An apparatus for dissolving and dispensing soluble material comprising a container having an upper and a lower chamber. The upper chamber is separated into a first and a second compartment. A rotary receptacle in the first compartment receives liquid through an inlet in the first compartment and is periodically emptied, releasing precisely the same amount of liquid each cycle. The second compartment contains a magazine which holds soluble solids to be dissolved by the liquid. A control valve regulates the amount of liquid contact with the solid. The lower chamber receives the solution from the second compartment and thus valve means releases the solution into the liquid system to be treated. The apparatus provides means for dispensing a wide range of concentrations of solutions, for example, solutions containing carefully controlled amounts of available chlorine which can be supplied to a swimming pool.

23 Claims, 5 Drawing Figures
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1
Dissolving and Dispensing Apparatus Having Rotary Liquid Receptacle

This application is a continuation-in-part of co-pending application Ser. No. 285,714, filed Sept. 1, 1972.

This invention relates to apparatus for the preparation and controlled feeding of aqueous solutions of solid particulate material. More particularly, the apparatus provides means for preparing aqueous solutions of water-soluble solids and dispensing said solutions at controlled rates. Still more particularly, this invention relates to apparatus for supplying solutions containing available chlorine over a wide range of concentrations from solid hypochlorite compositions in conveniently handled granular, pressed or tabletted forms at accurately controlled rates for use in a variety of chlorination and water treating applications differing widely in the ultimate concentration of the solution required.

In the treatment of water supplies, including particularly swimming pools, a supply of aqueous solution of an available halogen compound, preferably a hypochlorite, is commonly metered into a flowing body of the liquid to be treated. Sodium hypochlorite solutions are available commerically at concentrations not exceeding 15 percent of available chlorine but such solutions deteriorate rapidly during shipment and storage. Solid sodium hypochlorite compositions are not available because they are very unstable. Calcium hypochlorite, on the other hand, can be shipped as a relatively stable solid containing 70 percent or more of available chlorine and can be stored for long periods without appreciable loss of available chlorine.

In spite of the advantages of solid calcium hypochlorite over other sources of available halogen for use as a sterilizing agent, there is a problem in applying the solid continuously and directly to water in such a manner that only a few parts per million of available chlorine are ultimately present in the water. In conventional methods of application in swimming pools, granular calcium hypochlorite is sometimes added directly to the water in the pool or tablets are placed in the skimmer or in dissolving baskets around the pool. Preferably, however, solid calcium hypochlorite is dissolved in water to form a solution of desired concentration which is metered into the water in the circulating system at a rate to maintain residual chlorine concentration generally from about 0.3 to about 1.5 parts per million in the pool.

Many devices have been devised to control dissolution of soluble materials but which are not satisfactory for use with calcium hypochlorite or other substances having similar solubility and solution characteristics.

U.S. Pat. No. 1,216,051 shows a dispensing device having a solute-containing magazine covered at one end by a perforated disk and supported at a fixed elevation in the total stream of flowing water to be treated. The flow of the total stream promotes turbulence in the region of the perforated end of the magazine and extensive wetting of undissolved solute. Contact between solute and liquid and hence the degree of liquid treatment is dependent on liquid pressure.

U.S. Pat. No. 2,971,825 shows a dispenser for dissolving and dispensing solids by passing a variable controlled portion of the inflowing liquid into a mixing chamber which contains the solute and which is partially covered by a screen. Turbulent flow in the region of the perforated end and extensive wetting and mixing of solvent and undissolved solute are encouraged by the structure of the device of this patent. The range of concentrations for treated solutions is limited by the extent stream deflection is permitted by the controls. The uniformity of concentrations of treated solutions is dependent on liquid pressure.

The dispensing device of U.S. Pat. No. 3,107,156 comprises a solute containing magazine suspended into a container into which a constant flow of water enters. The magazine has a water soluble plastic film at the lower end which dissolves in contact with water and exposes the solute to the dissolving action of water. The extent of contact of solute with water is adjusted by raising or lowering the magazine. A siphon tube determines the upper and lower liquid levels in the container and periodically releases a quantity of treated water.

In contrast to the above dispensers, the apparatus of the present invention provides for accurately controlled concentrations of treated solutions which are independent of changes in pressure on the liquid being introduced. The present apparatus provides controlled turbulence in the area of liquid-solute contact and prevents undesired contact between the liquid and the soluble material. Continuous immersion of the soluble material in the liquid is avoided by the apparatus of this invention. Periodic, release of a controlled quantity of liquid from the receptacle permits liquid-solute contact which is essentially unaffected by changes in liquid flow rates. The present invention permits a zero feed rate of soluble material while maintaining a continuous flow of liquid through the apparatus under normal operating conditions.

In the apparatus of this invention, if the flow of liquid is stopped, the solution retained in the dispenser does not remain in contact with the soluble material, thus the solution does not become highly concentrated and therefore does not cause corrosion, for example, to pumps, filters, or lines upon standing or when the flow of solution is resumed.

In general, the apparatus of the present invention for dissolving and dispensing soluble material comprises in combination a closed container having an upper chamber and a lower chamber and at least one first partition separating the chambers. The upper chamber is divided into a first and a second compartment by a second partition. An inlet in the upper part of the first compartment introduces liquid from an external source into a rotary receptacle housed in the first compartment. The receptacle is located below the inlet and is attached to the sidewalls of the first compartment by a pair of trunnions. Means are provided for periodically emptying liquid from the receptacle. Liquid flow is regulated by a first flow control means associated with at least one opening between the first and the second compartment. A magazine in the second compartment for holding soluble solids has a pervious lower end permitting the liquid from the receptacle to contact the solids. At least one opening is provided in the second compartment permitting liquid to flow between the second compartment and the lower chamber. An outlet in the lower chamber is equipped with a second flow control means which permits the regulation of liquid flow through the outlet.

FIGS. 1-5 show various embodiments of the novel dispenser of this invention. Corresponding parts have the same identifying numbers in FIGS. 1-4. FIG. 5
shows a diagram utilizing the dispenser of this invention.

FIGS. 1-4 illustrate one embodiment of the dispensing apparatus of the present invention.

FIG. 1 is a vertical cross section of one embodiment of the apparatus of the present invention.

FIG. 2 is a top view of the embodiment of FIG. 1 with parts broken away.

FIG. 3 is an end view partially sectioned which is taken along the line 3-3 of FIG. 2.

FIG. 4 is a partial perspective view of an alternate embodiment of FIG. 3.

FIG. 5 is a diagrammatic plan of a swimming pool circulating system incorporating the dispensing apparatus of the present invention.

The dispensing apparatus of this invention, as shown in FIG. 1, is divided into upper chamber 1 and lower chamber 2 by first partition 3. Upper chamber 1 is separated into first compartment 4 and second compartment 5 by second partition 6. Liquid from an external source enters the apparatus by way of tube 7 passing thru flow indicator 8 and inflow valve 9 into inlet 10 attached to the upper part of wall 14 of first compartment 4. Receptacle 11 is attached to the sidewalls of first compartment 4 by means of a pair of trunnions 12. Receptacle 11 empties itself when the liquid volume reaches a predetermined level by pivoting on trunnions 12 stopping when the front edge of receptacle contacts protuberance 13.

Upon emptying, receptacle 11 returns to its original position, stopping when contacting inlet 10. Liquid from receptacle 11 flows down first partition 3 to horizontal partition 15 where first flow control means 16 regulates the rate of liquid flow from first compartment 4 to second compartment 5 thru channel 17. Magazine 18, having removable cover 60 and with the lower peripheral end comprising grid 19 and supporting a liquid soluble particulate material (not shown), is contained in second compartment 5. Dial control 20 attached to first flow control means 16 regulates the rate of liquid flow thru channel 17 in second partition 6 and thus the height of the liquid column passing thru grid 19 containing the solid soluble particulate material to form a solution of the material. Dial control settings (not shown) are indicated on cover 61 of first compartment 4. From second compartment 5 the solution formed passes thru drain 21 into lower chamber 2. Second flow control means comprised of float 22 and valve 23 regulate the flow of solution from lower chamber 2 thru outlet 24 to the body of liquid to be treated. Overflow tube 25 allows any build-up of liquid which might occur in first compartment 4 to flow directly into lower chamber 2 without contacting the liquid soluble particulate material.

FIG. 2 is a top view of the embodiment of FIG. 1. Orifice 28 in partition 15 permits liquid to by-pass first flow control means 16 (not shown) and flow into second compartment 5. Dial control settings are shown on cover 61 of first compartment 4. The setting for dial control 20 determines the position of first flow control means 16 and thus the rate of liquid flow entering second compartment 5 and up thru grid 19. The solution formed then passes thru drain 21 into lower chamber 2 (not shown).

FIG. 3 illustrates an embodiment of first flow control means 16 between first compartment 4 and second compartment 5 of upper chamber 1. Hollow cylinder 27 is attached to first partition 3 and contains openings 28 for liquid flow. Inner cylinder 29 has a semicircular portion cut away at one end thereof and is free to rotate. It is attached to cylinder support 30 which is attached to rod 31 having a bushing 32 at the upper end thereof. Movement of dial control 20 alters the position of inner cylinder 29 and thus changes rate of liquid flow thru openings 28 of cylinder 27 and thru channel 17.

FIG. 4 illustrates the partial perspective view of an additional embodiment of first flow control means 39 to replace first flow control means 16 where an L-shaped member 40 attached to first partition 3 and second partition 6 by pivot pin 46, has tube 41 attached at the end of the horizontal arm of the L. Tube 41 contains spring 42 and studs 43. Opening 44 in second partition 6 and opening 45 in first partition 3 are counterpositioned so that movement of member 40 increases the flow of liquid thru one opening while decreasing the flow thru the other. The liquid from receptacle 11 (not shown) flows down first partition 3 into channel 49, formed between first partition 3 and second partition 6. Liquid flowing thru opening 44 in second partition 6 enters second compartment 5 to contact the solid soluble particulate material. Liquid flowing thru opening 45 in first partition 3 passes directly into lower chamber 2 without containing the solid soluble particulate material.

FIG. 9 illustrates the use of the present invention in supplying chlorinated water to a swimming pool system including swimming pool 50, a pump 51 with its low pressure or suction side connected by conduit 52 to pool 50 and with its high pressure or outlet side by conduit 53 to filter 54. A portion of the water discharged from filter 54 through conduit 55 passes through conduit 56 into dispensing apparatus 57. For example, when magazine 18 of the dispenser of this invention contains calcium hypochlorite and pool water is contacted with the calcium hypochlorite contained therein, the resulting chlorine-containing solution formed by dispenser apparatus 57 is discharged through outlet 24 (not shown) to conduit 58 to pump 51, through conduit 53 to filter 54 and through conduit 55 to pool 50.

The dispensing apparatus of this invention is suitably fabricated of metal or plastic depending on the solute and liquid with which it is to be used. When solid hypochlorites, for example, calcium hypochlorite, or solutions of hypochlorites are employed, the materials of construction are preferably those resistant to its action. Particularly suitable for this purpose are a considerable number of plastic compositions, for example, Lucite which has the additional advantage of transparency. The apparatus may also be constructed of other resins, for example, acrylonitrile-butadiene-styrene, Bakelite, nylon, polyethylene, polyvinyl chloride, and polystyrene and of suitable metals including copper, brass, stainless steels, and titanium.

The dispenser is designed to operate with liquid supplied at suitable pressures and may be operated without controlling means or liquid flow rates. In systems with highly variable liquid flow rates, it may be desirable however, to equip the inlet with means to regulate liquid flow. In the case of treating swimming pool water, for example, control means combining a visual flow indicator and a valve member are useful in indicating a pressure build-up in the filter or at the hair and lint screen or to indicate that the check valve is functioning.
in case the filter pump stops. An example of a suitable inlet liquid flow control means is a combination of a ball flow indicator and a tee valve.

The receptacle for the liquid is self-emptying and provides for the release of liquid on a periodic basis, controlled, for example, by a predetermined volume or weight of liquid. It can, for example, be shaped generally cylindrical, ellipsoidal or circular, having at least one opening for solvent to enter and be discharged. In one embodiment, a tear drop shaped receptacle is attached to the walls of the container, for example, by a pair of trunnions or pivot pins and is carefully balanced so that upon emptying the liquid it returns to its original position. A stopping means for maintaining the receptacle at a suitable position for filling may be provided by the appropriate length of the inlet tube or by appropriately located protuberances as shown in FIG. 1.

One or more openings are provided in the first compartment to permit flow of liquid to the second compartment and/or the lower chamber when the dispensing device is operating to produce solutions of low concentration.

Flow of liquid from the first compartment to the second compartment is regulated by the flow control means, for example, a valve member selected to provide a wide range of flow rates. Suitable examples are illustrated in FIGS. 1–4.

The supply magazine has the form, for example, of a hallow rectangular or cylindrical solid having a pervious lower end. The magazine is insertable into the second compartment of the upper chamber and stop means are provided to establish the level of the pervious lower end of the magazine at an appropriate distance above the bottom of the compartment. The pervious lower end can be, for example, a grid of suitable mesh attached to the magazine and made integral therewith. The magazine can be removable from or made integral with the second compartment. A removable cover permits the magazine to be filled with soluble material in a form which is suitable for dissolving in the liquid being supplied to the apparatus of the invention. While a magazine is a preferred embodiment for containing the soluble solids it will be recognized that other supports or holders having suitable openings for liquid may be used.

The lower portion of the magazine is periodically submerged in liquid, with the volume of the submerged portion usually being no greater than about 5 percent of the total volume of the magazine. The extent of contact is regulated by the adjustable flow control means.

As soluble material dissolves at the pervious end of the magazine and is removed, the soluble material originally in the air space above and not wetted by liquid, gradually descends to the pervious end to replace that dissolved. Only soluble material about to be dissolved is contacted by liquid flowing across the pervious end of the magazine.

At least one opening is provided to permit the flow of solution between the second compartment and the lower chamber. This may comprise, for example, a drain with a suitable dam to maintain liquid level near the grid. In addition, drain means suitably notched to minimize plugging by non-dissolved particles can be employed. If desired, drain means with a variable size orifice can be advantageously used especially where particulate materials of differing degrees of solubility are employed with a common solvent.

Liquid communication means can be provided between the first compartment and the lower chamber. A suitable example is an opening or overflow tube which prevents the build-up of liquid in the first compartment.

Release of solution from the lower chamber through outlet 24 to the liquid to be treated is controlled by a second flow control means, a float valve, for example, so arranged that air is prevented from being drawn into the pump suction line causing undesired introduction of air into the recirculating system.

The dispenser is designated to operate with liquid supplied at suitable pressure and to discharge the solution at or below atmospheric pressure into the liquid to be treated.

The rotary receptacle accumulates a volume of liquid and periodically instantaneously releases the liquid to a dissolving zone wherein the liquid contacts a soluble material in the lower end of the magazine to form a solution containing a carefully controlled amount of the soluble material. By releasing precisely the same amount of liquid during each cycle, accurately controlled solution concentrations are consistently obtained for a particular setting of the dial control. A wide range of concentrations are available, for example, when dissolving solid calcium hypochlorite in water for swimming pool treatment, available chlorine in amounts of from zero to greater than 4,000 grams per day can be supplied. Currently available erosion type dispensing devices for chlorinating swimming pools cannot provide a zero feed rate of available chlorine while operating, nor can they feed more than approximately 600 grams of available chlorine per day.

The device of the present invention is used particularly advantageously when it is desired to dispense solutions of solvent solid materials supplied to a suitable form at accurately controlled rates. These rates are varied by controlling the volume of liquid in contact with the solvent material. The dispenser of this invention is particularly useful in the application of solid hypochlorites, for example, calcium hypochlorite, to bodies of water, for example, in treating water in swimming pools, water plants in small municipalities, bottling plants, dairies and cooling systems where the addition of a sterilizing agent or other chemical is desirable. The device also can be advantageously used in the treatment of industrial wastes to destroy color, odor, and toxic constituents, and for odor and bacterial control in sewage effluents. Pressed tablets of hypochlorite are especially suitable in the present apparatus, but granular shapes and sizes of particles are also suitable. The apparatus can be used for dissolving and feeding other chemicals, for example, sodium fluoride in minor amounts for water supplies, polyphosphates and compositions containing them for water softening, soda ash furnished as briquettes or fused soda ash for adjusting the alkalinity of aqueous bodies, sodium chloride, alum and available chlorine compound other than hypochlorite including, for example, dichlorocyanuric acid and salts thereof, trichlorocyanuric acid and salts thereof, tetrachloroglycoluril, 1,3-dichloro-5,5-dimethylhydantoin and 1-chloro-3-bromo-5,5-dimethylhydantoin.
The following examples are presented to illustrate the invention more fully. All parts and percentages are by weight unless otherwise specified.

EXAMPLE I

A dissolving and dispensing apparatus, substantially as shown in FIGS. 1-2, was fabricated substantially of polymethyl methacrylate. The tear drop shaped receptacle had a capacity of approximately one quart of liquid. The magazine had a grid forming the pervious end and was filled with tableted calcium hypochlorite containing at least 70 percent Ca(OCl)₂. The flow control valve between the first and second compartment of the upper chamber is the valve shown in FIG. 3. A loose fitting cap for the supply cartridge was provided. The described dispenser was connected to a test stand simulating a swimming pool installation to test uniformity in maintaining available chlorine levels.

The test stand consisted of a stirred tank having a capacity of 150 gallons of water. Fresh water at a temperature of 71°F. was added to the dispersing device at the rate of 14 gallons per hour.

At a dial control setting of 1, the dispensing apparatus was operated for a period of 7 ½ hours with the treated solution being retained in the stirred tank. Periodic analysis showed a uniform available chlorine concentration of 21.6 parts per million.

EXAMPLE II

The dissolving and dispensing apparatus of example I was used in a 25,000 gallon swimming pool installation such as illustrated in FIG. 9. Water, having a total hardness in the range of 650-900 parts per million, was withdrawn from the pool thru a plastic conduit, using the low pressure side of a pump. The high pressure side of the pump forced water thru a cartridge filter and into a plastic conduit having a smaller plastic line connected to it. This plastic line supplied water thru the inlet of the dispensing apparatus to a receptacle of 1 quart capacity at the rate of approximately 1 quart per minute. The magazine of the dispensing apparatus was filled with calcium hypochlorite tablets ¾ inch thick and ¾ inch in diameter.

At a dial control setting of 2, the available chlorine residual in the pool was maintained at 1.0 to 1.5 parts per million for a period of greater than 90 days. The temperature of the water averaged about 80° to 85°F. in the pool located in an unshaded area and without a screened enclosure. The pump was operated for about 12 hours per day. During the period of operation, the dispenser apparatus required no cleaning nor other maintenance.

What is claimed is:

1. An apparatus for dissolving and dispensing soluble solid material comprising in combination a closed container having an upper chamber and a lower chamber and at least one first partition separating said chambers, said upper chamber having a first and a second compartment separated by a second partition; an inlet for liquid in the upper part of said first compartment, a rotary receptacle in said first compartment and attachment means therefore comprising a pair of protrusions, said receptacle receiving said liquid from said inlet and upon rotation periodically emptying said receptacle; first flow control means associated with at least one opening for controlling liquid flow between said first compartment and said second compartment; a magazine in said second compartment to hold soluble solids, said magazine having a pervious lower end permitting said liquid to contact the lower portion of said solids, at least one opening for liquid flow between said second compartment and said lower chamber, and an outlet in said lower chamber and second flow control means for liquid flow thru said outlet.

2. The apparatus of claim 1 in which said receptacle is a tear drop shaped vessel having at least one opening therein.

3. The apparatus of claim 2 in which said first partition separating said upper and said lower chambers comprises an inclined section, a substantially vertical section and a substantially horizontal section.

4. The apparatus of claim 3 in which said opening between said second compartment and said lower chamber comprises a drain having a liquid retaining dam.

5. The apparatus of claim 4 having at least one opening for liquid communication between said first compartment and said lower chamber.

6. The apparatus of claim 5 in which said second flow control means for controlling said outlet is a float valve.

7. The apparatus of claim 6 which said magazine contains soluble solids selected from the group consisting of a calcium hypochlorite, dichloroacuanic acid and salts thereof, trichloroacuanic acid and salts thereof, tetrachloroglycoluril, 1,3-dichloro-5,5-dimethylhydantoin, and 1-chloro-3-bromo-5,5-dimethylhydantoin.

8. The apparatus of claim 7 in which said soluble solid is calcium hypochlorite.

9. The apparatus of claim 1 wherein said second partition contains at least one opening in the lower part thereof, said opening for liquid flow between said second compartment and said lower chamber is a variable size orifice flow control means, and having at least one opening for liquid communication between said first compartment and said lower chamber.

10. The apparatus of claim 9 in which said receptacle is a tear drop shaped vessel having at least one opening therein.

11. The apparatus of claim 9 in which said receptacle is a cylinder having at least one opening therein.

12. The apparatus of claim 9 in which said partition separating said upper and said lower chambers comprises an inclined section, a substantially vertical section and a substantially horizontal section.

13. The apparatus of claim 9 in which said partition separating said first and said second compartments is substantially vertical having a channel in the lower part thereof.

14. The apparatus of claim 9 in which said flow control means between said first compartment and said second compartment comprises valve means having two concentric cylinders, an outer hollow cylinder attached to said partition defining said upper and said lower chamber, said outer cylinder having at least one opening therein; an inner cylinder attached to control means, and said inner cylinder having at least one opening therein.

15. The apparatus of claim 9 in which said flow control means between said first compartment and said second compartment comprises valve means having an L-shaped member with means attached at the end of
3,802,845

the horizontal arm of said L, said means being transverse to said horizontal arm, said means containing a pair of studs and pressure means for exerting an outward force on said studs.

16. The apparatus of claim 9 in which said flow control means between said first compartment and said lower chamber comprises an overflow tube.

17. The apparatus of claim 9 in which said flow control means for controlling said outlet is a float valve.

18. The apparatus of claim 9 in which said inlet has control means comprising a flow indicator tube attached to valve means.

19. The apparatus of claim 9 in which said magazine is removable from said compartment.

20. The apparatus of claim 9 in which said pervious end of said magazine is a grid.

21. The apparatus of claim 9 in which said magazine is filled with soluble solids selected from the group consisting of calcium hypochlorite, dichlorocyanuric acid and salts thereof, trichlorocyanuric acid and salts thereof, tetrachloroglycoluril, 1,3-dichloro-5,5-dimethylhydantoin, and 1-chloro-3-bromo-5,5-dimethylhydantoin.

22. The apparatus of claim 21 in which said soluble solid is calcium hypochlorite.

23. The apparatus of claim 6 in which said first compartment has an opening in said first partition separating said upper chamber from said lower chamber, said second compartment having an opening in said first partition separating said upper chamber from said lower chamber, and flow control means for controlling liquid flow between said opening in said first compartment and said opening in said second compartment.

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