

FLUID FLOW INLET

BACKGROUND OF THE INVENTION

5 The invention relates to a method and apparatus for preventing particulate material from adhering to the inner surface of an inlet.

Certain industries produce toxic gaseous effluent as a result of their particular manufacturing or fabrication process. For example, chemical vapor deposition and etch processes associated with semiconductor fabrication utilizes highly toxic and pyrophoric gases. Many of these gases go through the process tool without reacting, 10 or react to form other gaseous species and/or particulate. These gases and particulate are then exhausted from the process tool and require treatment prior to going to the atmosphere. The effluent gases may be scrubbed by reacting with liquid. Many times this reaction will cause particulate to form which is either washed away or collected and removed. Typically, effluent gases are introduced through an inlet into a chamber 15 where jet sprays spray the gases with liquid. The gaseous material reacts with the liquid and many times forms a solid particulate. During the process, particulate material tends to adhere to the inner surface of the inlet and chamber due to moisture which have collected thereon and may impede the flow of gases through the inlet and chamber. Various methods and apparatus have been devised to prevent adherence of particulate material to the inner surfaces of inlets and chambers. 20

Referring now to Fig. 1, a typical prior art scrubbing chamber is shown generally at 1. The scrubbing chamber 1 has a cylindrical chamber 2, tangential water intakes 3, a tangential gaseous effluent intake 4 and opening 5. Water is injected tangentially into cylindrical chamber 2, which forms a downwardly spiraling wall of water along the inner surface of cylindrical chamber 2. Rings 6 serve as ledges in the 25 path of the downwardly spiraling wall of water, forming curtains of water across gaseous effluent opening 5. Gaseous effluent is introduced tangentially into cylindrical chamber 2. The gaseous effluent diffuses through the curtains of water and spirals up the chamber. Particulate material in the gaseous effluent reacts with the water and is carried away by the water through a funnel section 7 and outlet 8. 30

SUMMARY OF THE INVENTION

In one embodiment, the invention relates to a method for preventing particulate material from adhering to an inner surface defining a passage through an inlet body, the inlet body having a proximal inlet end and a distal exit end, comprising the steps of forming a film of inert gas within the passage at the proximal inlet end of the inlet body, forming a wall of swirling fluid within the passage at the distal exit end of the inlet body, and forming a solid cone of fluid as the wall of swirling fluid exits the inlet body.

In another embodiment, the invention relates to an apparatus for preventing particulate material from adhering to an inner surface defining a passage through an inlet body, the inlet body having a proximal inlet end and a distal exit end, comprising a porous wall for forming a film of inert gas within the passage at the proximal inlet end of the inlet body, an outlet, circumferential reservoir and weir for forming a wall of swirling fluid within the passage at the distal exit end of the inlet body, which, when exiting the inlet body, forms a solid cone of fluid.

In yet another embodiment, the invention relates to an apparatus for preventing particulate material from adhering to an inner surface of an inlet, comprising an inlet body having an inner surface defining a passage through the inlet body, a film of inert gas within the passage at a proximal inlet end of the inlet body, a wall of swirling fluid within the passage at a distal exit end of the inlet body, and a solid cone of fluid at the exit of the inlet body.

Advantages and features of the invention include one or more of the following. A film of inert gas along the inner surface of the proximal inlet end of the inlet and a wall of swirling fluid along the inner surface of the distal exit end of the inlet prevent solid accumulation. A solid cone of fluid formed as the wall of swirling fluid exits the inlet prevents backflow of moisture through the exit. Other advantages and features will become apparent from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates a prior art method for scrubbing effluent gases.

Fig. 2 illustrates an inlet according to one embodiment of the present invention.

Fig. 3 illustrates a closeup view of the method and apparatus for providing a film of inert gas according to the embodiment of Fig. 2.

5 Fig. 4 illustrates a closeup view of the method and apparatus for providing a wall of swirling fluid and solid cone of fluid according to the embodiment of Fig. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

10 Following is a description of the preferred embodiment of the present invention according to Fig. 2.

Referring to Fig. 2, an inlet is shown generally at 10. The inlet 10 has an inlet body 15. An inner surface 16 defines a passage through the inlet body 15. The inlet body 15 is threaded at an upper opening 17 so as to enable the inlet to securely engage an outlet 18 from, for example, a combustion chamber (not shown).

15 A porous wall section 20, which may be a fritted pipe, is housed within the passage at a proximal inlet end of the inlet body 15. An outer surface 21 of porous wall section 20 forms an external chamber 25 with the inner surface 16 of the inlet body 15. A gas intake 26 is connected to external chamber 25 by a conduit 27. The external chamber 25 receives a supply of inert gas, for example He, Ne, Ar, Kr, Xe, 20 N₂ and Rn, through gas intake 26 and conduit 27. The inert gas passes through the outer surface 21 of the porous wall section 20 and into the passage of inlet body 15, forming a film of inert gas 30 along an inner surface 22 of porous wall section 20.

An outlet pipe 35 is engaged within the passage at a distal exit end of inlet body 15. Outlet pipe 35 is secured to inlet body 15 by threading outlet pipe 35 into inlet body at threads 39. A seal 43 prevents leakage and is compressed by flange 48 25 which forms a part of annular bracket 38. Bracket 38 attaches the inlet 10 to a scrubbing chamber. An outer surface 36 of outlet pipe 35 forms a circumferential reservoir 40 and weir 41 with inner surface 16 of inlet body 15. Reservoir 40 receives a continuous injection of fluid through fluid intake 42 in a tangential direction so as to 30 cause the fluid to swirl around within reservoir 40. As more fluid is injected, the fluid

level within reservoir 40 rises up and over weir 41 and down outlet pipe 35. coating an inner surface 37 of outlet pipe 35 with a wall of swirling fluid 45.

Referring now to Fig. 3, porous wall section 20 contains pores 23. It will be appreciated that pores 23 are spaced within porous wall section 20 so as to allow the inert gas to pass through porous wall section 20 in an evenly distributed manner.

Referring now to Fig. 4, the wall of swirling fluid 45 forms a solid cone of fluid 50. As the wall of swirling fluid 45 exits outlet pipe 35, the swirling motion of the fluid causes solid cone of fluid 50 to be formed.

In operation, inlet 10 receives a flow of effluent gases through outlet 18, which may be from, for example, a CVD process chamber. Typically these effluent gases are heavily laden with toxic gaseous material and must be cleaned, or "scrubbed," before being released into the atmosphere. Some toxic gaseous material will react with moisture to form particulate material, which may adhere to inlet 10 upon contact with the inner surface of inlet 10. Over time, a layer of particulate material may form on the inner surface of inlet 10 and may clog inlet 10 and impede the flow of effluent gases.

However, as can be seen in the embodiment of the present invention in Fig. 2, the reactant particulate material is prevented from adhering to the inner surface of inlet 10 by a film of inert gas 30 and wall of swirling fluid 45. Effluent gases entering inlet 10 will encounter a film of inert gas 30 in the proximal inlet end of inlet body 15. The film of inert gas 30 serves to cool the reactant particulate material and prevent them from adhering to the proximal inlet end of inlet body 15.

As effluent gases continue to travel through inlet 10, a wall of swirling fluid 45 at the distal exit end of inlet body 15 is encountered. The wall of swirling fluid 45 serves to further cool the particulate material and prevent them from adhering to the distal exit end of inlet body 15. Particulate material that come in contact with wall of swirling fluid 45 are washed away by the fluid.

As effluent gases exit inlet 10, they diffuse through a solid cone of fluid 50. The solid cone of fluid 50 serves to prevent stray moisture from diffusing back up inlet 10 and into outlet 18, preventing premature reaction of the gases with water vapor.

It is to be understood that the embodiment described above is merely illustrative of some of the many specific embodiments of the present invention, and that other arrangements can be devised by one of ordinary skill in the art at the time the invention was made without departing from the scope of the invention.

WHAT IS CLAIMED IS:

1. A method for preventing particulate material from adhering to an inner surface defining a passage through an inlet body, said inlet body having a proximal inlet end and a distal exit end, comprising the steps of:
- 5 forming a film of inert gas within said passage at said proximal inlet end of said inlet body;
- forming a wall of swirling fluid within said passage at said distal exit end of said inlet body; and
- 10 forming a solid cone of fluid as said wall of swirling fluid exits said inlet body.
2. The method of claim 1, wherein said step of forming a film of inert gas comprises:
- 15 supplying an inert gas into an external chamber formed by said inner surface of said inlet body and an outer surface of a porous wall section located at said proximal inlet end of said inlet body, said inert gas passing through said outer surface of said porous wall section and into said passage, and forming said film of inert gas along an inner surface of said porous wall section.
- 20 3. The method of claim 1, wherein said step of forming a wall of swirling fluid comprises:
- injecting fluid into a circumferential reservoir in said inlet body in a tangential direction causing said fluid to swirl within said reservoir, and expelling said
- 25 fluid into said passage to form a coating on said inner surface with a wall of swirling fluid.
4. An apparatus for preventing particulate material from adhering to an inner surface defining a passage through an inlet body, said inlet body having a proximal inlet end and a distal exit end, comprising:
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means for forming a film of inert gas within said passage at said proximal inlet end of said inlet body;

means for forming a wall of swirling fluid within said passage at said distal exit end of said inlet body; and

5 means for forming a solid cone of fluid as said wall of swirling fluid exits said inlet body.

5. The apparatus of claim 4, wherein said means for forming film of inert gas comprises:

10 a porous wall section housed within said passage at said proximal inlet end of said inlet body;

said inner surface of said inlet body forming an external chamber with an outer surface of said porous wall section;

15 said external chamber adapted to receive a supply of an inert gas into said external chamber; and

said inert gas passing through said outer surface of said porous wall section and into said passage, and forming said film of inert gas along an inner surface of said porous wall section.

20 6. The apparatus of claim 4, wherein said means for forming a wall of swirling fluid comprises:

an outlet pipe engaged within said passage at said distal exit end of said inlet body;

25 said inner surface of said inlet body forming a circumferential reservoir and weir with said outlet pipe;

said reservoir adapted to receive an injection of fluid in a tangential direction and cause said fluid to swirl within said reservoir. rise up and over said weir and down said outlet pipe. and coat an inner surface of said outlet pipe with a wall of swirling fluid.

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7. An apparatus for preventing particulate material from adhering to an inner surface of an inlet, comprising:

an inlet body having an inner surface defining a passage through said inlet body;

5 a film of inert gas formed within said passage at a proximal inlet end of said inlet body;

a wall of swirling fluid formed within said passage at a distal exit end of said inlet body; and

10 a solid cone of fluid formed as said wall of swirling fluid exits said inlet.

8. The apparatus of claim 7, wherein said film of inert gas is located along an inner surface of a porous wall section;

15 said porous wall section being housed within said passage at said proximal inlet end of said inlet body;

said inner surface of said inlet body forming an external chamber with an outer surface of said porous wall section; and

said external chamber adapted to receive a supply of an inert gas.

20 9. The apparatus of claim 7, wherein said wall of swirling fluid is located on an inner surface of an outlet pipe;

said outlet pipe being engaged within said passage at said distal exit end of said inlet body;

25 said outlet pipe forming a circumferential reservoir and weir with said inner surface of said inlet body; and

said reservoir adapted to receive an injection of fluid in a tangential direction causing said fluid to swirl within said reservoir, rise up and over said weir and down said outlet pipe, and coat an inner surface of said outlet pipe with said wall of swirling fluid.

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