

Water closet

The present invention refers to a water closet, briefly "WC" in the following.

WCs having a WC-bowl, a flushing water supply therefore and a drain for the wastewater being typically connected via a siphon are commonly used and known. Recently, mainly additional features like shower means, odor-extraction, and the like became a subject of technological development.

A WC has a WC body which comprises in particular a hollow form being open to the top, namely the WC bowl which is typically made of a ceramic material, even though the latter does not apply necessarily. Further technical means can be provided in the ceramic part of the WC body or also in attached parts or behind/under covers at the ceramic body.

Above or at an upper inner rim of the WC bowl, a conventional WC body comprises a so-called flush rim, namely a circumferential flushing water channel having entry openings pointing downwards for the influx of the flushing water into the WC bowl; as regards the supply of the flushing water to the bowl, the flush rim works comparably to a ring-shaped shower. Furthermore, WCs having a rotating flushing water flow in the WC bowl are known, wherein a vortical flow in the bowl prior to the exit of the flushing water through the siphon and the wastewater drain is caused by a basically tangential entry of the flushing water into the bowl.

The technical problem of the present invention is to provide a WC being improved with respect to the water flushing.

This problem is solved by a water closet having a bowl and a flushing water supply which ends in an entry opening into said bowl, wherein the flushing water supply and the entry opening are adapted to allow the flushing water to flow into the bowl with a preponderant tangential velocity component with respect to the inner shape of the bowl and to perform a rotational movement in the bowl, characterized in that the inner shape of the bowl has, even apart from flushing water afflux openings, an asymmet-

rical form with respect to a first vertical center plane which defines a flow path for the flushing water, which flow path is located deeper on one side of the center plane than on the other side and superimposes a downward movement caused by the inner shape of the bowl onto a rotational flushing water movement, thus.

In addition, the invention refers to a corresponding use of the WC and to a WC-installation comprising a WC and a cistern.

Preferred embodiments are provided in the dependent claims and explained in further detail below. Therein, all features shall be disclosed with respect to all types of claims.

A basic idea of the invention is to generate a rotational movement of the flushing water in the WC bowl and, therein, add already a vertical (axial with respect to the rotation) component of movement pointing downwards, which is caused by the inner shape of the bowl. Known WC bowls adapted for a rotational movement of the flushing water have an inner shape of the bowl being quite adapted to the rotational flow. However, the vertical water movement downwards is caused by gravity and not by the inner shape of the bowl.

However, the inventors found that, to achieve an effective flushing, in particular with a small quantity of flushing water, not only a rotational flow cleaning the inner faces of the bowl is of interest, but also a pronounced vertical velocity component. In other words, the flushing water shall advantageously have a "momentum" for the passage through the drain and in particular through the siphon providing an air trap.

Consequently, according to the invention, a bowl with an asymmetrical inner shape is provided, which defines or generates a downward movement comparable to a helical line by locating a region important for the flushing water flow deeper on one side (for instance on the right when looking onto the mounting wall behind the WC) in comparison to the other side (on the left, accordingly). Correspondingly, the good surface cleaning properties of a rotational flow in the bowl are combined with a comparably pronounced momentum when entering the siphon. Thus, the kinetic energy of the flushing water, resulting for instance from the height of the fall with respect to a cis-

tern, can be used twice. Besides that, the design of the inner shape of the bowl follows a down trend of the water flow caused by gravity and prevents some of the turbulences which are caused when water flows down independently of the inner shape of the bowl. Such turbulences reduce the kinetic energy of the flushing water. For comparable reasons, a rotational flushing water movement in the bowl, as known from the prior art, is for instance much more effective in terms of surface cleaning than the conventional approach comprising a classical flushing rim, as described at the beginning, which significantly reduces the kinetic energy of the flushing water arriving from the flushing water supply.

For defining the asymmetrical inner shape of the bowl, reference is made to a vertical center plane which is, assuming a conventional mounting in front of a plane wall, perpendicular to this mounting wall. More general, the vertical center plane can be defined as a center plane which is parallel to a conventional drain for the wastewater and typically intersects the latter (and a user which is assumed to sit uprightly on the WC) centrically. This center plane is referred to as first vertical center plane and partitions the WC into a right and a left side.

The preponderant tangential velocity component of the flushing water emerging from the entry opening into the bowl, which velocity component is known as such, relates to a projection of a central flushing water path onto a horizontal plane. Thus, the flushing water does not leave the entry opening in direction to the water level in the siphon, but rather obliquely thereto, wherein, in a general sense, the exact angle does not matter and can depend on the individual geometry of the entry opening and the subsequent flow path. In particular, the velocity of the flushing water leaving the entry opening does not have to be exactly horizontal, but preferably is basically horizontal.

For an illustration of the asymmetrical inner shape of the bowl, reference can be made to two edges (in terms of two extreme value lines of the radius of curvature of the inner shape of the bowl), namely an outer concave edge and an inner convex edge. The region in between those two is on one side of said center plane higher than on the other. Preferably, the height of this region decreases continuously (which means monotonously) along its way around the water level of the siphon. Further-

more, this region between the two edges preferably is steeper on the one side than on the other, which is illustrated by the preferred embodiment. Therein, the side located deeper (with respect to the center plane) is the side which is steeper and the side located higher is the side which is flatter. Of course, both statements, regarding the steepness and the height, refer to a mean value between the two edges. By the way, the term "steepness" refers to a direction from the edge of the bowl to the water level or the center of the water level.

Preferably, the entry opening of the flushing water is located in a rear region of the bowl, which means behind a second vertical center plane which is perpendicular to the first center plane described above. The WC is intersected by this second center plane and partitioned into a front and a rear part. Hence, the rotating water flow can still cover a comparably large angle around the water level in the siphon. Therein, on the one hand, the water flow emerging from the entry opening can be directed inward, namely primarily onto a rear center region of the inner shape of the bowl where a significant dirtying can occur. On the other hand, contrarily, the flow can also be directed outward or forward, for instance to simplify the geometry of the flushing water supply towards the respective entry opening or even for fluidic reasons with respect to the bowl itself.

Preferably, a WC according to the invention works gravimetrically only, which means by making solely use of gravity and of the kinetic energy of the water. In particular, this implies to abandon a supply pump internally said WC, which can help reducing the price of a respective WC and also the running costs for the operation thereof.

Likewise, a static siphon is preferred, which means not a so-called dynamic siphon. A dynamic siphon is for instance an embodiment which artificially pens up the flushing water in the WC bowl by an artificial constriction or interruption of the drain, for instance by a flap, to allow a rather sudden draining thereupon by making use of a pressure drainage effect (siphon effect). Thus, a dynamic siphon comprises movable parts to influence the drainage behavior.

Equally, an entry opening in the lower part of the bowl, which shall, in conventional solutions, enlarge the average kinetic energy of the flushing water draining through

the siphon, is abandoned. The "lower" region is defined by a third center plane which is located horizontally and shall extend through the center of the total vertical height of the inner shape of the bowl, the total height including the siphon.

A WC according to the invention can be implemented with different methods of generating the flushing water in terms of supplying it with a certain flushing water pressure, in particular with a pressurized water line, namely without a cistern. However, combining the WC with a cistern is preferred, because the invention allows to make use of the limited potential energy of the flushing water in a cistern in a particularly effective manner. In particular, this applies for a concealed cistern in a mounting wall behind the WC.

In particular, rather small quantities of flushing water can be sufficient due to the inventive concept, which is economically and ecologically advantageous. Preferably, a maximum quantity of flushing water is below 6 l, preferably below 5,5 l, and particularly preferred below 5 l.

As mentioned above, entry openings for the flushing water in the lower region of the bowl are preferably abandoned; namely, entry openings shall only be provided in the upper region. Therein, in particular, one single entry opening is preferred. This entry opening can specifically be provided at somehow the highest point of the flushing water path, like illustrated by the exemplary embodiment. In principle, however, the invention can also be implemented with more than one entry opening.

The flushing water flow according to the invention allows a good wetting and cleaning of those faces of the inner shape of the bowl, being subjected to a dirtying, namely by a rotating and therein sloping flow, as described above. Correspondingly, a conventional flushing rim, which has been compared with a shower at the beginning, is preferably abandoned. This can simplify the manufacturing of the WC bowl and also its cleaning, because conventional flushing rims are particularly susceptible to a dirtying and calcification; furthermore, its bottom side is barely accessible. Basically, respective steps or rims are disadvantageous in terms of cleaning and can preferably be abandoned in the context of this invention, too. In other words, the invention enables a bowl showing a smooth transition from the actual inner faces of the bowl to an up-

per edge of the bowl, namely to those regions of the bowl which face upward, in particular below a WC seat.

In one embodiment of the invention, the entry opening mentioned above, which is arranged subsequent to the flushing water supply (and preferably provided as the only entry opening), can itself be comparably high, in particular higher than 5 cm and in this order increasingly preferred higher than 5,5 cm, 6 cm, 6,5 cm. A high entry opening allows a large cross-section, which is fluidically advantageous, without affecting the inner shape of the bowl by the entry opening unduly, namely regarding the flow configuration and also its aesthetical appearance.

In general, the cross-section of flow of the flushing water supply preferably is comparably large. In particular, in one embodiment of the invention, it can, along the length of the flushing water supply internally the WC, namely between the entry opening (including the entry opening) and the transition to parts of the ducting outside the WC itself, namely in particular within a mounting wall behind, amount to more than 8 cm², preferably to more than 9 cm², and particularly preferred to more than 10 cm² or even 11 cm². Thereby, use can be particularly well made of the kinetic energy of the flushing water resulting from a slope or a pressurized line.

For similar reasons, the parts of the flushing water supply internally the WC shall have comparably large radii of curvature, namely shall not have kinks pronounced too much. Likewise, the kinetic energy of the flushing water can also be better preserved. This is worth mentioning in particular, because no simple straight geometries come (can come) into question for a flushing water supply providing a rotating flushing water flow within the WC bowl and having correspondingly tangential entry openings. Thus, rather "a bending as known from manifolds" is possible with for instance a single curve in case of an outward direction of the flow at the entry opening, rather away from the center outward, or double-curved (S-like) shapes in case of the inverse direction. For an illustration, reference is made to the exemplary embodiment. Preferably, the described radii of curvature along the flushing water supply internally the WC amount all to more than 1 cm, preferably to more than 1,5 cm, and particularly preferred to more than 2 cm. In a further embodiment, the inner shape of the bowl can be designed asymmetrically, which means with a sloping flow path for the flush-

ing water, in such a way that the flow path basically arrives below the entry opening after having performed one circulation. In detail, the flow path can be bordered towards the outside by a concave edge, which has been mentioned already; after circulating around the water level in the siphon, this concave edge can approximately reach the lower end of the entry opening. Also in this respect, reference is made to the exemplary embodiment.

Hereafter, the invention is explained in further detail by means of an exemplary embodiment which relates to all categories of the invention, and wherein also different combinations of the features can be of relevance.

- Fig. 1 shows a top view of a WC according to the invention.
- Fig. 2 shows a perspective view of the WC, from the front top right.
- Fig. 3 shows a perspective view of the WC, from the front top left.
- Fig. 4 shows a sectional view of the WC, namely along the first center plane.
- Fig. 5 shows a side view of the WC from the left.
- Fig. 6 shows a front elevation of the WC.

The figures show a WC having a ceramic WC bowl 1 which leads downwards to a siphon 2 known as such and serving as an air trap; the siphon 2 is connected to a drain 3 located on the back side. For the purpose of simplification, the WC bowl 1 is shown without a jacket. Seen from the top, the WC bowl has an upper side edge 4 of the bowl having a basically elliptical shape, wherein a water level WS defined by the siphon 2 is arranged in a rear part within this ellipse and centrically with respect to the first center plane, as known for WC bowls. (In Fig. 6, the first center plane is shown dashed and referenced with M1.)

The WC bowl is the bowl of a shower WC, wherein the shower means are not shown for the sake of clarity and are attached on the upper edge 4, namely at its rear side.

Figs. 1 to 5 show a basically conventional flushing water inlet 5 which merges into a curve 6 of the flushing water supply, via which the flushing water reaches the entry opening 7 which is particularly good visible in Figs. 3 and 4. Towards the entry opening 7, the curve 6 first has a significant curvature to the right having almost a right

angle and afterwards a curvature to the left having an angle of about 180° ; the curve 6 ends inside the bowl, having a pronounced orientation to the left and, therein, also somewhat backward, with respect to the WC, respectively. Therein, the direction of the curve 6 and of the water flow, thus, is basically tangential to the inner shape of the WC bowl 1 at the location of the entry opening 7.

Thus, in this example, the entry opening 7 is fluidically directed from the right, inward to the rear center of the bowl 1. Referring to Fig. 1, it is easily understandable that an arrangement being basically inverse, namely for instance directing at the same location rather forward to the right or directing from the center to the right, would also be possible, wherein the curve 6 could possibly be provided with a single curvature only. In both cases, the entry opening 7 is located behind the second vertical center plane M2 of the inner shape of the bowl, shown dashed in Fig. 1.

Along this way, the curve 6 has a basically constant cross-section of flow, wherein the cross-sectional shape changes from a circular shape at the beginning, namely at the flushing water inlet 5, to a narrow and high shape at the entry opening 7, which can be also seen in Fig. 1 from the decreasing width. Therein, the cross-section of flow always amounts to more than 11 cm^2 , and the entry opening 7 approximately has a height of a bit more than 7 cm and a width of about 2 cm. Due to its significant height, the entry opening 7 can provide a remarkable cross-section of about 13 to 14 cm^2 , even though it has a slim shape, so that the flushing water is slowed down only slightly by the curve 6 and the entry opening 7 in comparison to the prior art. Hereto, the large radii of curvature (referring to the shown center line M4), which can be seen in Fig. 1, of the two opposed curvatures of the curve 6 contribute also. Without an exception, the radii amount to more than 2 cm, wherein the smallest radius of curvature occurs directly prior to the entry opening 7, in the region which is covered by the rim of the bowl in Fig. 1.

In particular, the flushing water inlet 5 can be connected to a conventional flushing water outlet of a concealed cistern in a typical mounting wall for a WC, comprising also a mounting frame adapted for a mechanical mounting; likewise, the flushing water drain 3 is connected to a corresponding standard connection.

Fig. 6 illustrates that the inner shape of the bowl 1 is asymmetrical with respect to the center plane M1, also apart from the entry opening 7 causing obviously an asymmetry. This even applies neglecting the flank, which can be seen in Fig. 3, being located at the same height as the entry opening 7 and to its right. In Fig. 6, both sides of the inner shape on the bowl have a section which has a comparably flat slope. These sections extend between the two shown lines 8 and 9 and have, in comparison to the remaining inner shape of the bowl, a comparably significant upward orientation. In this disclosure, the lines 8 and 9 have been referred to as "edges". They can also be described as lines which comprise the extreme values of the bowl curvature, seen from the inside concave in case of line 8 and convex in case of line 9. Therein, the curvatures refer to imaginary sections through the inner shape of the bowl to the center of the water level WS in the siphon, which can, in some sense, be considered as the center of the water flow described hereafter more in detail. In case of edge 8, the concave shape of the inner shape of the bowl is most pronounced (wherein further extreme values of curvature can occur further to the top); in case of edge 9, the inner shape protruding convexly seen from the inside is most pronounced (wherein further extreme values of curvature can occur further to the bottom). In between, the described regions are located, which form a flow path 10 defined by the two edges around the water level WS, as shown in the figures.

The figures show that the flow path 10 extends around the water level, performing approximately a full circulation; therein, the flow path is, on the average, located deeper on the right side than on the left side. Therein, the two edges 8 and 9 do not necessarily perform together a slope from the left to the right; rather, Fig. 6 illustrates that the slope of edge 9 is steeper in this example.

By the way, in this exemplary embodiment, large regions of the path, extending over a large part of the circulation of the flow path 10 and over a significant part of the distance between the edges 8 and 9, are flat (which basically means neither convex nor concave in the sense as defined above). However, this does not apply necessarily. Likewise, the water flow is not necessarily restricted to the so-called flow path; also, the water flow does not necessarily cover the flow path completely. This is a model to explain the asymmetrical shape of the bowl.

Further, Figs. 2 and 3 illustrate that the upper edge 8 starts, referring to the height of the entry opening 7, in a lower region thereof and a little behind the entry opening 7; after the full circulation described above, the edge 8 ends slightly below the lower end of the entry opening 7.

The lower edge 9 starts below the upper edge 8 at the entry opening 7 and, during the full circulation, significantly extends downward in direction to the water level WS, which can be seen in Fig. 4.

By the way, in Fig. 1, the upper edge 8 is hidden behind the upper rim of the bowl 1, protruding slightly inward; in Fig. 3, the lower edge 9 is hidden behind a front part of the rim of the bowl.

In the so-shaped bowl, the flow path 10 supports a rotational movement of the flushing water, which is initially caused by the tangential afflux of the flushing water from the entry opening 7; therein, the flow path 10 also supports the downward movement which is caused by gravity, so that the downward movement is already defined by the inner shape of the bowl. Thus, the flushing water flow does not have to drain downward flowing over a lower edge due to gravity in the end, which is known from the prior art for symmetrical concepts; the flushing water flow does not have to propagate downward independent of the inner shape of the bowl but can, supported by the shape of the bowl, enter the siphon 2, having a certain momentum or a significant kinetic energy. Accordingly, the flushing water flow does not only have a strong flushing effect regarding the inner faces in the upper region of the bowl 1 but also in the lower region directly above the siphon 2. In particular, the flushing water flow can cause the flushing water pass through the curved siphon 2 powerfully and also clean the lower region of the bowl 1, thus, namely without a pressure drainage based on the quantity of flushing water or achieved by dynamic siphons.

Thus, in the lower region of the inner shape of the bowl, which means below the center plane M3 shown dashed in Fig. 4, no further entry openings for the flushing water are provided.

Claims

1. A water closet having
a bowl (1) and
a flushing water supply (5, 6) which ends with an entry opening (7) into said bowl (1),
wherein an inner shape of said bowl (1) has, even apart from flushing water afflux openings, if any, an asymmetrical form with respect to a first vertical center plane (M1) and said inner shape of said bowl (1) defines a flow path for said flushing water, which is located deeper on one side of said center plane (M1) than on the other side and which superimposes a downward movement caused by the inner shape of said bowl (1) onto a rotational flushing water movement, thus,
characterized in that said flushing water supply (5, 6) and said entry opening (7) are adapted to allow the flushing water to flow into the bowl (1) with a preponderant tangential velocity component with respect to said inner shape of said bowl (1) and said flushing water to perform a rotational movement in said bowl (1), wherein said inner shape of said bowl (1) shows a smooth transition from the inner faces of said bowl (1) to an upper edge of said bowl (1).
2. The water closet according to claim 1, wherein said entry opening (7) is located behind a second vertical center plane (M2) being perpendicular to said first center plane (M1).
3. The water closet according to claim 1 or 2, wherein the flushing is adapted for a purely gravimetric operation, which means without a flushing water supply pump internally said WC.
4. The water closet according to one of the preceding claims having a static siphon (2).
5. The water closet according to one of the preceding claims having only an upside flushing water supply to said bowl, which means a flushing water supply

without an entry opening below a third horizontal center plane (M3) of said inner shape of said bowl (1) with respect to its total height including a siphon.

6. The water closet according to claim 5 having exactly one entry opening (7) above said third center plane (M3) of said inner shape of said bowl.
7. The water closet according to one of the preceding claims wherein said inner shape of said bowl has, even apart from flushing water afflux openings, if any, an asymmetrical shape being asymmetrical with respect to said first vertical center plane (M1) in such a way that said flow path is, on an average, steeper on that side of said center plane (M1) on which said flow path is located deeper than on the other side.
8. The water closet according to one of the preceding claims having an entry opening (7) for flushing water, which has a height of at least 5 cm.
9. The water closet according to one of the preceding claims, wherein a part of said flushing water supply (5, 6) internally said WC has, along its length up to said entry opening (7), a cross-section of flow of at least 5 cm² and said entry opening (7) itself has a cross-section of flow of at least 5cm², too.
10. The water closet according to one of the preceding claims, wherein a center line (M4) of a part of said flushing water supply (5, 6) internally said WC has, along its length up to said entry opening (7), radii of curvature of at least 1 cm.
11. The water closet according to one of the preceding claims, wherein said flow path of said inner shape of said bowl (1) is bordered towards the outside by a concave edge (8) which approximately meets a lower end of said entry opening (7) of said flushing water after one circulation around a water level (WS) of a siphon.
12. A use of a water closet according to one of the preceding claims for flushing, wherein said flushing water performs, starting from said entry opening (7) for

said flushing water, a rotational movement around a water level (WS) of a siphon, said rotational movement having a component sloping like a helical line.

13. The use according to claim 12, wherein a quantity of flushing water used for one flushing process amounts to 6 l at maximum.
14. A use of a water closet according to one of the claims 1 to 11 in combination with a cistern, in particular with a concealed cistern, also in combination with the use according to claim 12 or 13.
15. A WC-installation having a water closet according to one of the preceding claims and a cistern, preferably a concealed cistern, which is adapted for a quantity of flushing water limited to 6 l at maximum.