CLAIMS

1. A method of adsorbing an arsenic material, comprising:

contacting an arsenic-containing fluid with an adsorbent composition, the adsorbent composition comprising a bismuth material on a support comprising at least one of a metal oxide, a metalloid oxide or an activated carbon, wherein the support comprises a moisture content of 15% by mass or less.

2. The method of claim 1, wherein the bismuth material is selected from a group consisting of elemental bismuth and a bismuth compound.

3. The method of claim 1, wherein the bismuth material comprises a bismuth oxide.

4. The method of claim 3, wherein the bismuth oxide is derived from a precursor selected from a group consisting of an organic bismuth compound, an inorganic bismuth compound, an organic bismuth salt and an inorganic bismuth salt.

5. The method of claim 3, wherein the bismuth oxide is at least partially derived from a bismuth citrate precursor, a bismuth nitrate precursor or a combination thereof.

6. The method of claim 3, wherein the bismuth oxide is bismuth (III) oxide (Bi_2O_3).

7. The method of claim 1, wherein the support comprises the metal oxide.

8. The method of claim 7, wherein the metal oxide is selected from a group consisting of a titanium oxide, a cerium oxide, an aluminum oxide, zirconium oxide, magnesium oxide, and mixtures thereof.

9. The method of claim 7, wherein the metal oxide comprises titanium dioxide.

10. The method of claim 9, wherein the titanium dioxide is in an anatase form.

11. The method of claims 7 to 10 further comprising silicon dioxide (SiO_2).

12. The method of claim 1, wherein the arsenic material is selected from a group consisting of elemental arsenic and an arsenic-containing compound.

13. The method of claim 1, wherein the arsenic-containing fluid comprises arsine.

14. The method of claim 1, wherein the adsorbent composition comprises a lead content of 5% by mass or less.

15. The method of claim 1, wherein the adsorbent composition is lead-free.

16. The method of claim 1, wherein the adsorbent composition comprises 0.1% to 2% by mass of the bismuth material.

17. The method of claim 1, wherein the adsorbent composition comprises 2% to 50% by mass of the bismuth material.

18. The method of claim 17, wherein the adsorbent composition comprises 5% to 15% by mass of the bismuth material.

19. The method of claim 18, wherein the adsorbent composition comprises 8% to 11% by mass of the bismuth material.

20. The method of claim 7, wherein the support comprises at least 5% by mass of the metal oxide.

21. The method of claim 20, wherein the support comprises at least 50% by mass of the metal oxide

22. The method of claim 21, wherein the support comprises at least 75% by mass of the metal oxide.

23. The method of claims 7-10, wherein the metal oxide comprises particles having a

size of 1 μm to 10 mm.

24. The method of claims 7-10, wherein the metal oxide has a surface area of 50 m^2/g to 600 m^2/g.

25. The method of claim 1, wherein the support is moisture-free.

26. The method of claim 1, wherein a surface area of the support is 20 m^2/g to 600 m^2/g.

27. The method of claim 26, wherein the surface area is 250 m^2/g to 350 m^2/g.

28. The method of claim 1, wherein the adsorbent composition is in a form selected from a group consisting of a tablet, an extrudate, a pellet, a rod, a molding and a monolith.

29. The method of claim 1, wherein the adsorbent composition has an arsine removal efficiency of 90% or more as measured by a dry colorimetry method using an arsine analyzer.

30. The method of claim 1, wherein the adsorbent composition has an arsine removal efficiency of 100% as measured by a dry colorimetry method using an arsine analyzer.

31. The method of claim 1, wherein the adsorbent composition further comprises on the support at least one compound selected from a group consisting of a silver oxide, an iron oxide, a manganese oxide, a cerium oxide, a vanadium oxide, a tin oxide and mixtures thereof.

32. The method of claim 1, wherein the support comprises a pore volume of 0.01 cc/g to 5 cc/g.

33. The method of claim 32, wherein the support comprises a pore volume of 0.2 cc/g to 1 cc/g.

34. The method of claim 1, wherein the support comprises a pore size of 1 Å to 750 Å.

35. The method of claim 34, wherein the support comprises a pore size of 10 Å to 500 Å.

36. The method of claim 1, wherein the arsenic-containing fluid is a process stream, and wherein the process stream is part of a process selected from a group consisting of a petroleum process, a petrochemical process, a polymerization process, a synthesis gas process and a semiconductor process.

37. The method of claim 36, wherein the process stream is a part of a petrochemical process, the process stream comprising natural gas.

38. The method of claim 36, wherein the process stream comprises a gas selected from a group consisting of refinery off-gas, fluid catalytic cracking off-gas, steam cracker off-gas, shale gas and combinations thereof, the gas containing reactive components comprising at least one of acetylene, methyl acetylene and propadiene.