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APPARATUS FOR ADSORPTION

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1 Claim. (Cl. 183-4)

This invention relates to an apparatus for adsorption and more particularly to such as applied to the adsorption of gases, vapors and other fluids from gaseous, vaporous or other fluid mixtures.

An object of the invention is to provide means for increasing the efficiency of the adsorption and at the same time obviate destructive electrolytic effects in the apparatus.

With these and other objects in view one embodiment of the invention contemplates an apparatus for adsorption in which a mixture of gaseous substances is brought into contact with an adsorptive material and maintaining the adsorbent electrically isolated the while.

Other objects and characteristic features of the invention will appear from the following detailed description of one embodiment taken in connection with the annexed drawing in which the same reference numerals are applied to identical parts in the several figures and in which

Fig. 1 is a broken view in side elevation and partly in central vertical longitudinal section of an adsorber tank constructed in accordance with the invention;

Fig. 2 is an enlarged view thereof in transverse vertical section taken on the line 2-2 of Fig. 1;

Fig. 3 is an enlarged fragmentary view in transverse horizontal section taken on the line 3-3 of Fig. 1, and

Fig. 4 is an enlarged fragmentary view showing a modified form of curtain supporting means.

In the embodiment of the invention herein disclosed there is employed a cylindrical tank generally indicated by the numeral 10, horizontally disposed and having conventionally formed bulged end walls 11 secured with cylindrical side walls 12. The tank walls are constructed in a customary fashion from sections of rolled steel plate which are preferably joined together by welding but may be fastened by riveting or any other approved means. The tank may also be made of any other approved material. One or more manholes 13 may be provided, preferably in one end of the tank to give access to the interior and may be closed by covers not shown of appropriate conventional form.

An endless strip 14 of steel, angular in cross section, is welded or otherwise attached to the inner surface of the walls of the tank to act as a support for a grid system 15 and to support the grids in a horizontal position at about one quarter of the interior vertical dimension of the tank. The grid system is composed for convenience of juxtaposed independent sections formed to abut against each other and against the walls of the tank around the whole perimeter thereof, thus forming a substantially continuous perforated floor. The grid sections may be thought of as composed of a well known, cor-

rosion-resisting iron alloy containing nickel and silicon, although any appropriate material may be used in some cases wood or other electrically non-conducting material. For convenience the individual grid sections may be dimensioned to be able to pass through the manholes 13.

A sheet of screen or similar foraminous structure, in one piece or in overlapping sections, composed for example of copper wire woven in well known fashion may be laid on the grid floor. This screen is not shown in the drawing as it is not essential to the invention, its desirability depending on the relative sizes of the perforations in the grid floor and of the granular material to be supported thereby.

A bed 16 of granular solid adsorbent material is spread on the grid floor with or without interposition of the woven screen. The nature of this adsorbent is not pertinent to the invention and depends on the nature of the substance to be adsorbed thereby. In one instance where acetone is to be recovered from waste vapors comprising a mixture of air and acetone, the adsorbent may be thought of as granular activated charcoal such as is well known in the art.

If thought best a second layer of woven wire screen or the like, also not shown in the drawing, may be spread over the top of the bed of adsorbent to prevent disturbance thereof by currents of vapors passing over and through the bed, and this retaining cover may be further held in place, if desired, by barks of timber laid on or by any other approved means. But this retaining screen is also not pertinent to the invention, necessity therefor depending solely on the physical characteristics of the particular adsorbent in use.

The tank is further provided with inlet and outlet means for the vapor mixtures to be treated, for steam, hot or cold air, etc., as required by the characteristics of the particular process. These are not shown on the drawing or further described, as their precise nature, location and number is no part of the invention and is variable in practice.

All of the structure thus far disclosed is old and well known in the art. A principal characteristic feature of the invention is the provision of means to electrically isolate the bed of adsorbent material from the tank walls and/or from ground. As herein disclosed this means comprises a curtain 17 of insulating material such as "no-cold-flow" rubber or the like carried by a sheet of canvas or the like and interposed between the tank walls on the one hand and the adsorbent bed 16 and its supporting grids 15 on the other hand. The upper edge of the curtain 17 is clamped firmly between the inner surface of the tank wall and a substantially continuous supporting strip 18 held in place by a plurality of bolts 19 passing through the strip, curtain and tank wall.

The body of the curtain is pressed against the tank wall by the adsorbent bed. The lower edge of the curtain, before the grids 15 are put in place, hangs down over the grid supporting ledge 14 and when the grids are set in place, the bottom of the curtain is firmly gripped between the overlying substantially continuous perimeter of the grid floor and the underlying grid support 14.

The horizontal curtain supporting strip 18 is located to be well above and out of contact with the adsorbent 16. Thus the adsorbent and its supporting grid both are electrically isolated by the curtain 17 from the tank walls and hence also from ground.

For convenience, the grid sections are made, as herein disclosed, with their ends which abut against the inclined tank walls, vertical, thus leaving a tapering gap between the grid floor and the tank walls. If desired this gap may be filled, after the grids are in place and before the adsorbent is spread, with any inert cement, or other suitable material as shown at 20, although this is no part of the invention, it being possible to form the grids with end surfaces to fit the slope and curvature of the tank walls.

The curtain will preferably be made to fit the tank as an endless band or zone. However, it may be more convenient to use a strip of material and to overlap the ends of the strip along a vertical band as shown at 21. In this case a vertical retaining piece 22 may be applied against the inner surface of the overlap 21 and attached with bolts 23 or otherwise to the tank wall. If this retaining member 22 be of metal it will be dimensioned to extend down near to but not to reach the grid floor leaving a gap 24 therebetween. The bed 16 will then be in electrical communication with the tank; but since adsorbents such as are here in question, are poor conductors, especially in view of their granular state, the effectiveness of this contact is in practice negligible so long as the member 22 does not have direct contact with the grids 15 when these are of metal. However, if thought desirable, even this slight electrical leakage may be obviated by providing an additional curtain piece 31 of insulating material hung over the member 22 and supported by being clamped at its upper edge between the strip 18 and a short auxiliary strip 32 as best shown in Fig. 3. This will prevent contact between the bed 16 and the member 22. The member 22, if of metal, being relatively small, may, without prohibitive cost, be made of Monel metal or similar non-corroding alloy.

A modified method of suspending the insulating curtain is disclosed in Fig. 4. An angle strip 25 is welded or otherwise firmly attached to the inner surface of the wall of the tank, its one member forming an inwardly extending shelf like support 26. The upper edge of the curtain 17 is applied against the under side of this support and clamped against it by means of a rigid band 27 applied thereto and fastened to the support 26 as for example by bolts 28.

In operation, this invention has two distinct and important advantages. On the one hand the efficiency of the adsorption is increased by the complete or virtually complete electrical isolation of the adsorbent. On the other hand, the electrical separation of the adsorbent and its support from the rest of the structure prevents the severe electrolytic corrosion which has hitherto been an annoying feature of such apparatus.

The precise nature of the molecular mechanics involved in the adsorption of fluids on the surface of more or less finely divided or porous solids is not well understood. It seems however to be strongly influenced by the electrical state of the adsorbing surfaces. Applicant finds that the efficiency of the adsorption of acetone vapors on activated charcoal is notably enhanced by the isolation electrically of the charcoal and its cast metal supporting grids from the steel tank and its grounded supports. This is true even where the curtain closing member 22 is in electrical communication with both the adsorbent bed and the tank wall so long as the member 22 does not have contact with the grids 15. The loose granular material of the bed is so poor a conductor that its electrical state is not appreciably affected as a whole by the electrical leakage to ground through the member 22 except perhaps in a restricted zone immediately contiguous to the member. If, however, the member 22 be in direct contact with the grid floor 15 the effective electrode area of the grids in contact with the charcoal is so great as to be distinctly deleterious.

The electrical isolation could of course be accomplished in other ways beside that herein disclosed. For example, the interior of the tank might be enameled with an insulating composition or painted or sprayed or otherwise coated before the grids and adsorbent are put in place. However, there are distinct practical advantages in providing an independent, rugged member for the isolating function as herein disclosed.

If no such isolation is provided for, i. e. if the steel walls, cast ferrous alloy grids, and the charcoal for example are in mutual electrical contact, there may be severe electrolytic corrosion of the steel tank walls, since in practice in most adsorption processes traces at least of moisture and of soluble electrolytes, acids, amines, volatile salts, etc. are present.

By isolating the grids and charcoal from the tank walls, this electrolytic corrosion is obviated thus not only indefinitely prolonging the life of the apparatus but also, in some instances, preventing the poisoning or destruction of the adsorbent by the products of corrosion.

The embodiment of the invention herein disclosed is evidently illustrative only and may be varied and departed from in many ways without departing from the spirit and scope of the invention as pointed out in and limited only by the appended claim.

What is claimed is:

An apparatus for the recovery of fluids by adsorption comprising a tank having inlet and outlet apertures, a grating supported therein, a bed of adsorbent material supported on the grating, a loose curtain of electrically insulating material applied against the inner face of the tank and interposed between the tank on the one hand and the grating and bed on the other hand, the curtain consisting of a band of material with overlapping ends and being supported at its upper edge by a strip applied against the curtain and attached to the tank wall and the overlap of the curtain being sealed by a further strip applied thereover and attached to the tank wall, and a flap of electrically insulating material positioned over the last named strip and interposed between the strip on the one hand and the grating and bed on the other hand.

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