

Description

The present invention relates to a method of treating poisonous gases containing hydrides of As, B, P, Sb or Se.

Although hydrides such as AsH_3 , B_2H_6 , PH_3 , SbH_3 and H_2Se have been used in large quantities as raw material gas for the production of semiconductors, fumigation gas, etc., such hydrides even in trace amounts are extremely noxious to the human body, and development of removing efficiently these hydrides in gases is strongly demanded.

As the method of removing hydrides of As, B, P, Sb and Se in gases, there have been proposed processes of washing with chemical solutions such as oxidizing solutions or methods of adsorption by use of activated carbon, etc., and the like. Nevertheless, such processes and methods exhibit poor removal effect, and the efficient adsorbents have been long wanted.

DE—C—1099360 discloses a method for removal of As and P hydrides from a gas containing the same, which comprises contacting the gas with an activated carbon containing: (i) copper ions (e.g. in the form of copper carbonate); (ii) a solution of an alkali metal (= potassium) chromate or bichromate; and (iii) compounds of Cr, namely a solution of potassium chromate and a solution of silver chromate.

US—A—2,513,508 discloses copper oxide as a particularly important example of metal compounds which have heretofore been deposited on activated carbons to increase their abilities to remove poisonous gases from gaseous mixtures and particularly air-gas mixtures.

The present inventors, in view of such circumstances, conducted intensive investigation, and as a result, found that arsines in fluids substantially not containing oxygen can be removed very efficiently by using an activated carbon containing copper oxides and alkali metal compounds, alkaline earth metal compounds or metal compounds of Al, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Cd and Pb, which has culminated in the present invention.

Thus, the present invention relates to a method for removal of at least one of the hydrides of As, B, P, Sb or Se from a gas containing the same and substantially not containing oxygen which comprises contacting the gas with an adsorbent consisting of activated carbon containing:

(1) Copper oxide in an amount of 0.1 mg-atom to 3.0 mg-atom as metal per g of activated carbon and
(2) at least one of (a), (b) and (c) in an amount of 0.1 mg-atom to 5.0 mg-atom as metal per g of activated carbon, selected from the group consisting of:

(a) at least one of alkali metal compounds,

(b) at least one of alkaline earth metal compounds and

(c) at least one of the compounds of Al, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Cd and Pb

under a pressure of not more than 50 kg/cm^2 ($50 \times 0.9806 \times 10^5 \text{ Pa}$) at a temperature of not more than 200°C for a time of $1/10$ to 100 seconds as converted at 25°C and 1 kg/cm^2 ($0.9806 \times 10^5 \text{ Pa}$).

In the present method, an activated carbon containing components (1) and (2) is used as adsorbent. The adsorbent can be prepared by allowing activated carbon to contain components (1) and (2).

The activated carbon may be any type of activated carbon, provided it is produced by the known processes with coal, coke, charcoal, coconut shells, resins, etc. employed as raw material and shows a specific surface area of 200 to $2000 \text{ m}^2/\text{g}$; with reference to its shape or form, use is made of proper-shaped activated carbon, such as spherical- or cylindrical-shaped, crushed, powdered and fiber-like one, depending upon the treatment method of gases.

The copper oxide which is employable as component (1) in the present invention may be either cuprous or cupric oxide.

Examples of the alkali metal compound, which is one of the components (2), include inorganic acid salts or inorganic compounds of Li, Na, K, Rb and Cs, such as hydrogencarbonates, carbonates, nitrates, borates, silicates, sulfates, halides and hydroxides, and organic acid salts thereof, such as formates, acetates, oxalates, benzoates, salts of phenols and salts of sulfonic acids.

Examples of the alkaline earth metal compound, which is another component (2), include inorganic acid salts or inorganic compounds of Be, Mg, Ca, Sr and Ba, such as carbonates, nitrates, sulfates, phosphates, halides, oxides and hydroxides, and organic acid salts thereof, such as formates, acetates and oxalates.

Examples of the compounds of Al, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Cd and Pb, which are still other component (2), include inorganic acid salts or inorganic compounds of these metals, such as carbonates, hydrogen-carbonates, nitrates, borates, silicates, sulfates, phosphates, halides, hydroxides, ammonium salts and oxides, and organic acids salts, such as formates, acetates, oxalates, benzoates, salts of phenols and salts of sulfonic acids.

Though the adsorbents used in the present invention consist of an activated carbon containing the components (1) and (2), the component (2) may be composed of an alkali metal compound [hereinafter referred to in some instances as "component (a)"] solely, an alkaline earth metal compound [hereinafter referred to in some instances as "component (b)"] alone or compounds of Al, Cr, Ti, V, Mn, Fe, Co, Ni, Zn, Cd and Pb [hereinafter referred to in some instances as "component (c)"] solely, also may comprise two kinds of the components out of these, such as the components (a) and (b), components (b) and (c) and components (c) and (a), and may consist of three kinds of the components, the components (a), (b) and (c). In addition, the adsorbents may contain at least two compounds as the component (1), and may contain

two or more components within the same component group as the components (2), for example two different components within the group of the component (a).

The content of the component (1) in the activated carbon containing metal compounds is 0.1 mg-atom to 3.0 mg-atom as metal per g of activated carbon, preferably 0.2 mg-atom to 2.0 mg-atom, while the content of the second component is 0.1 mg-atom to 5.0 mg-atom as metal per g of activated carbon, preferably 0.2 mg-atom to 4.0 mg-atom.

Each of the components contained in the activated carbon may be one either supported or deposited on activated carbon, and the adsorbent may be made up of the one obtained by adding each of the components to a raw material for activated carbon and activating the mixture. Furthermore, the adsorbents may constitute the one produced by adding part of the components (1) and (2) to a raw material for activated carbon and activating the mixture, followed by depositing the remainder of the components on the resulting activated product. In cases in which the components (b) and (c) to be deposited as the component (2) on activated carbon are other than oxides and the component (a) is other than hydroxides, carbonates and hydrogencarbonates, it is desirable to conduct drying or calcining after the deposition.

With reference to the method of depositing each of the components on activated carbon, a procedure of impregnating or spraying activated carbon with a solution or suspension of each of the components in water (inclusive of aqueous acid or alkali solutions) or a variety of solvents may be conceivable. In the above preparation process, meanwhile, the term "drying" denotes a step of evaporating the water or solvent in activated carbon deposited with the metal compounds at a temperature of not more than 130°C, while the expression "calcining" means a step of heating in an atmosphere of inert gas, carbon dioxide gas, steam, combustion waste gas, etc. at a temperature of not less than 130°C the dried activated carbon deposited with the metal compounds to thermally decompose the metal compounds partially or wholly.

Also, the activated carbon supported with copper oxide can be obtained by depositing on activated carbon inorganic acid salts or inorganic compounds of copper such as carbonates, basic carbonates, nitrates, sulphates, phosphates, halides, and hydroxides and organic acid salts thereof such as formates, acetates and oxalates in place of the component (9) and then calcining the mixture at a temperature of not less than 130°C to convert only part of or all of these salts into copper oxide. The adsorbents of the present invention containing the components (1) and (2) can be produced by performing the deposition of the components (2), before, after or simultaneously with, the calcining.

The method of the present invention is conducted by contacting a gas containing hydrides of As, B, P, Sb and Se with the activated carbon containing the metal compounds as obtained by the above procedure. The objective substances, which are to be removed by the present method are hydrides of B, P, Sb and Se, such as AsH_3 , B_2H_6 , PH_3 , SbH_3 and H_2Se .

As the procedure of contacting, use is made of the known means, such as the fixed bed, moving bed and fluidized bed. In such cases, the contacting temperature is not more than 200°C, preferably 0 to 150°C, while the pressure is not more than 50 kg/cm², preferably 0.1 to 40 kg/cm² (1 kg/cm²=0.9806×10⁵Pa). The contacting time is 1/10 to 100 seconds as converted at 25°C and 1 kg/cm² (0.9806×10⁵Pa), preferably 1/5 to 80 seconds.

The contact of the poisonous gas with the activated carbon in the present method is conducted in the absence of oxygen. Though hydrides of As, B, P, Sb or Se can be removed to a certain extent from a poisonous gas containing oxygen by a known method in which activated carbon not containing any metal compound is used, the hydrides are hardly removable from a poisonous gas not containing oxygen by the known method. Therefore, the method of the present invention is applied to the treatment of a poisonous gas not containing oxygen.

The examples are described below to illustrate the present invention more specifically.

Example 1

Activated carbon A₀ of 16 to 24 mesh (1.205 to 0.74 mm) having the BET specific surface area of 1.150 m²/g was sprayed uniformly with aqueous solutions containing a given amount each of the component (1) (copper nitrate) and the component (2) (nitrate of an alkali metal, nitrate of an alkaline earth metal and nitrate of Al, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Cd or Pb (sulphate for V alone).

50 ml of the resultant activated carbon deposited with the metal compounds was packed into a 4 cmφ column made of quartz glass, which was then heated at a heating rate of 5°C/min while passing nitrogen gas at a linear flow rate of 10 cm/sec, followed by calcining at 300°C for 30 minutes.

The content of each of the metal compounds in the resultant adsorbent was 0.2 to 2.0 mg/atom as respective metals per g of activated carbon, as shown in Table 1.

By following the same procedure as described above, as control reference, activated carbon A₀ was deposited with nitrate of each metal alone, and calcined in a nitrogen gas at 300°C for 30 minutes to prepare adsorbents.

15 ml each of the adsorbents as obtained in this manner was packed into a 6 cmφ column made of glass, respectively, and a gas (N₂—97.5 vol. % and H₂O—2.5 vol. %) of 30°C containing 12 ppm of PH₃ was passed through the columns at a linear flow rate of 40 cm/sec to conduct the breakthrough adsorption tests for PH₃. The removal percentages for PH₃ at different times were measured, and the results are shown in Table 1.

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Example 2

Packed into a 1.6 cm ϕ column made of glass was 20 ml each of the adsorbents of Example 1, A₀, A₁, A₂, A₃, B₂, B₃, C₄, C₈, C₉, D₂, D₃, D₈, D₁₀, D₁₂, D₁₃, D₁₄ and D₁₅, and a gas (N₂—97.5 vol. % and H₂O—2.5 vol. %) of 30°C containing 10 ppm of B₂H₆, 10 ppm of H₂Se or 10 ppm of SbH₃ was passed through the columns at a linear flow rate of 30 cm/sec to conduct the breakthrough adsorption test for B₂H₆ and H₂Se or SbH₃ with each of the adsorbents alone. The length of time required until B₂H₆ and H₂Se or SbH₃ leaked out of the column (the length of time for which the breakthrough ratio of respective hydride compounds reached 5%) was measured, and the results are shown in Table 2.

Example 3

Activated carbon A of 16 to 24 mesh (1.205 to 0.74 mm) having the BET specific surface area of 1040 m²/g was sprayed uniformly with aqueous solutions containing a given amount each of the component (1) (copper nitrate) and the component (2) (nitrate of an alkali metal, nitrate of an alkaline earth metal and nitrate of Al, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Cd or Pb (sulphate for V alone).

50 ml of the resultant activated carbon deposited with the metal compounds was packed into a 4 cm ϕ column made of quartz glass, which was heated at a heating rate of 5°C/min while passing a nitrogen gas at a linear flow rate of 10 cm/sec, followed by calcining at 300°C for 30 minutes.

The content of each of the metal compounds in the resultant adsorbents was 0.2 to 2.0 mg/atom as respective metals per g of activated carbon, as shown in Table 3.

By following the same procedure as described above, as control reference, activated carbon A was deposited with nitrate of each metal alone, and calcined in a nitrogen gas at 300°C for 30 minutes to prepare adsorbents.

20 ml each of the adsorbents as obtained in this manner, A through L and (1) through (40), were packed into a 1.6 cm ϕ column made of glass, and a gas (N₂—97.5 vol. % and H₂O—2.5 vol. %) of 30°C containing 30 ppm of AsH₃ was passed through the columns at a linear flow rate of 20 cm/sec to conduct the breakthrough adsorption tests for AsH₃. The length of time required until AsH₃ leaked out of the column (the length of time for which the breakthrough ratio reached 5%) was measured, and the results are shown in Table 3.

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TABLE 1 (1)

Adsorbent No.	Amount of copper (mg-atom/g)	The second component; and its amount (mg-atom/g)	Percent removal of PH ₃ at the elapsed time shown below (%)		
			5 hrs	10 hrs	30 hrs
A ₀ (Control)	0	0	2	0	0
A ₁ (")	2.0	0	95	50	15
A ₂ (")	0	Na—2.0	58	31	23
A ₃ (")	0	K—2.0	59	35	20
A ₄ (")	0	Mg—2.0	48	20	15
A ₅ (")	0	Ca—2.0	45	34	15
A ₆ (")	0	Sr—2.0	40	23	10
A ₇ (")	0	Al—2.0	39	33	11
A ₈ (")	0	Cr—2.0	50	39	25
A ₉ (")	0	Fe—2.0	45	30	18
A ₁₀ (")	0	Ni—2.0	48	19	11
A ₁₁ (")	0	Pb—2.0	40	21	12
B ₁ (The present invention)	1.0	Na—1.0	100	98	50
B ₂ (")	1.0	K—1.0	100	100	68
B ₃ (")	1.0	Mg—1.0	100	100	75
B ₄ (")	1.0	Ca—1.0	100	100	63
B ₅ (")	1.0	Sr—1.0	100	100	54

TABLE 1 (2)

Adsorbent No.	Amount of copper (mg-atom/g)	The second component; and its amount (mg-atom/g)	Percent removal of PH ₃ at the elapsed time shown below (%)		
			5 hrs	10 hrs	30 hrs
(The C ₁ present invention)	1.0	Al—1.0	100	100	63
C ₂ (")	1.0	Ti—1.0	100	100	54
C ₃ (")	1.0	V—1.0	100	100	50
C ₄ (")	1.0	Cr—1.0	100	100	73
C ₅ (")	1.0	Mn—1.0	100	100	41
C ₆ (")	1.0	Fe—1.0	100	100	29
C ₇ (")	1.0	Co—1.0	100	100	45
C ₈ (")	1.0	Ni—1.0	100	100	59
C ₉ (")	1.0	Zn—1.0	100	100	61
C ₁₀ (")	1.0	Cd—1.0	100	95	39
C ₁₁ (")	1.0	Pb—1.0	100	73	54
C ₁₂ (")	0.2	Cr—1.0	100	72	50
C ₁₃ (")	0.5	Cr—1.0	100	95	62
C ₁₄ (")	2.0	Cr—1.0	100	100	80
D ₁ (")	1.0	Na—0.3, Al—0.5	100	100	95
D ₂ (")	1.0	K—0.3, V—0.5	100	100	100
D ₃ (")	1.0	K—0.3, Cr—0.5	100	100	100

TABLE 1 (3)

Adsorbent No.	Amount of copper (mg-atom/g)	The second component; and its amount (mg-atom/g)	Percent removal of PH ₃ at the elapsed time shown below (%)		
			5 hrs	10 hrs	30 hrs
D ₄ (the present invention)	1.0	K—0.3, Mn—0.5	100	100	100
D ₅ (")	1.0	K—0.3, Fe—0.5	100	100	100
D ₆ (")	1.0	Mg—0.3, Co—0.5	100	100	100
D ₇ (")	1.0	Ca—0.3, Ni—0.5	100	100	100
D ₈ (")	1.0	K—0.3, Zn—0.5	100	100	100
D ₉ (")	1.0	Na—0.3, Cd—0.5	100	100	95
D ₁₀ (")	1.0	K—0.3, Pb—0.5	100	100	88
D ₁₁ (")	0.2	K—0.3, Cr—0.5	100	81	67
D ₁₂ (")	0.5	K—0.3, Mn—0.5	100	99	83
D ₁₃ (")	0.2	Mg—0.5, Cr—0.5	100	95	75
D ₁₄ (")	0.5	Mg—0.5, Cr—0.5	100	98	80
D ₁₅ (")	1.0	K—0.3, Mg—0.3 Cr—0.5, Fe—0.25	100	100	100

TABLE 2

Adsorbent No.	The length of time for which the removal percentages for B_2H_6 reached 95% (hrs)	The length of time for which the removal percentages for H_2Se reached 95% (hrs)	The length of time for which the breakthrough ratio of SbH_3 reached 5% (hrs)
A ₀ (Control)	1/6	1/4	1/3
A ₁ (")	11	15	15
A ₃ (")	6	7	9
A ₉ (")	15	11	11
(The B ₂ present invention)	38	35	30
B ₃ (")	45	40	41
C ₄ (")	40	40	39
C ₆ (")	52	45	41
C ₉ (")	48	43	47
D ₂ (")	67	59	63
D ₃ (")	85	71	90
D ₈ (")	71	75	62
D ₁₀ (")	60	73	58
D ₁₂ (")	83	79	65
D ₁₃ (")	68	68	60
D ₁₄ (")	80	78	79
D ₁₅ (")	103	105	110

TABLE 3 (1)

Adsorbent No.	Amount of copper (mg-atom/g)	The second component; and its amount (mg-atom/g)	The length of time for which the breakthrough ratio of AsH_3 reached 5% (min.)
A (Control)	0	0	15
B (")	2.0	0	45
C (")	0	Na—2.0	50
D (")	0	K—2.0	65
E (")	0	Mg—2.0	65
F (")	0	Ca—2.0	80
G (")	0	Sr—2.0	85
H (")	0	Al—2.0	40
I (")	0	Cr—2.0	70
J (")	0	Fe—2.0	85
K (")	0	Ni—2.0	75
L (")	0	Pb—2.0	80
(1) (The present invention)	1.0	Na—1.0	610
(2) (")	1.0	K—1.0	885
(3) (")	1.0	Mg—1.0	900

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TABLE 3 (2)



Adsorbent No.	Amount of copper (mg-atom/g)	The second component; and its amount (mg-atom/g)	The length of time for which the breakthrough ratio of AsH_3 reached 5% (min.)
(4) (The present invention)	1.0	Ca—1.0	880
(5) (")	1.0	Sr—1.0	870
(6) (")	1.0	Al—1.0	730
(7) (")	1.0	Ti—1.0	700
(8) (")	1.0	V—1.0	960
(9) (")	1.0	Cr—1.0	950
(10) (")	1.0	Mn—1.0	880
(11) (")	1.0	Fe—1.0	790
(12) (")	1.0	Co—1.0	990
(13) (")	1.0	Ni—1.0	850
(14) (")	1.0	Zn—1.0	750
(15) (")	1.0	Cd—1.0	700
(16) (")	1.0	Pb—1.0	730
(17) (")	0.2	Cr—1.0	450
(18) (")	0.5	Cr—1.0	600
(19) (")	2.0	Cr—1.0	1050

TABLE 3 (3)



Adsorbent No.	Amount of copper (mg-atom/g)	The second component; and its amount (mg-atom/g)	The length of time for which the breakthrough ratio of AsH ₃ reached 5% (min.)
(20) (The present invention)	1.0	Pb—1.0	800
(21) (")	1.0	Cs—1.0	600
(22) (")	1.0	Ba—1.0	630
(23) (")	1.0	Na—0.3, Al—0.5	1050
(24) (")	1.0	K—0.3, V—0.5	1100
(25) (")	1.0	K—0.3, Cr—0.5	1320
(26) (")	1.0	K—0.3, Mn—0.5	1260
(27) (")	1.0	K—0.3, Fe—0.5	1130
(28) (")	1.0	Mg—0.3, Co—0.5	1290
(29) (")	1.0	Ca—0.3, Ni—0.5	1350
(30) (")	1.0	K—0.3, Zn—0.5	1190
(31) (")	1.0	Na—0.3, Cd—0.5	1200
(32) (")	1.0	K—0.3, Pb—0.5	1150
(33) (")	0.2	K—0.3, Cr—0.5	700
(34) (")	0.5	K—0.3, Mn—0.5	930
(35) (")	0.2	Mg—0.5, Cr—0.5	850

TABLE 3 (4)

Adsorbent No.	Amount of copper (mg-atom/g)	The second component; and its amount (mg-atom/g)	The length of time for which the breakthrough ratio of AsH ₃ reached 5% (min.)
(36) (The present invention)	0.5	Mg—0.5, Cr—0.5	900
(37) (")	1.0	K—0.3, Mg—0.3	1300
(38) (")	1.0	K—0.3, Co—0.5, Ni—0.5	1400
(39) (")	1.0	Mg—0.3, Cr—0.5, Mn—0.5	1420
(40) (")	1.0	K—0.3, Mg—0.3, Cr—0.5, Fe—0.25	1510

Claims

1. A method for removal of at least one of the hydrides of As, B, P, Sb or Se from a gas containing the same and substantially not containing oxygen which comprises contacting the gas with an adsorbent consisting of activated carbon containing:

(1) copper oxide in an amount of 0.1 mg-atom to 3.0 mg-atom as metal per g of activated carbon and
(2) at least one of (a), (b) and (c), in an amount of 0.1 mg-atom to 5.0 mg-atom as metal per g of activated carbon, selected from the group consisting of:

(a) at least one of alkali metal compounds,

(b) at least one of alkaline earth metal compounds, and

(c) at least one of the compounds of Al, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Cd and Pb under a pressure of not more than 50 kg/cm² ($50 \times 0.9806 \times 10^5$ Pa) at a temperature of not more than 200°C for a time of 1/10 to 100 seconds as converted at 25°C and 1 kg/cm² (0.9806×10^5 Pa).

2. A method as claimed in Claim 1, wherein the adsorbent is one consisting of activated carbon containing:

(1) copper oxide; and

(2) at least one alkali metal compound.

3. A method as claimed in Claim 1, wherein the adsorbent is one consisting of activated carbon containing:

(1) copper oxide; and

(2) at least one alkaline earth metal compound.

4. A method as claimed in Claim 1, wherein the adsorbent is one consisting of activated carbon containing:

(1) copper oxide and

(2) at least one of the compounds of Al, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Cd and Pb.

5. A method as claimed in Claim 1, wherein the adsorbent is one consisting of activated carbon containing:

(1) copper oxide; and

(2) (a) at least one of the alkali metal compounds, and

(b) at least one of the compounds of Al, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Cd and Pb.

6. A method as claimed in Claim 1, wherein the adsorbent is one consisting of activated carbon containing:

(1) copper oxide; and

(2) (a) at least one of the alkali metal compounds,

(b) compounds of at least one of the alkaline earth metals, and

(c) at least one of the compounds of Al, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Cd and Pb.

7. A method as claimed in Claim 1, wherein the adsorbent is one consisting of an activated carbon containing:

(1) copper oxide; and

(2) (a) a compound of potassium, and

(c) a compound of chromium.

TABLE 3 (4)

Adsorbent No.	Amount of copper (mg-atom/g)	The second component; and its amount (mg-atom/g)	The length of time for which the breakthrough ratio of AsH ₃ reached 5% (min.)
(36) (The present invention)	0.5	Mg—0.5, Cr—0.5	900
(37) (")	1.0	K—0.3, Mg—0.3	1300
(38) (")	1.0	K—0.3, Co—0.5, Ni—0.5	1400
(39) (")	1.0	Mg—0.3, Cr—0.5, Mn—0.5	1420
(40) (")	1.0	K—0.3, Mg—0.3, Cr—0.5, Fe—0.25	1510

Claims

1. A method for removal of at least one of the hydrides of As, B, P, Sb or Se from a gas containing the same and substantially not containing oxygen which comprises contacting the gas with an adsorbent consisting of activated carbon containing:

(1) copper oxide in an amount of 0.1 mg-atom to 3.0 mg-atom as metal per g of activated carbon and
(2) at least one of (a), (b) and (c), in an amount of 0.1 mg-atom to 5.0 mg-atom as metal per g of activated carbon, selected from the group consisting of:

(a) at least one of alkali metal compounds,

(b) at least one of alkaline earth metal compounds, and

(c) at least one of the compounds of Al, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Cd and Pb under a pressure of not more than 50 kg/cm² ($50 \times 0.9806 \times 10^5$ Pa) at a temperature of not more than 200°C for a time of 1/10 to 100 seconds as converted at 25°C and 1 kg/cm² (0.9806×10^5 Pa).

2. A method as claimed in Claim 1, wherein the adsorbent is one consisting of activated carbon containing:

(1) copper oxide; and

(2) at least one alkali metal compound.

3. A method as claimed in Claim 1, wherein the adsorbent is one consisting of activated carbon containing:

(1) copper oxide; and

(2) at least one alkaline earth metal compound.

4. A method as claimed in Claim 1, wherein the adsorbent is one consisting of activated carbon containing:

(1) copper oxide and

(2) at least one of the compounds of Al, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Cd and Pb.

5. A method as claimed in Claim 1, wherein the adsorbent is one consisting of activated carbon containing:

(1) copper oxide; and

(2) (a) at least one of the alkali metal compounds, and

(b) at least one of the compounds of Al, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Cd and Pb.

6. A method as claimed in Claim 1, wherein the adsorbent is one consisting of activated carbon containing:

(1) copper oxide; and

(2) (a) at least one of the alkali metal compounds,

(b) compounds of at least one of the alkaline earth metals, and

(c) at least one of the compounds of Al, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Cd and Pb.

7. A method as claimed in Claim 1, wherein the adsorbent is one consisting of an activated carbon containing:

(1) copper oxide; and

(2) (a) a compound of potassium, and

(c) a compound of chromium.



Patentansprüche

1. Verfahren zur Entfernung wenigstens eines der Hydride von As, B, P, Sb oder Se aus einem dieselben enthaltenden und im wesentlichen keinen Sauerstoff enthaltenden Gas, umfassend das In-Berührung-Bringen des Gases mit einem aus Aktivkohle bestehenden Adsorptionsmittel, das
- (1) Kupferoxid in einer Menge von 0,1 mg-Atom bis 3,0 mg-Atom als Metall pro g Aktivkohle und
 - (2) wenigstens einen Bestandteil aus (a), (b) oder (c) in einer Menge von 0,1 mg-Atom bis 5,0 mg-Atom als Metall pro g Aktivkohle ausgewählt aus der aus
- (a) wenigstens einer der Alkalimetall-Verbindungen,
 - (b) wenigstens einer der Erdalkalimetall-Verbindung und
 - (c) wenigstens einer der Verbindungen von Al, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Cd und Pb bestehenden Gruppe enthält, unter einem Druck von nicht mehr als 50 kg/cm^2 ($50 \times 0,9806 \times 10^5 \text{ Pa}$) und einer Temperatur von nicht mehr als 200°C während einer Zeitspanne von $1/10$ bis 100 s, umgeformt auf 25°C und 1 kg/cm^2 ($0,9806 \times 10^5 \text{ Pa}$).
2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß das Adsorptionsmittel eines ist, das aus Aktivkohle besteht, die
- (1) Kupferoxid und
 - (2) wenigstens eine Alkalimetall-Verbindung enthält.
3. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß das Adsorptionsmittel eines ist, das aus Aktivkohle besteht, die
- (1) Kupferoxid und
 - (2) wenigstens eine Erdalkalimetall-Verbindung enthält.
4. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß das Adsorptionsmittel eines ist, das aus Aktivkohle besteht, die
- (1) Kupferoxid und
 - (2) wenigstens eine der Verbindungen von Al, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Cd und Pb enthält.
5. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß das Adsorptionsmittel eines ist, das aus Aktivkohle besteht, die
- (1) Kupferoxid und
 - (2) (a) wenigstens eine der Alkalimetall-Verbindungen und
 - (b) wenigstens eine der Verbindungen von Al, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Cd und Pb enthält.
6. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß das Adsorptionsmittel eines ist, das aus Aktivkohle besteht, die
- (1) Kupferoxid und
 - (2) (a) wenigstens eine der Alkalimetall-Verbindungen
 - (b) wenigstens eine der Erdalkalimetall-Verbindungen und
 - (c) wenigstens eine der Verbindungen von Al, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Cd und Pb enthält.
7. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß das Adsorptionsmittel eines ist, das aus Aktivkohle besteht, die
- (1) Kupferoxid und
 - (2) (a) eine Kalium-Verbindung und
 - (b) eine Chrom-Verbindung enthält.

Revendications

1. Procédé pour éliminer au moins l'un des hydrides de As, B, P, Sb ou Se d'un gaz qui le contient et qui ne contient pratiquement pas d'oxygène, selon lequel on met en contact le gaz avec un agent adsorbant consistant en charbon activé contenant:
- (1) de l'oxyde de cuivre en une quantité de 0,1 atome-mg à 3,0 atomes-mg, calculé en métal, par gramme de charbon activé et
 - (2) l'un au moins de (a), (b) et (c) en une quantité de 0,1 atome-mg à 5,0 atomes-mg, calculé en métal, par gramme de charbon activé, choisi dans le groupe consistant en
- (a) l'un au moins des composés de métal alcalin,
 - (b) l'un au moins des composés de métal alcalino-terreux et
 - (c) l'un au moins des composés de Al, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Cd et Pb sous une pression qui n'est pas supérieure à 50 kg/cm^2 ($50 \times 0,9806 \times 10^5 \text{ Pa}$), à une température qui n'est pas supérieure à 200°C , pendant un laps de temps de $1/10$ à 100 secondes, selon conversion à 25°C et 1 kg/cm^2 ($0,9806 \times 10^5 \text{ Pa}$).
2. Procédé selon la revendication 1, dans lequel l'agent adsorbant consiste en charbon activé contenant:
- (1) de l'oxyde de cuivre, et
 - (2) au moins un composé de métal alcalin.
3. Procédé selon la revendication 1, dans lequel l'agent adsorbant consiste en charbon activé contenant:
- (1) de l'oxyde de cuivre, et
 - (2) au moins un composé de métal alcalino-terreux.



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4. Procédé selon la revendication 1, dans l'agent adsorbant consiste en charbon activé contenant:

(1) de l'oxyde de cuivre, et

(2) au moins un des composés de Al, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Cd et Pb.

5. Procédé selon la revendication 1, dans lequel l'agent adsorbant consiste en charbon activé contenant:

(1) de l'oxyde de cuivre, et

(2) (a) au moins un des composés de métal alcalin, et

(b) au moins un des composés de Al, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Cd et Pb.

10 6. Procédé selon la revendication 1, dans lequel l'agent adsorbant consiste en charbon activé contenant:

(1) de l'oxyde de cuivre, et

(2) (a) au moins des composés de métal alcalin,

(b) des composés d'au moins un des métaux alcalino-terreux, et

(c) au moins un des composés de Al, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Cd et Pb.

15 7. Procédé selon la revendication 1, dans lequel l'agent adsorbant consiste en charbon activé contenant:

(1) de l'oxyde de cuivre, et

(2) (a) un composé de potassium, et

(c) un composé de chrome.

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