 to 150 μm (average particle diameter: 35 μm)) were added, followed by further thorough mixing. Thus, a particle suspension was prepared.

15 A nonwoven glass fabric of 0.3 mm thick (40 g/m²) was coated and impregnated with this particle suspension by dip coating, followed by heating and drying at 175 °C to obtain a sheet-form product. This sheet-form product has a specific surface area of 33 m²/g and a void volume of 91%.

20 The resulting sheet-form product (10 g) was put in a hermetically enclosed 2 liter container containing ammonia gas in a concentration of 200 ppm. After 20 minutes, the concentration of ammonia gas was measured to reveal that it was 5 ppm or less.

Example 5

25 In a ball mill, 50 g of manganese dioxide (average particle diameter: 2.0 μm), 50 g of cupric oxide (average particle diameter:

1.9 μm) and 160 g of activated carbon (particle diameter: 100 mesh(150 μm)-pass) were mixed, and 70 g of ultrahigh-molecular weight polyethylene particles (particle diameters: 20 to 40 μm (average particle diameter: 30 μm)) were added thereto, followed
5 by further thorough mixing.

Separately, 2 liter of water was put into a 3 liter polyethylene container, and the particle mixture previously obtained by mixing in the ball mill was added thereto little by little while stirring. Subsequently, 3 g of SUMICAGEL (available
10 from Sumitomo Chemical Co., Ltd.) (viscosity: 150cp) was added thereto, followed by thorough mixing to obtain a homogeneously dispersed suspension.

This suspension thus obtained was coated on a nonwoven glass fabric of 35 g/m^2 (thickness: about 0.2 mm) by dip coating
15 using a vertical coater, followed by heating and drying. The coating was carried out at a rate of 1 m/min, and the heating and drying at a temperature of 170 $^{\circ}\text{C}$. The sheet-form product thus obtained was a nonwoven glass fabric in which 50% by weight per unit area was held by the substrate and the remaining 50% by
20 weight was held by the activated carbon particles, manganese and copper oxides particles and ultrahigh-molecular weight polyethylene particles.

The sheet-form product obtained was cut in a size of 100 mm $\times$ 100 mm, and put in a hermetically enclosed 2 liter
25 container, and hydrogen sulfide gas was fed into the container in a concentration of 100 ppm. After 10 minutes, the concentration

of hydrogen sulfide gas was measured using a hydrogen sulfide gas indicator tube. As a result, the concentration of hydrogen sulfide gas was zero.

Example 6

5 The same particle suspension as the particle suspension obtained in the first half stage in Example 4 was coated on a nonwoven polyester fabric of 70 g/m² (thickness: about 0.2 mm) by gravure coating using a horizontal coater, followed by heating and drying. The coating was carried out at a rate of 1 m/min, and
10 the heating and drying at a temperature of 160 °C. The sheet-form product thus obtained was a nonwoven polyester fabric in which 45% by weight per unit area was held by the substrate nonwoven polyester fabric and the remaining 55% by weight was held by the respective particles of activated carbon, manganese
15 oxide, copper oxide and ultrahigh-molecular weight polyethylene.

 The sheet-form product obtained was cut to a size of 100 mm × 100 mm, and put in a hermetically enclosed 2 liter container, and ammonia gas was fed into the container in a concentration of 100 ppm. After 30 minutes, the concentration of
20 ammonia gas was measured using an ammonia gas indicator tube. As a result, the concentration of ammonia gas was zero.

Example 7

 The same particle suspension as the particle suspension obtained in the first half stage in Example 4 was coated on a
25 nonwoven polyester-pulp mixed fabric of 30 g/m² (thickness: about 0.2 mm) by dye head coating using a horizontal coater,

followed by heating and drying. The coating was carried out at a rate of 2 m/min, and the heating and drying at a temperature of 160 °C. The sheet-form product thus obtained was a nonwoven polyester-pulp mixed fabric in which 45% by weight per unit area was held by the substrate nonwoven polyester-pulp mixed fabric and the remaining 55% by weight was held by the respective particles of activated carbon, manganese oxide, copper oxide and ultrahigh-molecular weight polyethylene.

The sheet-form product obtained was cut to a size of 100 mm × 100 mm, and put in a hermetically enclosed 2 liter container, and ammonia gas was fed into the container in a concentration of 100 ppm. After 30 minutes, the concentration of ammonia gas was measured using an ammonia gas indicator tube. As a result, the concentration of ammonia gas was zero.

Example 8

In a ball mill, 50 g of manganese dioxide (average particle diameter: 2.0 μm), 50 g of cupric oxide (average particle diameter: 1.9 μm), 50 g of magnesium oxide (average particle diameter: 1.5 μm) and 110 g of activated carbon (particle diameter: 48 mesh(300 μm)-pass) were mixed, and 70 g of ultrahigh-molecular weight polyethylene particles (particle diameters: 20 to 40 μm (average particle diameter: 30 μm)) were added thereto, followed by further thorough mixing.

Separately, 2 liters of water was put into a 3 liter polyethylene container, and the particle mixture previously obtained by mixing in the ball mill was added little by little

thereto while stirring. Subsequently, 3 g of SUMICAGEL (available from Sumitomo Chemical Co., Ltd.) was added thereto, followed by thorough mixing to obtain a homogeneously dispersed suspension.

This suspension thus obtained was coated on a nonwoven
5 glass fabric of 35 g/m² (thickness: about 0.2 mm) by dip coating using a vertical coater, followed by heating and drying. The coating was carried out at a rate of 1 m/min, and the heating and drying at a temperature of 170 °C. The sheet-form product thus obtained was a nonwoven glass fabric in which 50% by weight per
10 unit area was held by the substrate of nonwoven glass fabric and the remaining 50% by weight was held by the activated carbon, manganese, copper and manganese oxides particles and ultrahigh-molecular weight polyethylene particles.

The sheet-form product obtained was cut to a size of 100
15 mm × 100 mm, and put in a hermetically enclosed 2 liter container, and hydrogen sulfide gas was fed into the container in a concentration of 100 ppm. After 10 minutes, the concentration of hydrogen sulfide gas was measured using a hydrogen sulfide gas indicator tube. As a result, the concentration of hydrogen
20 sulfide gas was zero.

Example 9

Five sheets of the sheet-form product obtained in Example 4 were superposed one another, and then held between two mirror plates, followed by treatment at a temperature of 170 °C and a
25 pressure of 1,470 kPa (15 kg/cm²) for 60 minutes. Thus a multi-layer sheet-form product was obtained, which was denser than

the sheet-form product of Example 4.

The resulting sheet-form product (10 g) was put in a hermetically enclosed 2 liter container containing ammonia gas in a concentration of 200 ppm. After 30 minutes, the concentration
5 of ammonia gas was measured to reveal that it was 5 ppm or less.

Example 10

One sheet of the sheet-form product obtained in Example 5 and one sheet of the sheet-form product obtained in Example 8 were superposed on each other, and then held between two mirror
10 plates, followed by treatment at a temperature of 160 °C and a pressure of 1,960 kPa (20 kg/cm²) for 30 minutes.

The double-layer sheet-form product obtained was cut to a size of 100 mm × 100 mm, and put in a hermetically enclosed 2 liter container, and hydrogen sulfide gas was fed into the
15 container in a concentration of 100 ppm. After 5 minutes, the concentration of hydrogen sulfide gas was measured to reveal that it was zero.

The double-layer sheet-form product obtained was also cut to a size of 100 mm × 100 mm, and put in a hermetically enclosed
20 2 liter container, and acetic acid was fed into the container in a concentration of 150 ppm. After 20 minutes, the concentration of acetic acid was measured to reveal that it was 10 ppm or less.

Example 11

One liter of water was put in a 2 liter container, and 1 g of
25 a water-absorptive resin SUMICAGEL (trade name of a vinyl acetate-acrylate copolymer saponified product; available from

Sumitomo Chemical Co., Ltd.) was added thereto, followed by thorough stirring. Thereafter, 20 g of manganese dioxide (average particle diameter: 2.0 μm), 25 g of cupric oxide (average particle diameter: 1.9 μm) and 55 g of activated carbon (particle diameter: 100 mesh(150 μm)-pass) were put in a ball mill, and mixed for a stated time. Then, 20 g of ultrahigh-molecular weight polyethylene particles (particle diameters: 20 to 150 μm ; average particle diameter: 35 μm) was added thereto, followed by further mixing, to obtain a particle suspension. This suspension was coated on a nonwoven glass fabric of 30 g/m^2 so as for the particles to be in a total weight of 37 g/m^2 (coating weight of the particles was 55% by weight of the whole sheet-form product) followed by drying at 160 $^{\circ}\text{C}$ to obtain a sheet-form product.

Next, both on the top and bottom sides of this sheet-form product, sheets of 65 μm thick nonwoven glass fabric (30 g/m^2) were superposed, which were then held between two mirror plates, followed by heating and pressing at a temperature of 170 $^{\circ}\text{C}$ and a pressure of 1,960 kPa (20 kg/cm^2) for 30 minutes to obtain a laminated integral product as shown in Fig. 4. In Fig. 4, reference numeral 1 denotes the two sheets of the sheet-like products superposed, and 2, the nonwoven glass fabric.

The laminated integral sheet-like product was cut to a size of 100 mm $\times$ 150 mm, and put in a hermetically enclosed 2 liter container containing ammonia gas in a concentration of 200 ppm. After 30 minutes, the concentration of ammonia gas was

measured to reveal that it was 5 ppm or less.

Example 12

Two sheets of the sheet-form product obtained in the first half stage in Example 11 were superposed on each other, and the subsequent procedure was repeated in the same manner as in
5 Example 11 to produce a laminated integral sheet-form product with surface protective materials.

This laminated integral sheet-form product was cut to a size of 100 mm × 150 mm, and put in a hermetically enclosed 2 liter container containing ammonia gas in a concentration of 200
10 ppm. After 15 minutes, the concentration of ammonia gas was measured to reveal that it was 10 ppm or less.

Example 13

In a ball mill, 50 g of manganese dioxide (average particle diameter: 2.0 μm), 50 g of cupric oxide (average particle diameter: 1.9 μm) and 160 g of activated carbon (particle diameter: 48 mesh(300 μm)-pass) were mixed, and 70 g of ultrahigh-molecular weight polyethylene particles (particle diameters: 20 to 40 μm ; average particle diameter: 30 μm) were added thereto, followed
20 by further thorough mixing to obtain mixed particles. Two liters of water was put into a 3 liter container, and the mixed particles were added thereto little by little while stirring. Subsequently, 3 g of a water-absorptive resin SUMICAGEL was added thereto, followed by thorough mixing to form a homogeneously dispersed
25 particle suspension.

This suspension was coated on a glass nonwoven fabric of

35 g/m² by dip coating using a vertical coater, followed by drying to obtain a first sheet-form product. The coating was carried out at a rate of 1 m/min, and the drying at a temperature of 170 °C. The coating weight of the particles was controlled to be 35 g/m² (coating weight of the particles was 50% by weight of the whole sheet-like product).

Separately, 260 g of activated carbon (particle diameter: 48 mesh(300 µm)-pass) and 85 g of ultrahigh-molecular weight polyethylene particles (particle diameters: 20 to 40 µm; average particle diameter: 30 µm) were mixed in a ball mill to obtain mixed particles. Two liters of water was put into a 3 liter container, and the mixed particles were added thereto little by little while stirring. Subsequently, 3 g of a water-absorptive resin SUMICAGEL was added thereto, followed by thorough mixing to form a homogeneously dispersed particle suspension. Like the above, this suspension was coated on a glass nonwoven fabric of 35 g/m² by dip coating using a vertical coater, followed by drying to obtain a second sheet-form product.

On the top and bottom sides of the first sheet-form product, sheets of the second sheet-form product were superposed to form a three-layer structure. Then, on the top and bottom sides thereof, sheets of nonwoven rayon fabric of 40 g/m² were superposed, which were then held between two mirror plates, followed by heating and pressing at a temperature of 160 °C and a pressure of 1,960 kPa (20 kg/cm²) for 30 minutes to obtain a laminated integral product.

The laminated integral sheet-form product provided with surface protective materials was cut to a size of 100 mm × 100 mm, and put in a hermetically enclosed 2 liter container. Hydrogen sulfide gas was fed into the container in a concentration of 100 ppm. After 5 minutes, the concentration of hydrogen sulfide gas was measured using a hydrogen sulfide gas indicator tube. As a result, the concentration of hydrogen sulfide gas was zero.



Claims

1. An environment purifying material comprising;
 - (a) particles of at least one of a metal and a metal oxide;
 - (b) adsorbent particles; and
 - 5 (c) thermoplastic resin particles;said component-(a) particles of at least one of a metal and a metal oxide and said component-(b) adsorbent particles respectively standing bound to the surfaces of said component-(c) thermoplastic resin particles at their mutual contact portions,
10 and the particles of said component-(c) thermoplastic resin particles standing joined to each other at their contact portions.
2. The environment purifying material according to claim 1, wherein;
15 said component-(a) particles of at least one of a metal and a metal oxide are made of at least one selected from the group consisting of manganese, copper, zinc, iron, vanadium, nickel, magnesium, aluminum, titanium, palladium, platinum, cerium and silicon, and oxides thereof;
20 said component-(b) adsorbent particles are made of at least one selected from the group consisting of activated carbon, zeolite, silica gel, sepiolite, activated alumina and activated clay; and
said component-(c) thermoplastic resin particles are made
25 of at least one selected from the group consisting of ultrahigh-molecular weight polyethylene, polyethylene, polycarbonate,



polyamide acrylonitrile-butadiene-styrene resins, polyimide, polyvinyl chloride, cellulose acetate, polysulfone, polystyrene phthalate and polypropylene.

5 3. The environment purifying material according to claim 2, wherein;

 said component-(a) particles of at least one of a metal and a metal oxide are manganese dioxide and particles of cupric oxide;

 said component-(b) adsorbent particles are activated
10 carbon; and

 said component-(c) thermoplastic resin particles are ultrahigh-molecular weight polyethylene having an average molecular weight of from 1,000,000 to 9,000,000 as measured by viscometry.

15

 4. The environment purifying material according to any one of claims 1 to 3, wherein;

 said component-(a) particles of at least one of a metal and a metal oxide have an average particle diameter of from 0.1 μm to
20 10 μm ;

 said component-(b) adsorbent particles contain particles that pass a sieve of 48 meshes (300 μm), in an amount not less than 50% by weight based on the total weight of the adsorbent particles; and

25 said component-(c) thermoplastic resin particles have an average particle diameter of from 20 μm to 50 μm .



5. The environment purifying material according to any one of claims 1 to 4, wherein said component-(c) thermoplastic resin particles are contained in an amount of from 10 parts by weight to 80 parts by weight based on 100 parts by weight of the total of from 90 parts by weight to 10 parts by weight of said component-(a) particles and from 10 parts by weight to 90 parts by weight of said component-(b) adsorbent particles.
6. The environment purifying material according to any one of claims 1 to 5, wherein the environment purifying material is formed in any shape of grains, pellets, balls, and a plate.
7. A process for producing the environment purifying material according to any one of claims 1 to 6, said process comprising the steps of mixing;
- (a) particles of at least one of a metal and a metal oxide;
 - (b) adsorbent particles; and
 - (c) thermoplastic resin particles;
- and heating the mixture at a temperature not lower than the melting point of the thermoplastic resin and not higher than the thermal decomposition temperature thereof.
8. A process for producing the environment purifying material according to claim 7, wherein said mixture is heated under application of pressure.



9. A sheet-form environment purifying material comprising;

- 5 (a) particles of at least one of a metal and a metal oxide;
(b) adsorbent particles;
(c) thermoplastic resin particles; and
(d) an air-permeable sheet of fibrous substrate;

said component-(a) particles of at least one of a metal and a metal oxide and said component-(b) adsorbent particles
10 respectively standing bound to the surfaces of said component-(c) thermoplastic resin particles at their mutual contact portions;
and

said component-(c) particles standing joined to said component-(d) an air-permeable sheet of fibrous substrate.

15

10. The sheet-form environment purifying material according to claim 9, wherein;

said component-(a) particles of at least one of a metal and a metal oxide are selected from the group consisting of
20 manganese, copper, zinc, iron, vanadium, nickel, magnesium, aluminum, titanium, palladium, platinum, cerium and silicon, and oxides thereof;

said component-(b) adsorbent particles are selected from the group consisting of activated carbon, zeolite, silica gel,
25 sepiolite, activated alumina and activated clay;

said component-(c) thermoplastic resin particles are



selected from the group consisting of ultrahigh-molecular weight polyethylene, polyethylene, polycarbonate, polyamide acrylonitrile-butadiene-styrene resins, polyimide, polyvinyl chloride, cellulose acetate, polysulfone, polystyrene phthalate
5 and polypropylene; and

said component-(d) an air-permeable sheet fibrous substrate is a fibrous substrate having a void volume of from 60% to 98%.

10 11. The sheet-form environment purifying material according to claim 9, wherein;

said component-(a) particles of at least one of a metal and a metal oxide are manganese dioxide and particles of cupric oxide;

15 said component-(b) adsorbent particles are activated carbon;

said component-(c) thermoplastic resin particles are ultrahigh-molecular weight polyethylene having an average molecular weight of from 1,000,000 to 9,000,000 as measured by viscometry; and

20 said component-(d) an air-permeable sheet fibrous substrate is a non-woven glass fabric having a void volume of from 60% to 98%.

12. The sheet-form environment purifying material
25 according to any one of claims 9 to 11, wherein;

said component-(a) particles of at least one of a metal and



a metal oxide have an average particle diameter of from 0.1 μm to 10 μm ;

said component-(b) adsorbent particles contain particles that pass a sieve of 48 meshes (300 μm), in an amount not less than 50% by weight based on the total weight of the adsorbent particles; and

said component-(c) thermoplastic resin particles have an average particle diameter of from 20 μm to 50 μm .

10 13. The sheet-form environment purifying material according to any one of claims 9 to 12, wherein mixed particles of said components-(a) to (c) are in a weight of (a)+(b)+(c), of from 40 to 200 parts by weight based on 100 parts by weight of said component-(d) an air-permeable sheet fibrous substrate.

15 14. A multi-layer sheet-form environment purifying material comprising a plurality of environment purifying materials according to any one of claims 9 to 13 which are superposed in layers.

20 15. The multi-layer sheet-form environment purifying material according to claim 14, wherein at least two layers thereof respectively contain the component-(a) particles of at least one of a metal and a metal oxide or component-(b) adsorbent particles of different types.

25



16. A sheet-form environment purifying material with a surface protective material, comprising the environment purifying material according to any one of claims 9 to 15, at least one side of which is covered with an air-permeable surface
5 protective material.

17. A honeycomb type environment purifying material comprising said sheet-form environment purifying material according to any one of claims 9 to 13, having been three-
10 dimensionally worked.

18. A process for producing said sheet-form environment purifying material according to any one of claims 9 to 13, said process comprising the steps of;

15 1) mixing;

(a) particles of at least one of a metal and a metal oxide;

(b) adsorbent particles;

(c) thermoplastic resin particles;

(e) a water-absorptive resin; and

20 (f) water;

to prepare a homogeneously dispersed suspension;

2) bringing the suspension into contact with (d) an air-permeable sheet fibrous substrate in a stated quantity so as to be held thereon; and

25 3) carrying out heating at a temperature not lower than the melting point of the thermoplastic resin and not higher than the



thermal decomposition temperature thereof, to cause said component-(a) particles of at least one of a metal and a metal oxide and said component-(b) adsorbent particles to join to the fibrous substrate (d) via the component-(c) thermoplastic resin particles while removing water content.

19. The process according to claim 18, wherein said water-absorptive resin is selected from the group consisting of an acrylic acid-vinyl acetate copolymer saponified product, a polyacrylate cross-linked polymer, a starch-acrylonitrile graft copolymer, a starch-acrylate graft copolymer, a starch-vinylsulfonic acid graft copolymer and a starch-styrenesulfonic acid graft copolymer.

20. A process for producing a multi-layer sheet-form environment purifying material of either one of claims 14 and 15, comprising superposing a plurality of sheet-form environment purifying materials according to any one of claims 9 to 13, followed by heating under application of pressure.

20

21. A process for producing a sheet-form environment purifying material with a surface protective material, comprising covering at least one side of the environment purifying material according to any one of claims 9 to 15, with an air-permeable surface protective sheet material, followed by heating under application of pressure.



22. A method of purifying the environment for removing
pollutive substances contained in objects to be purified by
contacting the objects to be purified with said environment
5 purifying materials according to either one of claims 1 and 9.

ABSTRACT OF THE DISCLOSURE

A sheet-form environment purifying material of the present invention comprising (a) metal and/or metal oxide particles, (b) 5 adsorbent particles, (c) thermoplastic resin particles; and (d) an air-permeable sheet of fibrous substrate; the metal and/or metal oxide particles (a) and the adsorbent particles (b) respectively standing bound to the surfaces of the thermoplastic resin particles (c) at their mutual contact portions, and the 10 thermoplastic resin particles (c) standing joined to substrate (d). This is produced by mixing the particles (a), the particles (b), the particles (c), water-absorptive resin (e), and water to prepare a homogeneously dispersed suspension and bringing the suspension into contact with an air-permeable sheet fibrous substrate (d) in 15 a stated quantity so as to be held thereon, followed by heating at a temperature not lower than the melting point of the resin (c) and not higher than the thermal decomposition temperature thereof, to cause the particles to join to the fibrous substrate (d) via the thermoplastic resin particles (c) while removing water 20 content.

The metal and/or metal oxide particles and the adsorbent particles stand bound to the thermoplastic resin particles without being covered with thermoplastic resin layers and retain their inherent surface areas and performances, bringing about a 25 good environment purifying performance. Useful as deodorizers, harmful gas removers and so forth.

FIG. 1

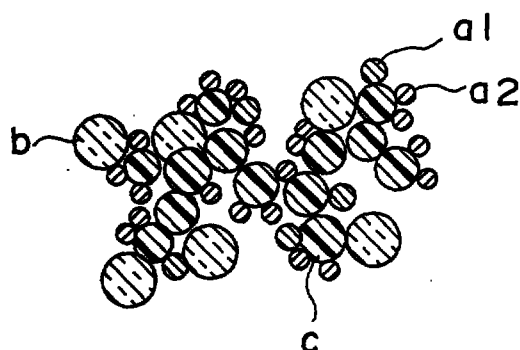


FIG. 2

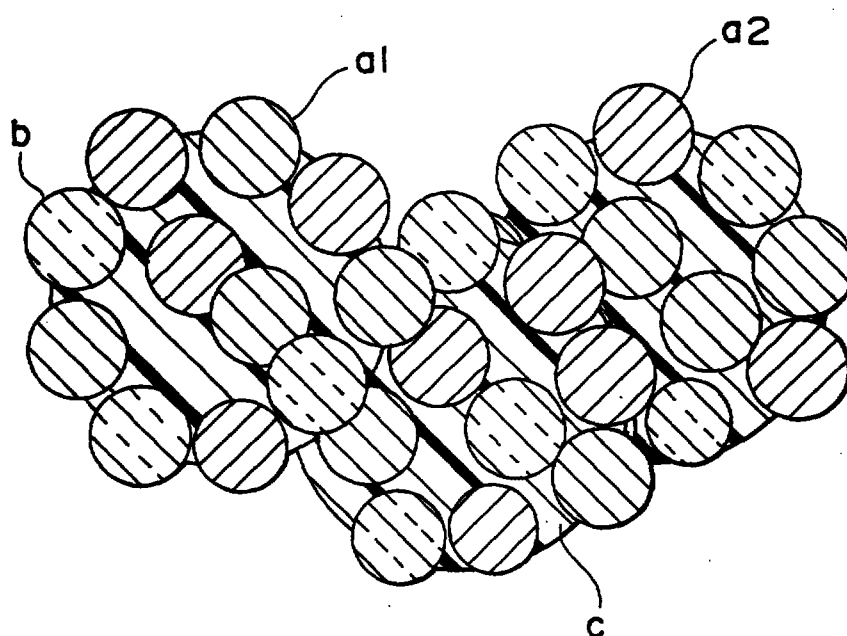


FIG. 3

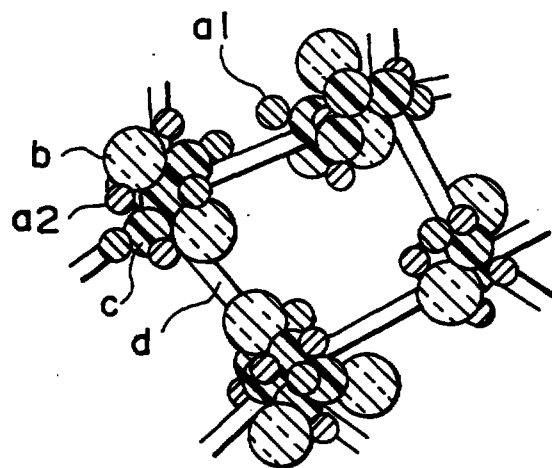


FIG. 4

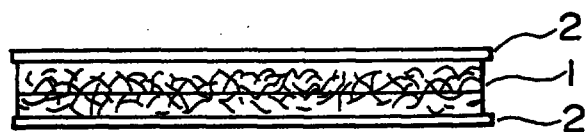


FIG. 5

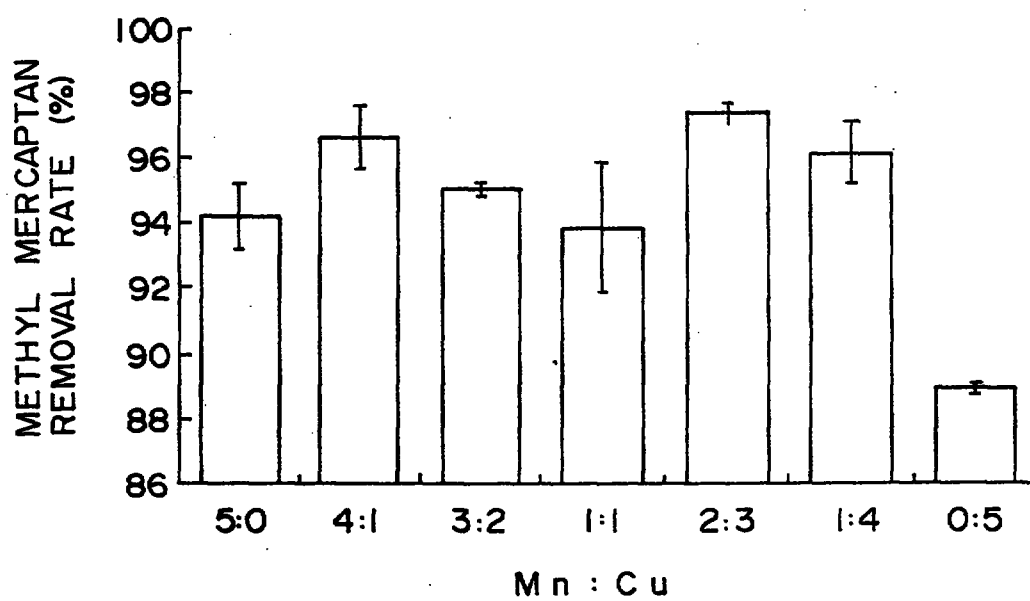


FIG. 7

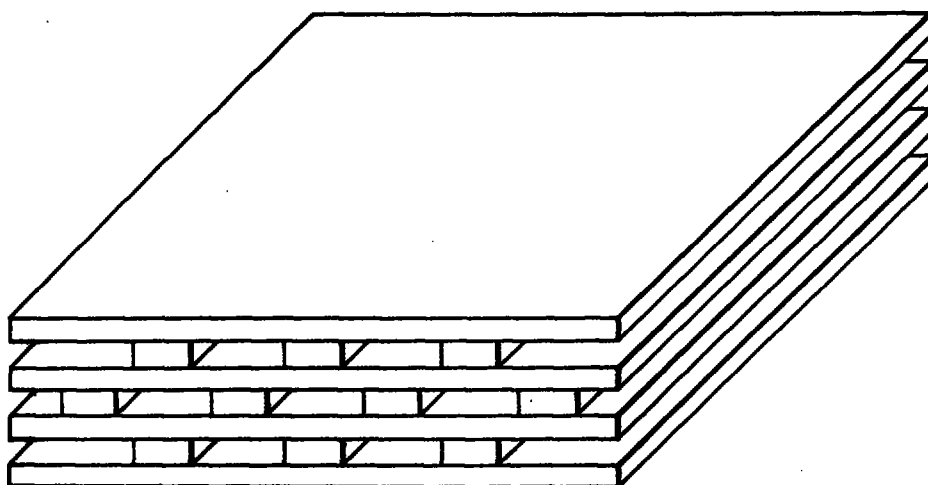
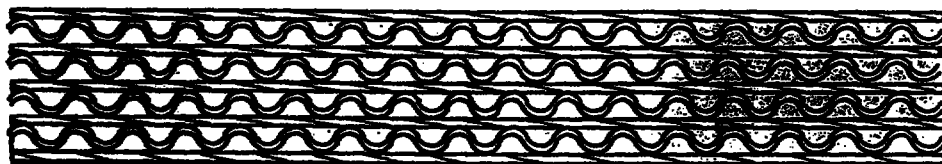
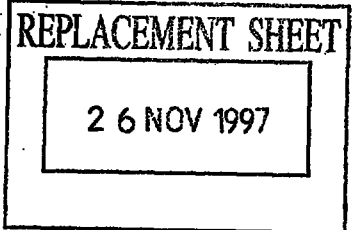


FIG. 6 A



FIG. 6 B





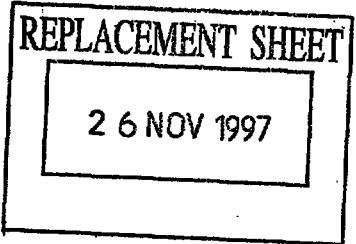
combination, it is preferable to use a material containing, for example, manganese dioxide particles and cupric oxide particles. In such a case, manganese and copper may preferably be in a weight ratio of Mn/Cu of about 4:1 or so, or about 2:3 or so, in terms of element weight ratio. Their use in such a ratio enables effective removal of sulfur-containing odor gases.

The adsorbent particles (b) used in the present invention include particles of activated carbon, zeolite, silica gel, sepiolite, activated alumina and activated clay and so forth. Any of these adsorbent particles supported with aluminum sulfate, iodine, ferrous sulfide, calcium phosphate, sodium carbonate, magnesium silicate, boric acid, phosphoric acid, ascorbic acid, tartaric acid, oxalic acid, tannic acid, gallic acid or the like may also be used. Any of these adsorbent particles may used alone, or may be used in combination of two or more kinds.

The activated carbon includes vegetable carbonaceous materials made from a material such as coconut shells and almond shells, charcoal, and bituminous coal, as well as synthetic resin carbonaceous

materials made from a material such as phenol resin, any of which may be used.

The thermoplastic resin particles (c) used in the present invention include particles selected from particles of ultrahigh-molecular weight polyethylene, polyethylene, polycarbonate, polyamide ABS (acrylonitrile-butadiene-styrene) resins, polyimide, polyvinyl chloride, polysulfone, polystyrene phthalate, polypropylene, and cellulose acetate or the like. The particles must have a melting point high enough to endure atmospheric



to be insufficient. If in an amount more than 80 parts by weight, environment purifying performance per unit weight tends to lower, and also such an amount cannot be said to be economical.

The environment purifying material described above can be
5 produced by mixing;

- (a) the particles of a metal and/or a metal oxide;
- (b) the adsorbent particles; and
- (c) the thermoplastic resin particles;

and heating the mixture at a temperature not lower than the
10 melting point of the thermoplastic resin (particles) used and not higher than the thermal decomposition temperature thereof. If necessary, an appropriate pressure may be applied to the mixture when heated.

The mixture may be heated at a temperature not lower than the melting
15 point of the thermoplastic resin up to a temperature not higher than its thermal decomposition temperature, and preferably at a temperature not lower than the melting point of the thermoplastic resin up to a temperature of the melting point plus 50 °C or below. In the case when the ultrahigh-molecular weight
20 polyethylene is used as the thermoplastic resin particles, the mixture may be heated at a temperature of from 130 °C to 200 °C, and preferably from 160 °C to 180 °C. If heated at a temperature lower than 130 °C, the binding of the metal and/or metal oxide particles (a) and adsorbent particles (b) to the ultrahigh-
25 molecular weight polyethylene particles may be insufficient, tending to result in an unsatisfactory strength of the porous

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When, in addition to the particles described above, the water-absorptive resin capable of homogeneously dispersing the particles in the water in which the particles are suspended is used, it is possible to obtain the porous structural material in which the metal and/or metal oxide particles and the adsorbent particles are entangled with the air-permeable surface protective material via the thermoplastic resin particles, i.e., the sheet-form environment purifying material. In this sheet-form environment purifying material, too, the performances and surface area inherent in the metal and/or metal oxide particles and adsorbent particles are retained, resulting in a good environment purifying material.

Further, according to the present invention, there is provided a method of purifying the environment with removing pollutive substances contained in objects to be purified, by contacting the objects with the environment purifying materials of the present invention. Here, the pollutive substance means substances causative of rank odors, pollution, turbidity and so forth, and the object to be purified is a liquid such as industrial waste water, a gas such as exhaust gas or air, or a solid such as soil.

As described above, the environment purifying materials of the present invention (any of those formed into grains, pellets, balls, plates, sheets or honeycomb structures) are porous structural materials, and the respective constituent particles effectively retain the properties and specific surface area

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ratio of elements (Mn:Cu) in a powdery mixture of manganese dioxide and cupric oxide, and removal rate of methyl mercaptan.

Figs. 6A and 6B are diagrammatic cross-sectional views showing examples of an environment purifying material with a honeycomb structure according to the present invention. Fig. 6A is a view where two sheet-like environment purifying materials are put together using a corrugated board manufacturing machine. Fig. 6B is a view where the materials shown in Fig. 6A are put together in four layers.

Fig. 7 is a diagrammatic cross-sectional view showing another example of the honeycomb structure.

MOST PREFERRED EMBODIMENT OF THE INVENTION

An experimental example will be shown first, concerning the relationship between the mixing ratio of manganese dioxide and cupric oxide, and the deodorizing ability.

Experimental Example

Manganese dioxide and cupric oxide were mixed in a weight ratio of elements (Mn:Cu), of 5:0, 4:1, 3:1, 1:1, 2:3, 1:4 or 0:5. The mixture obtained was blended using a ball mill made of agate to form a deodorizing metal oxide powdery mixture. This deodorizing metal oxide powdery mixture was observed with a microscope to examine its particle diameters, to find that it was a fine powder with particle diameters of about 5 μm or smaller. In a hermetically enclosed 1 liter beaker made of polypropylene, 10 μl of an aqueous 25% methyl mercaptan sodium salt solution

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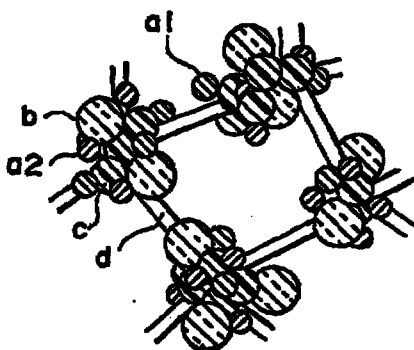
特許協力条約に基づいて公開された国際出願



(51) 国際特許分類6 B01J 20/02, 23/84	A1	(11) 国際公開番号 WO96/37288 (43) 国際公開日 1996年11月28日(28.11.96)									
(21) 国際出願番号 PCT/JP96/01423 (22) 国際出願日 1996年5月27日(27.05.96) (30) 優先権データ <table border="0"> <tr> <td>特願平7/128101</td> <td>1995年5月26日(26.05.95)</td> <td>JP</td> </tr> <tr> <td>特願平7/147342</td> <td>1995年6月14日(14.06.95)</td> <td>JP</td> </tr> <tr> <td>特願平7/306975</td> <td>1995年11月27日(27.11.95)</td> <td>JP</td> </tr> </table> (71) 出願人 (米国を除くすべての指定国について) 日立化成工業株式会社 (HITACHI CHEMICAL COMPANY, LTD.)(JP/JP) 〒163-04 東京都新宿区西新宿二丁目1番1号 Tokyo, (JP) (72) 発明者: および (75) 発明者/出願人 (米国についてのみ) 関根嘉香(SEKINE, Yoshika)(JP/JP) 〒305 茨城県つくば市松代3-4-1 日立化成松代ハウスB-206 Ibaraki, (JP) 外木健之(TONOKI, Kenji)(JP/JP) 〒307 茨城県結城市新福寺8085 Ibaraki, (JP) 内田達也(UCHIDA, Tatsuya)(JP/JP) 〒308 茨城県下館市女方699-17 Ibaraki, (JP)		特願平7/128101	1995年5月26日(26.05.95)	JP	特願平7/147342	1995年6月14日(14.06.95)	JP	特願平7/306975	1995年11月27日(27.11.95)	JP	宮寺康夫(MIYADERA, Yasuo)(JP/JP) 〒305 茨城県つくば市松代1-14-3 Ibaraki, (JP) 河田博之(KAWADA, Hiroyuki)(JP/JP) 〒307 茨城県結城市公達9732-9 Ibaraki, (JP) 千田孝之(SENDA, Takayuki)(JP/JP) 〒308 茨城県下館市女方61-78 Ibaraki, (JP) (74) 代理人 弁理士 富田和子, 外(TOMITA, Kazuko et al.) 〒220 神奈川県横浜市西区北幸2丁目9-10 横浜HSビル7階 Kanagawa, (JP) (81) 指定国 CN, JP, KR, SG, US, 欧州特許(AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). 添付公開書類 国際調査報告書
特願平7/128101	1995年5月26日(26.05.95)	JP									
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特願平7/306975	1995年11月27日(27.11.95)	JP									

(54) Title: ENVIRONMENT PURIFYING MATERIAL

(54) 発明の名称 環境浄化材



(57) Abstract

A sheetlike environment purifying material comprising (a) particles of a metal and/or a metal oxide, (b) particles of an absorbent, (c) particles of a thermoplastic resin and (d) an air-permeable fibrous base sheet, wherein the particles (a) and (b) are bonded to the surfaces of the particles (c) via the contacts of particles with each other and the particles (c) are bonded to the base sheet (d). This material can be produced by mixing the particles (a), (b) and (c), a water-absorbing resin (e) and water together to form a homogeneous suspension, making a predetermined amount of this suspension held on the fibrous base sheet (d), and heating the resulting composite in a temperature range from the melting point of the resin of the particles (c) to the thermal decomposition temperature thereof to bond the particles to the fibrous base sheet (d) via the particles (c) through the removal of water. The particles of a metal and/or a metal oxide and the particles of an adsorbent are not covered with any thermoplastic resin layer and therefore retain their respective original surface areas and performances to exhibit an excellent environment purifying power. This material is useful as deodorizer, toxic gas remover, and the like.

(57) 要約

本発明のシート状環境浄化材は、(a) 金属及び／又は金属酸化物粒子；(b) 吸着材粒子；(c) 熱可塑性樹脂粒子；及び(d) 通気性シートの繊維状基材；からなり、粒子(a)と粒子(b)は、粒子(c)表面に粒子どうしの接触部分で結合し、粒子(c)は基材(d)に結合している。

これは、粒子(a)、粒子(b)、粒子(c)、吸水性樹脂(e)及び水を混ぜて均一に分散された懸濁液をつくり、この所定量を繊維状基材(d)に保持させ、粒子(c)の樹脂の融点以上熱分解温度以下の温度で加熱し、水分を除去しながら粒子どうしを熱可塑性樹脂粒子(c)を介して繊維状基材(d)に結合させて、製造できる。

金属及び／又は金属酸化物粒子と吸着材粒子は、熱可塑性樹脂層で被覆されることなく各々の本来の表面積及び性能を有効に保持しているので、優れた環境浄化能を示す。脱臭材、有毒ガス除去材等に有用。

情報としての用途のみ

PCTに基づいて公開される国際出願をパンフレット第一頁にPCT加盟国を特定するために使用されるコード

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