can cause damage to the internal parts within the toilet bowl such as rubber seals and the like. Finally, some of such systems are not aesthetically pleasing and have many external parts that are within plain site of the user.

[0030] There is a need in the art for a self-cleaning toilet that can operate upon demand to minimize the impact of cleaning agents in the toilet, is safer for use in homes with children and pets, and which is preferably portable and compact so that it is easy to seat and not visually undesirable. Further, there is a need in the art for such as system that provides easy dosing and replacement of cleaning agent and/or the actual cleaning system so that systems can be easily replaced, repaired and maintained by consumers without the need for special tools or a plumber.

BRIEF SUMMARY OF THE INVENTION

[0031] The invention includes a toilet assembly with a toilet and a cleaning system, a method for cleaning a toilet assembly with a toilet and such a cleaning system on a periodic basis at a user's initiation, as well as a cleaning system for use with a toilet assembly. The toilet in the assemblies herein is most preferably a toilet having an isolated rim path, although the system can be used with other types of toilets. The invention provides a self-cleaning toilet assembly. Unlike prior toilet assemblies with cleaning systems, the system does not automatically actuate with the flush cycle so that a user can clean the toilet upon his or her own actuation and upon need. In preferred embodiments, the system enables minimal exposure of humans and animals to standing cleaning agent in the flush water when not in use while providing excellent cleaning capability.

[0032] In one embodiment, the invention provides a toilet assembly with a cleaning system, comprising: (a) a toilet assembly configured to initiate a flush cycle comprising a toilet bowl defining an interior space, a toilet tank defining a tank interior, a flush valve, a rim inlet and an isolated rim flow path extending from an outlet of the flush valve to the rim inlet, wherein the flush valve is configured to deliver fluid to the rim inlet of the toilet bowl; and (b) a cleaning system comprising an arm actuator assembly adapted to operate independently of a flush actuator assembly of the toilet assembly, comprising a reservoir for holding a liquid cleaning agent having a body defining an interior space and having an outlet port in fluid communication with the interior space of the reservoir body; a housing configured to receive the reservoir; a supply conduit in fluid communication with the interior of the reservoir and having a first end for receiving fluid from within the reservoir; a flow control device capable of controlling flow through the supply conduit; and a control system activatable

rim inlet of a toilet bowl, and operating the flush valve to open the flush valve to introduce flush water with the dose of the liquid cleaning agent into the rim inlet of a toilet bowl, wherein the cleaning system comprises an arm actuator assembly adapted to operate independently of a flush actuator assembly of the toilet assembly.

[0060] In the cleaning system herein, an optional vent line may be provided in fluid communication with the interior of the reservoir and configured to have a first end situated to receive entrained air and/or liquid from within the reservoir and a second open end located at least above a height of a full liquid level in the reservoir.

[0061] The control system may be adapted so as to introduce flush water and a liquid cleaning agent over a second period of time, and operate further to at least partially close the flush valve after delivering the flush water and the dose of a liquid cleaning agent.

[0062] The reservoir body preferably has an outlet portion and the outlet port is located in the outlet portion. The housing may have a seat portion configured to receive the outlet portion of the reservoir.

[0063] The system may further comprise at least one peripheral seal so that the outlet portion of the reservoir fits within the seat portion of the housing in sealing engagement.

[0064] In one embodiment, the system may include a tube defining a passage therethrough and having an upwardly extending first end and a second end, the first end for directing fluid from the interior space of the reservoir through the passage in the tube and into the first end of the supply conduit, wherein the tube is located in the seat portion and the seat portion may have a second opening for receiving the first end of the supply conduit. The first end of the tube may be pointed. The first end of the supply conduit may be situated within the second end of the tube when the reservoir is situated within the housing. The tube may be situated within the seat portion so that when the outlet portion of the reservoir is in the seat portion of the seat, the tube extends through the outlet port of the reservoir and upward within the outlet portion of the reservoir. The tube may also comprise optional side opening(s) extending therethrough for fluid entering the upwardly extending end of the tube to flow into a bottom area of the outlet portion. In an embodiment having a tube, the system may also further comprise an optional vent line in fluid communication with the interior of the reservoir and configured to have a first end situated to receive entrained air and/or liquid from within the reservoir and a second open end located at least above a height of a full liquid level in the reservoir, in which case, the seat portion may also comprise a first opening for receiving the first end of the vent line

[0065] The outlet port in the cleaning system may have a frangible seal capable of being penetrated by the upwardly extending end of the tube or a liquid supply valve fitting, wherein

cleaning agent and to open the flush valve again after a third period of time to purge an interior of a toilet bowl with new flush water at an end of the clean cycle.

[0071] The invention also includes a toilet assembly having a cleaning system, comprising: (a) a toilet assembly configured to initiate a flush cycle comprising a toilet bowl defining an interior space, a toilet tank defining a tank interior, a flush valve, a rim in fluid communication with the interior of the bowl through a rim flow path extending from an outlet of the flush valve to at least one rim outlet port, wherein the flush valve is configured to deliver fluid to the rim and wherein the flush valve is configured to operate in a flush actuation mode wherein the flush valve is able to provide flush water flow sufficient for the toilet assembly to initiate a flush siphon or provide a wash down flush and to operate in a cleaning actuation mode wherein the flush valve is only partially opened to allow for introduction of a cleaning agent and flush water mixture to the bowl that is insufficient to initiate a siphon but sufficient for cleaning the bowl; and (b) a cleaning system comprising an arm actuator assembly adapted to operate independently of a flush actuator assembly of the toilet assembly, comprising a reservoir for holding a liquid cleaning agent having a body defining an interior space and having an outlet port in fluid communication with the interior space of the reservoir body; a housing configured to receive the reservoir; a supply conduit in fluid communication with the interior of the reservoir and having a first end for receiving fluid from within the reservoir; a flow control device capable of controlling flow through the supply conduit; and a control system activatable by an actuator feature, wherein upon activation of the actuator feature, the control system is adapted to initiate a clean cycle by: operating the flow control device to deliver a dose of the liquid cleaning agent from the reservoir to the at least one rim outlet port, and operating the flush valve in the cleaning actuation mode to open the flush valve so as to introduce flush water to carry the dose of the liquid cleaning agent through the at least one rim outlet port into the toilet bowl at a flow rate insufficient to initiate a siphon but sufficient for cleaning the bowl.

[0072] In the above-embodiment, the flush valve may introduce flush water at a flow rate that is about 20% to about 80% slower in the cleaning actuation mode than the flow rate through the flush valve during a normal flush mode, and preferably about 40% to about 60% slower in the cleaning actuation mode than the flow rate through the flush valve during the normal flush mode. In addition, flush water may enter the valve in a flush actuation mode over a period of about 2 s to about 30 s. Flush water and cleaning agent may be introduced into the bowl and have a residence time of about 30s to about 30 min. for cleaning the bowl.

the toilet assembly in a cleaning actuation mode to open a flush valve in the toilet assembly so as to introduce flush water to carry the dose of the liquid cleaning agent through the at least one rim outlet port of the toilet assembly into a toilet bowl of the toilet assembly at a flow rate insufficient to initiate a siphon but sufficient for cleaning a toilet bowl in the toilet assembly, wherein the cleaning system comprises an arm actuator assembly adapted to operate independently of a flush actuator assembly of the toilet assembly.

[0077] Such a cleaning system may be used in a non-jetted, siphonic, gravity-powered bowl, a rim-jetted, siphonic, gravity powered bowl, or a gravity-powered, wash-down bowl. The control system may operate a flush valve in a toilet assembly that is a flapper-type flush valve with a poppet feature in the valve cover for use in opening the valve during the cleaning actuation mode. It may also operate a flush valve in a toilet assembly that is a flapper-type flush valve with a hook and catch feature for use in opening the valve during the cleaning actuation mode. It may further operate a flush valve in a toilet assembly that is a poppet-type flush valve, wherein a poppet-type valve cover opens the flush valve in a normal flush mode and the flush valve has a side port having a cover thereon for use in opening the valve during the cleaning actuation mode.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0078] The foregoing summary, as well as the following detailed description of preferred embodiments of the invention, will be better understood when read in conjunction with the appended drawings. For the purpose of illustrating the invention, there is shown in the drawings embodiments which are presently preferred. It should be understood, however, that the invention is not limited to the precise arrangements and instrumentalities shown. In the drawings:

[0079] Fig. 1 is a schematic flow diagram of a cleaning system for a toilet assembly according to an embodiment of the invention;

[0080] Fig. 2 is a perspective view of the interior of a toilet tank having flush valves for use with a cleaning system according to an embodiment of the invention and as part of a toilet assembly herein;

[0081] Fig. 3 is a perspective view of a cleaning system tank lid assembly according to an embodiment of the invention;

[0082] Fig. 3A is a perspective view of the cleaning system tank lid assembly of Fig. 3 with the control panel open

[0083] Fig. 4 is an exploded view of the embodiment of the cleaning system tank lid assembly according to Fig. 3;

CLAIMS

We claim:

1. A toilet assembly with a cleaning system, comprising:

(a) a toilet assembly configured to initiate a flush cycle comprising

a toilet bowl defining an interior space,

a toilet tank defining a tank interior,

a flush valve,

a rim inlet port and

an isolated rim flow path extending from an outlet of the flush valve to the rim inlet port, wherein the flush valve is configured to deliver fluid to the rim inlet port of the toilet bowl; and

(b) a cleaning system comprising an arm actuator assembly adapted to operate independently of a flush actuator assembly of the toilet assembly, comprising

a reservoir for holding a liquid cleaning agent having a body defining an interior space and having an outlet port in fluid communication with the interior space of the reservoir body;

a housing configured to receive the reservoir;

a supply conduit in fluid communication with the interior of the reservoir and having a first end for receiving fluid from within the reservoir;

a flow control device capable of controlling flow through the supply conduit; and

a control system activatable by an actuator feature, wherein upon activation of the actuator feature, the control system is adapted to initiate a clean cycle by:

operating the flow control device to deliver a dose of the liquid cleaning agent from the supply conduit to an interior space of the flush valve in a closed position, the flush valve configured for delivery of fluid to the rim inlet port, and

operating the flush valve to open the flush valve to introduce flush water to carry the dose of the liquid cleaning agent through the rim inlet port into the toilet bowl.

2. The toilet assembly according to claim 1, further comprising a vent line in fluid communication with the interior of the reservoir and configured to have a first end situated to

after introducing the flush water with the dose of the liquid cleaning agent; and operating the flush valve to open the flush valve again after a third period of time to purge the interior of the toilet bowl with new flush water at an end of the clean cycle.

45. A cleaning system for use with a toilet assembly, comprising

a reservoir for holding a liquid cleaning agent having a body defining an interior space and having an outlet port in fluid communication with the interior space of the reservoir body;

a housing configured to receive the reservoir;

a supply conduit in fluid communication with the interior of the reservoir and having a first end for receiving fluid from within the reservoir;

a flow control device capable of controlling flow through the supply conduit; and

a control system activatable by an actuator feature, wherein upon activation of the actuator feature, the control system is adapted to initiate a clean cycle by:

operating the flow control device to deliver a dose of the liquid cleaning agent from the supply conduit to an interior space of a closed flush valve configured for delivery of fluid to a rim inlet port of a toilet bowl, and

operating the flush valve to open the flush valve to introduce flush water with the dose of the liquid cleaning agent into the rim inlet port of a toilet bowl, wherein the cleaning system comprises an arm actuator assembly adapted to operate independently of a flush actuator assembly of the toilet assembly.

46. The cleaning system for use with a toilet according to claim 45, wherein the control system operates the flow control device for a first period of time sufficient to deliver the dose of the liquid cleaning agent from the supply conduit to the interior space of the flush valve in a closed position and operates the flush valve to open the flush valve and to introduce flush water and the liquid cleaning agent into a rim inlet port of a toilet bowl over a second period of time, and operates further to at least partially close the flush valve after delivering the flush water and the dose of the liquid cleaning agent.

47. The cleaning system for use with a toilet according to claim 45, wherein the reservoir body has an outlet portion and the outlet port is located in the outlet portion.

48. The cleaning system for use with a toilet according to claim 45, wherein the housing has a seat portion configured to receive the outlet portion of the reservoir.

49. The cleaning system for use with a toilet according to claim 48, further comprising at least one peripheral seal so that the outlet portion of the reservoir fits within the seat portion of the housing in sealing engagement.

place of a conventional tank cover and the bottom tray sits within an interior of the toilet tank above the flush valve.

59. The cleaning system for use with a toilet according to claim 46, wherein the control system is further adapted to at least partially close the flush valve after delivering the dose of the liquid cleaning agent and to open the flush valve again after a third period of time to purge an interior of the toilet bowl with new flush water at an end of the clean cycle.

60. A toilet assembly having a cleaning system, comprising:

(a) a toilet assembly configured to initiate a flush cycle, comprising

a toilet bowl defining an interior space,

a toilet tank defining a tank interior,

a flush valve, and

a rim in fluid communication with the interior of the bowl through a rim flow path extending from an outlet of the flush valve to at least one rim outlet port, wherein the flush valve is configured to deliver fluid to the at least one rim outlet port, and

wherein the flush valve is configured to operate in a flush actuation mode wherein the flush valve is able to provide flush water flow sufficient for the toilet assembly to initiate a flush siphon or provide a wash down flush and to operate in a cleaning actuation mode wherein the flush valve is only partially opened to allow for introduction of a cleaning agent and flush water mixture to the bowl that is insufficient to initiate a siphon but sufficient for cleaning the bowl; and

(b) a cleaning system comprising an arm actuator assembly adapted to operate independently of a flush actuator assembly of the toilet assembly, comprising

a reservoir for holding a liquid cleaning agent having a body defining an interior space and having an outlet port in fluid communication with the interior space of the reservoir body;

a housing configured to receive the reservoir;

a supply conduit in fluid communication with the interior of the reservoir and having a first end for receiving fluid from within the reservoir;

a flow control device capable of controlling flow through the supply conduit; and

a control system activatable by an actuator feature, wherein upon activation of the actuator feature, the control system is adapted to initiate a clean cycle by:

and the flush valve has a side port having a cover thereon for use in opening the valve during the cleaning actuation mode.

72. A method for periodically cleaning a toilet in a toilet assembly with a cleaning system that operates independently of a flush cycle of the toilet assembly, the method comprising

providing the toilet assembly according to claim 60;

activating the control system by the actuator feature to initiate the clean cycle;

operating the flow control device and opening it for a first period of time sufficient to deliver at least one dose of the liquid cleaning agent from the supply conduit to an interior space of the flush valve in a closed position; and

operating the flush valve to open the flush valve to introduce flush water along with the at least one dose of the liquid cleaning agent through the at least one rim outlet port into the toilet bowl at a flow rate insufficient to initiate a siphon but sufficient for cleaning a toilet bowl in the toilet assembly.

73. A cleaning system for use with a toilet assembly, comprising

a reservoir for holding a liquid cleaning agent having a body defining an interior space and having an outlet port in fluid communication with the interior space of the reservoir body;

a housing configured to receive the reservoir;

a supply conduit in fluid communication with the interior of the reservoir and having a first end for receiving fluid from within the reservoir;

a flow control device capable of controlling flow through the supply conduit; and

a control system activatable by an actuator feature, wherein upon activation of the actuator feature, the control system is adapted to initiate a clean cycle by:

operating the flow control device for a first period of time sufficient to deliver a dose of the liquid cleaning agent from the reservoir to the at least one rim outlet port of a toilet assembly, and

operating a flush valve in the toilet assembly in a cleaning actuation mode to open a flush valve in the toilet assembly so as to introduce flush water to carry the dose of the liquid cleaning agent through the at least one rim outlet port of the toilet assembly into a toilet bowl of the toilet assembly at a flow rate insufficient to initiate a siphon but sufficient for cleaning a toilet bowl in the toilet assembly, wherein the cleaning system comprises an arm

actuator assembly adapted to operate independently of a flush actuator assembly of the toilet assembly.

74. The cleaning system according to claim 73, wherein the cleaning system is for use in a non-jetted, siphonic, gravity-powered bowl.

75. The cleaning system according to claim 73, wherein the cleaning system is for use in a rim-jetted, siphonic, gravity powered bowl.

76. The cleaning system according to claim 73, wherein the cleaning system is for use in a gravity-powered, wash-down bowl.

77. The cleaning system according to claim 73, wherein the control system operates a flush valve in the toilet assembly that is a flapper-type flush valve with a poppet feature in a valve cover for use in opening the valve during the cleaning actuation mode.

78. The cleaning system according to claim 73, wherein the control system operates a flush valve in the toilet assembly that is a flapper-type flush valve with a hook and catch feature for use in opening the valve during the cleaning actuation mode.

79. The cleaning system according to claim 73, wherein the control system operates a flush valve in the toilet assembly that is a poppet-type flush valve, wherein a poppet-type valve cover opens the flush valve in a normal flush mode and the flush valve has a side port having a cover thereon for use in opening the valve during the cleaning actuation mode.

80. The toilet assembly according to claim 1, wherein the control system operates the flush valve to open the flush valve to introduce at least 3 liters or more of flush water to carry the dose of the liquid cleaning agent through the rim inlet port into the toilet bowl.

81. The method according to claim 41, wherein the flush valve is operated to open the flush valve and introduce at least 3 liters of flush water along with the dose of the liquid cleaning agent through the rim inlet port and into the toilet bowl.