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 that operates independently of the flush cycle 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, 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 into the toilet bowl.

[0033] The assembly may further include a vent line within the cleaning system. If a vent line is provided, it is preferably configured to be in fluid communication with the interior of the reservoir and 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.

[0034] The control system in the assembly cleaning system may also operate to at least partially close the flush valve after delivering the dose of a liquid cleaning agent and flush water through the rim inlet and into the toilet bowl. In addition the control system may operate the flush valve to deliver the dose of a liquid cleaning agent and flush water over a second period of time.

[0035] The reservoir body preferably has an outlet portion and the outlet port is located in the outlet portion. The housing may also have a seat portion configured to receive the outlet portion of the reservoir. The cleaning 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.

[0036] In an embodiment herein, the system may include a tube that defines a passage therethrough and has an upwardly extending first end and a second end. The first end is configured 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. A vent line as described above may be incorporated into the embodiment having a tube within the cleaning system. In such case, the seat portion may comprise a first opening for receiving the first end of the vent line and 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 preferably be situated within the second end of the tube when the reservoir is situated within the housing. The tube may also be situated within the seat portion so that when the outlet portion

liquid cleaning agent into a bottom of the flush valve, or to introduce a dose of a liquid cleaning agent into the toilet bowl through an opening in a rim flow path upstream of the rim inlet.

[0057] The invention also includes a method for periodically cleaning a toilet in a toilet assembly with a cleaning system that operates independently of a flush of the toilet assembly, the method comprising providing the toilet assembly as described above and elsewhere herein, activating the control system by the actuator feature to initiate the clean cycle; operating the flow control device and opening it 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 operating the flush valve to open the flush valve and introduce flush water along with the dose of the liquid cleaning agent through the rim inlet and into the toilet bowl.

[0058] The toilet assembly in the method preferably further includes a direct-fed jet, the flush valve is a rim flush valve and the toilet assembly further comprises a second flush valve operable for introducing flush water to the direct-fed jet in the toilet. The toilet assembly in the method preferably also has a fluid path for the rim flush valve is isolated from the jet flush valve. Preferably, in such an embodiment, the jet flush valve remains in a primed state before and after a flush cycle. The control system in the assembly provided in the method preferably operates to introduce the flush water and the dose of a liquid cleaning agent over the second period of time, and the method further comprises operating the flush valve to at least partially close the flush valve after introducing the flush water with the dose of a 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 a toilet bowl with new flush water at an end of the clean cycle.

[0059] The invention also includes 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 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 operates independently of a flush cycle 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 that operates independently of the flush cycle 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.

[0073] In one particular embodiment of this assembly, the bowl may be a direct-fed jet, siphonic, gravity-powered bowl. The bowl may alternatively be a rim-fed jetted siphonic bowl, a non-jetted siphonic gravity-powered bowl or a gravity-powered wash-down bowl.

[0074] Further, in an alternative embodiment of this assembly, the flush valve may be a flapper-type flush valve with a poppet feature in the valve cover for use in opening the valve during the cleaning actuation mode. Alternatively, the flush valve may be a flapper-type flush valve with a hook and catch feature for use in opening the valve during the cleaning actuation mode. In yet another embodiment, the flush valve may be 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.

[0075] Such a toilet assembly embodiment may also be used in a method for periodically cleaning a toilet in a toilet assembly with a cleaning system. The method comprises providing a toilet assembly as noted above, which may be used on various conventional toilet assembly configurations; activating the control system by the actuator feature to initiate the clean cycle; operating the flow control device and opening it for the first period of time sufficient to deliver at least one dose of a liquid cleaning agent from the supply conduit to an interior space of a 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 a 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 a toilet assembly.

[0076] A further embodiment of the invention based on the above-noted embodiment suitable for use in various conventional toilet designs includes 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 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 operates independently of a flus cycle 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 that operates independently of the flush cycle 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

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.

3. The toilet assembly according to claim 1, wherein the control system operates to at least partially close the flush valve after delivering the dose of the liquid cleaning agent and flush water through the rim inlet port and into the toilet bowl.

4. The toilet assembly according to claim 1, 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 to deliver the dose of the liquid cleaning agent and flush water through the rim inlet port into the toilet bowl over a second period of time.

5. The toilet assembly according to claim 1, wherein the reservoir body has an outlet portion and the outlet port is located in the outlet portion.

6. The toilet assembly according to claim 5, wherein the housing has a seat portion configured to receive the outlet portion of the reservoir.

7. The toilet assembly according to claim 6, 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.

8. The toilet assembly according to claim 6, having a 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.

9. The toilet assembly according to claim 6, wherein the assembly further comprises 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.

10. The toilet assembly according to claim 9, having a 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, and wherein the seat portion comprises a first opening for receiving the first end of the vent line and a second opening for receiving the first end of the supply conduit.

11. The toilet assembly according to claim 9, wherein the first end of the tube is pointed.

12. The toilet assembly according to claim 9, wherein the first end of the supply conduit is situated within the second end of the tube when the reservoir is situated within the housing.

13. The toilet assembly according to claim 9, wherein the tube is 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.

14. The toilet assembly according to claim 9, wherein the tube comprises at least one side opening extending therethrough for fluid entering the upwardly extending end of the tube to flow into a bottom area of the outlet portion.

15. The toilet assembly according to claim 14, wherein the outlet port has a frangible seal capable of being penetrated by the upwardly extending end of the tube, wherein the bottom area of the outlet portion is defined as an area below a peripheral seal when the reservoir is fully seated within the housing, and wherein the upwardly extending end of the tube or the liquid supply valve fitting passes through the frangible seal when the reservoir is fully seated within the housing.

16. The toilet assembly according to claim 1, wherein the flow control device is one of a mechanized valve, a peristaltic pump, a piston pump, a gear pump, and a gear motor.

17. The toilet assembly according to claim 1, wherein the outlet port of the reservoir is covered by a frangible cover.

18. The toilet assembly according to claim 17, wherein the frangible cover comprises a foil, a septum, a foil with a polymeric backing, or a membrane.

19. The toilet assembly according to claim 1, further comprising a gear motor activatable by the control system for operating the flow control device.

20. The toilet assembly according to claim 1, further comprising a tank lid having an upper surface and configured to be seated on top of the tank, wherein the upper surface of the tank lid is configured to receive the housing and includes an area configured to receive a seat portion of the housing.

21. The toilet assembly according to claim 20, wherein the tank lid further comprises at least one opening extending therethrough configured for receiving a lock mechanism.

22. The toilet assembly according to claim 21, wherein the lock mechanism comprises at least one lock body having a first end and a second end, the second end for extending through

the at least one opening, wherein the lock mechanism further comprises a locking cap on the first end of the lock body for releasably locking the lock mechanism to secure the tank lid.

23. The toilet assembly according to claim 21, further having a cover configured to be positioned over the tank lid and housing and having an opening therein for accessing a panel having an actuator button thereon.

24. The toilet assembly according to claim 22, wherein the tank lid further comprises an actuator opening extending therethrough for allowing extension of at least a portion of a lift arm actuator assembly comprising at least one gear actuated by a lift arm actuator gear motor, wherein the at least one gear is capable of engaging a lift arm to move the lift arm and controllably open a rim flush valve, wherein the lift arm is in operable connection to the flush valve through a direct or indirect linkage.

25. The toilet assembly according to claim 24, wherein the lift arm is also in operable connection with a flush handle and the flush handle and lift arm are connected so as to operate the flush valve during a flush cycle upon depression of the flush handle, and the lift arm actuator assembly is arranged so as to operate the flush valve without depression of the flush handle by operation of the lift arm actuator gear motor and the at least one gear.

26. The toilet assembly according to claim 1, further comprising a bottom tray configured to hold the reservoir and housing, and a top lid, wherein the bottom tray and top lid are configured to as to be positioned on a top of the toilet tank so that the top lid sits in place of a standard tank cover and the bottom tray sits within the interior of the tank above the flush valve.

27. The toilet assembly according to claim 1, further comprising a flush valve operation mechanism for controllably opening the flush valve in response to the actuator feature.

28. The toilet assembly according to claim 27, wherein the flush valve operation mechanism comprises a lift rod in communication with a linkage connected to a flapper lift mechanism seated around a valve body of the flush valve, the lift rod being mechanically actuated by a gear motor, and the gear motor being mechanically operative with a cam mechanism for moving the lift rod upon contact.

29. The toilet assembly according to claim 27, wherein the flush valve operation mechanism comprises a lift arm actuator assembly comprising at least one gear actuated by a lift arm actuator gear motor, wherein the at least one gear of the lift arm actuator assembly is capable of engaging the lift arm actuator assembly so as to move a portion of a lift arm in the lift arm

actuator assembly so that the lift arm can controllably open a rim flush valve, wherein the lift arm is in operable connection to the rim flush valve through a direct or indirect linkage.

30. The toilet assembly according to claim 4, wherein the control system is further adapted to at least partially close the flush valve after delivering the flush water with 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 at least 3 liters of new flush water at an end of the clean cycle.

31. The toilet assembly according to claim 30, wherein the flush valve is a rim flush valve and the toilet further comprises a direct-fed jet, a jet flush valve and a separate jet flow path and the control system operates to open the jet flush valve to release at least 1.0 liter of flush water to the jet path at about the same time a rim channel re-opens to introduce flush water to purge the toilet bowl.

32. The toilet assembly according to claim 1, further comprising a liquid supply valve positioned so as to be situated in fluid communication with the outlet port of the reservoir and in fluid communication with the supply conduit.

33. The toilet assembly according to claim 32, wherein the reservoir body has an outlet portion and the outlet port is located in the outlet portion, the housing has a seat portion configured to receive the outlet portion of the reservoir when the reservoir is seated in the housing, and wherein the liquid supply valve defines a valve passage therethrough and the liquid supply valve has a first upper end for directing fluid from the interior space of the reservoir through the valve passage and into the first end of the supply conduit and the liquid supply valve has a second end.

34. The toilet assembly according to claim 33, further comprising a valve fitting in communication with the second end of the liquid supply valve for connecting the second end of the liquid supply valve to the first end of the supply conduit.

35. The toilet assembly according to claim 34, wherein the liquid supply valve is one of an umbrella valve, a duckbill valve, a spring loaded valve, a rotating valve, a vented elastomeric valve, and a flap elastomeric valve.

36. The toilet assembly according to claim 32, wherein the liquid supply valve comprises a first mechanized valve and a second mechanized valve, and the assembly further comprises a dosing chamber configured to retain the dose of the liquid cleaning agent from within the interior space of the reservoir, the dosing chamber defining an interior space, having an inlet port and having an outlet port, wherein the inlet port of the dosing chamber is in fluid communication with an outlet port of the first mechanized valve and the outlet port of the

dosing chamber is in fluid communication with an inlet of the second mechanized valve, and wherein an outlet of the second mechanized valve is in fluid communication with the first end of a supply conduit.

37. The toilet assembly according to claim 1, wherein the toilet assembly further includes a direct-fed jet, the flush valve is a rim flush valve and the toilet assembly further comprises a second flush valve operable for introducing flush water to the direct-fed jet in the toilet assembly.

38. The toilet assembly according to claim 37, wherein the fluid path for the rim flush valve and the second flush valve are separate from each other and the second flush valve remains in a primed state before and after a flush cycle.

39. The toilet assembly according to claim 38, wherein a second end of the supply conduit is positioned to deliver fluid into an interior of an overflow tube connected to the rim flush valve.

40. The toilet assembly according to claim 1, wherein the actuator feature is a button positioned under a top lid and accessible through an opening in the top lid.

41. 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 1;

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 the dose of the liquid cleaning agent from the supply conduit to the interior space of the flush valve in a closed position; and

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

42. The method according to claim 41, wherein the toilet assembly further includes a direct-fed jet, the flush valve is a rim flush valve and the toilet assembly further comprises a second flush valve operable for introducing flush water to the direct-fed jet in the toilet.

43. The method according to claim 42, wherein the fluid path for the rim flush valve is isolated from the second flush valve and the second flush valve remains in a primed state before and after a flush cycle.

44. The method according to claim 43, wherein the control system operates to introduce the flush water and the dose of the liquid cleaning agent over a second period of time, and the method further comprises operating the flush valve to at least partially close the flush valve

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 a 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 operates independently of a flush cycle 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.

50. The cleaning system for use with a toilet according to claim 47, wherein the outlet port of the reservoir has a frangible seal capable of being penetrated by the upwardly extending end of a tube, wherein the bottom area of an outlet portion is defined as an area below a peripheral seal when the reservoir is fully seated within the housing, and wherein the upwardly extending end of the tube or the liquid supply valve fitting passes through the frangible seal when the reservoir is fully seated within the housing.

51. The cleaning system for use with a toilet according to claim 45, wherein the flow control device is one of a mechanized valve, a peristaltic pump, a piston pump, a gear pump or a gear motor.

52. The cleaning system for use with a toilet according to claim 51, wherein the flow control device comprises a gear motor activatable by the control system for operating the flow control device.

53. The cleaning system for use with a toilet according to claim 45, wherein the outlet port of the reservoir is covered by a frangible cover.

54. The cleaning system for use with a toilet according to claim 53, wherein the frangible cover comprises a foil, a septum or a membrane.

55. The cleaning system for use with a toilet according to claim 45, comprising a lift arm actuator assembly comprising at least one gear actuated by a lift arm actuator gear motor, wherein the at least one gear is capable of engaging the lift arm actuator assembly so as to move a lift arm in the lift arm assembly so that the lift arm can controllably open the flush valve, wherein the lift arm is in operable connection to the flush valve through a direct or indirect linkage.

56. The cleaning system for use with a toilet according to claim 55, further comprising a gear motor housing for enclosing the gear motor and mounting the at least one gear, the gear motor housing being configured so as to be positioned within a toilet tank and to extend upwardly through at least one opening in the housing for the reservoir.

57. The cleaning system for use with a toilet according to claim 56, wherein the housing has a mounting flange for securing the gear motor housing to the reservoir housing or to a tray configured to hold the reservoir and the reservoir housing.

58. The cleaning system for use with a toilet according to claim 45, further comprising a bottom tray configured to hold the reservoir and housing, and a top lid, wherein the bottom tray and top lid are configured to as to be positioned on a top of a toilet tank so that the top lid sits in

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 that operates independently of the flush cycle 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.

61. The toilet assembly according to claim 60, wherein the flush valve introduces flush water at a flow rate that is 20% to 80% slower in the cleaning actuation mode than the flow rate through the flush valve during a normal flush mode.

62. The toilet assembly according to claim 61, wherein the flush valve introduces flush water at a flow rate that is 40% to 60% slower in the cleaning actuation mode than the flow rate through the flush valve during the normal flush mode.

63. The toilet assembly according to claim 61, wherein flush water enters the valve in the flush actuation mode over a period of 2 s to 30 s.

64. The toilet assembly according to claim 63, wherein flush water and cleaning agent are introduced into the bowl and have a residence time of 30s to 30 min. for cleaning the bowl.

65. The toilet assembly according to claim 60, wherein the bowl is a direct-fed jet, siphonic, gravity-powered bowl.

66. The toilet assembly according to claim 60, wherein the bowl is a non-jetted, siphonic, gravity-powered bowl.

67. The toilet assembly according to claim 60, wherein the bowl is a rim-jetted, siphonic, gravity powered bowl.

68. The toilet assembly according to claim 60, wherein the bowl is a gravity-powered, wash-down bowl.

69. The toilet assembly according to claim 60, wherein the flush valve 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.

70. The toilet assembly according to claim 60, wherein the flush valve is a flapper-type flush valve with a hook and catch feature for use in opening the valve during the cleaning actuation mode.

71. The toilet assembly according to claim 60, wherein the flush valve 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.

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 operates independently of a flush cycle 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 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.

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.