

Invention Title: **Waterless Toilet Flushing System**

DESCRIPTION:

Field of Invention:

The present invention discloses features of the Waterless Toilet Flushing System, an alternative to conventional water and vacuum-based flushing systems, that operate entirely on compressed air to flush the toilet, saving water and supporting sustainability.

Background:

Toilet flushing is one of the primary and major household water usage globally. Older toilets use 13 to 14 liters per flush, while modern toilets use 4 to 6 liters per flush, and the average flush per person is 5 times. It is estimated that 57% of the global population (about 4.68 billion people) use safely managed toilets with the flushing system. So, the estimated global water use for toilet flushing is, assuming an average of 6 liters per flush and 5 flushes per person per day by 4.68 billion people, 140.4 billion liters (or 37.07 billion US gallons) or 1684.8 billion liters per year (or 444.86 billion US gallons).

The current toilet flushing system works with a sudden surge of water that creates a siphon effect in the trap-way (the curved pipe under the bowl). This siphon pulls waste and water down into the drainpipe. To trigger the siphon effect in a toilet, about 1.6 to 2.0 gallons (6 to 7.5 liters) of water must be released rapidly from the tank into the bowl. If the water volume is too low or released too slowly, the siphon won't form, and the flush will not be completed properly.

Modern toilets are optimized for water conservation while maintaining effective flushing, offering two flush volumes for liquid and solid waste. But it still requires 0.8 to 1 gallon of water to flush the waste out. Due to the low volume of water used for flushing in modern toilets, some users may prefer to flush again after noticing the waste sticking on the ceramic surfaces to ensure the toilet bowl is completely clean.

It is known that the top water-consuming sectors for toilet flushing are Airports, Stadiums, Event Venues, Shopping Malls, Hospitals, Hotels and Resorts, Universities and Schools, Office Buildings, Factories, and Industrial Buildings.

Global warming is creating many issues, such as Drought and Water Scarcity, Heat Stress and Pathogen Growth, Disruption of Wastewater Treatment, and Greenhouse Gas Emissions from Sanitation. Water scarcity has severe, far-reaching effects on both agriculture and livestock, threatening food security, rural livelihoods, and global supply chains.

Over-extraction of water from transboundary rivers that cross or form borders between countries can lead to serious geopolitical, environmental, and humanitarian issues. Over-

extraction of groundwater through excessive borewell drilling can also lead to serious environmental, social, and economic consequences.

Various types of waterless toilet systems use no water for flushing. These types include composting toilets that use dry material to cover waste, and modern electric models that use a bag system to seal waste and prevent odour automatically. These are often used in off-grid situations, for recreational vehicles, or where water and sewage connections are unavailable. Still, they do not help reduce flushing water consumption across all sectors.

Flushing a toilet without closing the lid can raise hygiene and environmental concerns by releasing microscopic particles into the air. Flushing creates a toilet plume—a burst of tiny droplets that can rise to 1.5 meters (5 feet) into the air. These droplets may contain bacteria, viruses, and fecal particles, contaminating nearby surfaces like toothbrushes, towels, and sinks. Also, open flushing can spread unpleasant odors throughout the room, and more frequent cleaning is required to address surface contamination, especially in public toilets.

Sustainable development across all other sectors is steadily growing, but the Sanitation sector is still lagging.

Summary of Invention:

Therefore, to overcome the above issues, the present invention discloses a solution: a Waterless Toilet Flushing System that operates entirely on compressed air to flush the toilet without using flushing water.

To achieve pneumatic air flushing without water, the toilet seat and lid are designed with soft rubber gaskets fitted at the bottom to provide a pressure-tight seal around the toilet bowl. A slam-to-close and push-to-open latch is added at the edge of the lid to hold it tightly during pressurization. A compressed air system is added to flush the waste by injecting compressed air into the toilet bowl from the outside. A refill water system is added to the toilet to refill the trapway with water immediately after air flushing, forming a barrier to prevent sewer gas from entering the bathroom from the main pipe. A couple of sensors are added to detect the user's presence and monitor the toilet condition. A control panel is added to run the air compressor and refill systems and interact with building automation and the wireless network. A display screen is added to interact with the user and show the toilet's condition. A power connection is added to run the entire waterless toilet flushing system.

The same system can also be used in the existing toilets after installing a new seat and lid with a soft rubber gasket at the bottom, and a slam-to-close and push-to-open latch at the edge of the lid to keep the toilet bowl pressure tight. The lid should also be designed with an airway and a pneumatic air chamber with a perforated plate at its bottom to inject the compressed air into the toilet bowl. The lid will also have ports for connecting the compressed air pipe and a pressure

transmitter. It is also required to modify the existing flushing system to stop the flushing function and to refill the trap seal with a minimum quantity of water. A control system must be added to the existing toilet as well.

The Waterless Toilet Flushing System can be configured to operate as a standalone unit for a single toilet, as part of a centralized system for multiple toilets, to interact with a building automation system with wireless networking.

Explanation of symbols

DESCRIPTION OF SYMBOLS: Toilet [100], Trap-way [101] Toilet Seat [102], Toilet Seat Operating Mechanism [102A], Toilet Lid [103] Toilet Lid Operating Mechanism [103A], Pneumatic Air Chamber c/w Perforated Plate [103B], Common passageway for the Pneumatic Air and Refill Water [104], Soft Rubber Gasket [105], Slam-to-close and Push-to-open Latch [106] Air Compressor [200], Air Compressor Motor [200A], Control Valve before Pneumatic Air Chamber [201], Pneumatic Air Chamber [202], Control Valve after Pneumatic Air Chamber [203], Pressure Relief Valve [204], Pressure transmitter [205], Pneumatic Air Piping [206], Flexible Air Hose [207] Domestic Water Supply Line [300] Refill Tank [301], Control Valve for Automatic Refill [302], Manual Filling Port [303], Spray Gun [304], Manual Refilling Push Button [305] Control Panel, Sensors, Display Screen and a power source [400], Sensor in Lid [401] Air cylinder [500], Piston with seal [501], Piston pulling wire [502], Rolling wheels [503], Rope pulling handle [504], Piston Stoppers [505], Non Return Valve [506], Vacuum Breaker [507], Weep hole [508].

Brief Description of the Drawings

The disclosure is herein described only through examples, with reference to the accompanying drawings. With specific reference now to the drawings in detail, it is stressed that the particulars shown are by way of example and for purposes of illustrative discussion of the preferred embodiments of the present disclosure only and are presented to provide what is believed to be the most helpful and readily understood description of the principles and conceptual aspects of the disclosure. In this regard, no attempt is made to show structural details of the disclosure in greater detail than is necessary for a fundamental understanding of the disclosure; the description, taken with the drawings, makes apparent to those skilled in the art how the several forms of the disclosure may be embodied in practice. In the drawings:

Figure 1: Control Diagram of Waterless Toilet Flushing System for New Toilet

Figure 2: Control Diagram of Waterless Toilet Flushing System for Existing Toilet

Figure 3: Detail Drawing of New Toilet with Waterless Toilet Flushing System

Figure 4: Detail Drawing of New Toilet with Waterless Toilet Flushing System with seat and lid in open position

Figure 5: Detail Drawing of Existing Toilet with Waterless Toilet Flushing System

Figure 6: Detail Drawing of Existing Toilet with Waterless Toilet Flushing System with seat and lid in open position

Figure 7: Flow Diagram of the Waterless Toilet Flushing System

Figure 8: Diagram of Centralized Waterless Toilet Flushing System for New Toilet

Figure 9: Diagram of Centralized Waterless Toilet Flushing System for Existing Toilet

Figure 10: Drawing of Existing Toilet with Compressed Air Flushing System through manual operation of the Air Cylinder via Piston.

Detailed Description of Preferred Embodiments

The following description provides the modus operandi of the Waterless Toilet Flushing System.

Figure 1 shows the control diagram of the waterless toilet flushing system for new toilets, which is comprising of Toilet [100], Trap-way [101] Toilet Seat [102], Toilet Seat Operating Mechanism [102A], Toilet Lid [103] Toilet Lid Operating Mechanism [103A], Pneumatic Air Chamber c/w Perforated Plate [103B], Common passageway for the Pneumatic Air and Refill Water [104], Soft Rubber Gasket [105], Slam-to-close and Push-to-open Latch [106] Air Compressor [200], Air Compressor Motor [200A], Control Valve before Pneumatic Air Chamber [201], Pneumatic Air Chamber [202], Control Valve after Pneumatic Air Chamber [203], Pressure Relief Valve [204], Pressure transmitter [205], Pneumatic Air Piping [206], Flexible Air Hose [207] Domestic Water Supply Line [300] Refill Tank [301], Control Valve for Automatic Refill [302], Manual Filling Port [303], Spray Gun [304], Manual Refilling Push Button [305] Control Panel, Sensors, Display Screen and a power source [400] and Sensor in Lid [401] for practical pneumatic air flushing function.

The diagram shows four major systems:

The first system is the Toilet [100] assembly with a Seat [102] and its Power-operated System [102A]; the Toilet Lid [103] and its Power-operated System [103A]; Slam-to-close and Push-to-open Latch [106], which is installed on the Toilet Lid, and the Pressure Transmitter [205]. The Toilet [100] has an in-built trap seal and a Common Passageway for the Pneumatic Air and Refill Water [104]. The Refill Water Tank [301] and Pneumatic Air Chamber [202] can be an integral part or installed separately.

The second system is a Compressed Air System, which comprises, Air Compressor [200], Air Compressor Motor [200A], Control Valve before Pneumatic Air Chamber [201], Pneumatic Air Chamber [202], Control Valve after Pneumatic Air Chamber [203], Pressure Relief Valve [204], Pressure transmitter [205], Pneumatic Air Piping [206] and Flexible Air Hose [207]

The third system is a Water Refill System, which comprises a Domestic Water Supply Line [300], a Refill Tank [301], a Control Valve for Automatic Refill [302], a Manual Filling Port [303], a Spray Gun [304], and a Manual Refilling Push Button [305]. The Control Valve for Automatic Refill [302] which will also prevent compressed air from entering the refilling system. A Manual Filling Port is added in the Water Refill Tank as a standby to run the toilet system during a water outage.

The fourth system is a Control system, which comprises a Control Panel, Sensors, a Display Screen, a power source [400], and a Sensor in the Lid [401]. The Control system will be connected to the power system, the building automation system, and the wireless network in the centralized waterless flushing system.

The entire system is configured to detect the presence of the user in front of the toilet, to prerinse the toilet bowl, to open and close the toilet seat and lid, to start and stop the air compressor system, to pressurize the toilet bowl chamber and hold it pressure tightly, to flush the waste by injecting compressed air into the toilet bowl, to refill the trapway with water to form a barrier to prevent sewer gas from entering the bathroom from the main pipe, to sense the toilet bowl condition and show the status through the display screen to the users.

Figure 2 shows the control diagram of the waterless toilet flushing system for existing toilets. It has the same four systems as described in Figure 1, except for a few changes in some parts as described below.

The compressed air piping will be connected to the Toilet Lid [103] through a Flexible Air Hose [207]. The lid will have an in-built air passageway and a pneumatic chamber complete with a perforated plate at its bottom to inject the compressed air into the toilet bowl.

The existing Flushing Tank should be reconfigured only for automatic refilling of the seal trap with a Control Valve for Automatic Refill [302] to prevent compressed air from entering the refilling system.

The entire system is configured to detect the presence of the user in front of the toilet, to prerinse the toilet bowl, to open and close the toilet seat and lid, to start and stop the air compressor system, to pressurize the toilet bowl chamber and hold the pressure tight in order to flush the waste by injecting compressed air into the toilet bowl, to refill the trapway with water to form a barrier to prevent sewer gas from entering the bathroom from the main pipe, to sense the toilet bowl condition and show the status through the display screen to the users.

Figure 3 shows a sectional and plan view of the waterless toilet flushing system for the new toilet. A new toilet bowl design is being considered for this system to optimize overall design and increase efficiency. Pneumatic air will be connected directly to the body of the Toilet Pneumatic Air Chamber [202] and injected through the common passageway [104] of the toilet bowl. The flushing tank can be resized smaller and be considered as refilling tank with less water capacity

only to refill the trap seal. The trap seal design can be changed to a larger diameter/area [D1] in the inlet and a smaller diameter/area [D2] in the outlet to create greater pressure within the toilet bowl, facilitating effective push-out of waste.

The Toilet Lid [103] is fitted with a Soft Rubber Gasket [105] at its bottom to rest on the toilet seat without an air gap, providing a pressure-tight seal when closed tightly. The Slam-to-close and Push-to-open Latch [106] is installed at the edge of the toilet lid to provide tight closure and maintain a pressure-tight chamber for compressed-air flushing. It can be configured with a power-operated mechanism [103A] or with a manual operation method. The pressure transmitter [205] will be connected to the lid to monitor pressure buildup within the toilet bowl and to activate the Pressure Relief Valve [204] in the event of a choke in the trap seal.

Figure 4 shows the general arrangement of a new waterless Toilet Flushing System in an open position of the seat and lid, clearly illustrating the assembly of the parts.

Figure 5 shows a sectional and plan view of the waterless toilet flushing system for the existing toilet. As shown in the plan view, the toilet lid [103] will have a pneumatic air chamber c/w perforated plate [103B] for compressed air injection into the toilet bowl. The flexible air hose [207] is considered to connect the air compressor piping with the toilet lid because it is a rotating part. The lid will also include a pressure transmitter [205] as shown in Figure 2, to monitor pressure buildup within the toilet bowl and to activate the Pressure Relief Valve [204] in the event of a choke in the trap seal.

Figure 6 shows the general arrangement of an existing Toilet with a waterless Toilet Flushing System in an open position of the seat and lid, clearly illustrating the assembly of the parts.

Figure 7 shows the flow diagram of the waterless toilet flushing system, clearly illustrating its function.

Figure 8 shows a conceptual schematic diagram of the centralized waterless toilet flushing system for new toilets. The system will have a common pneumatic air system with a standard air intake chamber, an air filtration unit, an air compressor, an air receiving tank, and pneumatic air piping directly connected to the toilet. This system will interact with the building automation system and communicate with wireless network systems.

Figure 9 shows the conceptual schematic diagram of the centralized waterless toilet flushing system for existing toilets. The system will also have a common pneumatic air system with a standard air intake chamber, an air filtration unit, an air compressor, an air receiving tank, and pneumatic air piping connected to the toilet lid of the existing toilets. This system will interact with the building automation system and communicate with wireless network systems.

Figure 10 shows a drawing of an existing toilet with a manual pneumatic flushing system with additional parts Air cylinder [500], Piston with seal [501], Piston pulling wire [502], Rolling wheels

[503], Rope pulling handle [504], Piston Stoppers [505], Non-Return Valve [506], Vacuum Breaker [507], Weep hole [508].

The operation principle of this toilet is that the user needs to close the toilet lid tightly after finishing business, then pull the piston-pulling handle to manually inject compressed air into the toilet bowl to flush the waste into the system with the help of all other parts shown in the drawing.

Claims:

In this Invention, a **Waterless Toilet Flushing System**, the claims are as follows:

1. The waterless toilet flushing system, an alternative to conventional water and vacuum-based flushing systems, comprises a toilet, a power operated seat and a lid, each fitted with a soft rubber gasket at its bottom, a slam-to-close and push-to-open latch installed at the edge of the lid, a compressed air system, a refill water system, a hand spray gun, sensors, control panel, a display screen to interact with the user, and power connection to perform the following functions: to detect the presence of the user in front of the toilet, to prerinse the toilet bowl, to open and close the toilet seat and lid, to start and stop the air compressor system, to pressurize the toilet bowl chamber and hold it pressure tight, to flush the waste by injecting compressed air into the toilet bowl, to refill the trapway with water to form a barrier to prevent sewer gas from entering the bathroom from the main pipe, to sense the toilet bowl condition and show the status through the display screen to the users.
2. The system, as claimed in Claim 1, can be configured to work as a standalone system for a single toilet, to work with a centralized system for multiple toilets, to interact with a building automation system, and to communicate with wireless network systems.
3. The system, as claimed in Claim 1, can be implemented in the existing toilets and bidets after changing the seat with a soft rubber gasket at its bottom, changing the lid with a pneumatic air chamber complete with a perforated plate at its bottom, adding a soft rubber gasket to the lid's bottom, and adding ports to connect the compressed air pipe, a pressure transmitter, and modifying the existing flushing system, including its sensors.
4. The system, as claimed in Claim 1, can be designed to operate manually with conventional mechanical components without the assistance of electronic instruments and controls, sensors, and electricity.
5. The system, as claimed in Claim 1, can be configured to include other ancillary systems such as a dedicated nozzle for prerinsing the toilet bowl, seat cover heating, an in-built anal washing jet nozzle, and drying up the anal & genital parts by blowing dry air.