

Research on different toilet options and toilet improvement methods

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Abstract. This paper describes the flushing principles of various modern toilets and the effects of using different liquids to flush on objects, and provides relatively optimal options and improvement schemes through related research. The flushing effect of modern toilets can wash away objects more easily and cleanly, and through different flushing methods, direct water pressure or siphon principle can wash away those strangely shaped, hard surface, and sticky foreign objects. The device is suitable for a variety of ordinary homes and a variety of public areas for the use of basic human excretion, it is simple to operate, flushing raw materials are easy to obtain, has a complete set of hydraulic system and drainage channel pumping system, and does not require external power supply, through the water pressure plus external force to press the flush button can complete the cleaning of the object in the toilet.

Keywords: Flushing principles, Modern toilets, Liquids.

1. Introduction

As early as the time of Queen Elizabeth I (1558-1603 AD), a British Sir John Harlem designed the world's first flush toilet between 1584 and 1591, and the toilet and storage pool connection were installed in his house, but the British public did not accept this invention at that time [1]. It was not until 1775 that the London watchmaker Alexander Cumming improved Harrington's design, invented a valve device, and developed a flush-type flush toilet. After the 19th century, European towns and cities were equipped with sewage systems for water pipes. For flush toilets, an important feature is the s-shaped pipe, or the water storage bend of the sewer, which always preserves some water, equivalent to a sealing gasket, covering the odor of excrement [2-3].

Before the invention of toilets or toilets, ancient people liked to use pots, or defecate everywhere, which had three disadvantages: 1. Hindered human life, inconvenient cleaning and odorous. 2. It is inconvenient to use and easy to cause some accidents. 3. It may breed bacteria and even infect infectious diseases [4]. The toilet has done the best solution in these aspects, there will be no odor residue, easy to operate and comfortable, and the excrement is collected uniformly, that is, to protect the environment and prevent disease infection. In China and other countries also use flush toilets, but Asians are different from other foreigners in terms of physical structure, Asians can fully squat with both feet, so China has developed squat toilets, which are widely used in major public areas, such as shopping malls and buildings [5]. Direct avoidance of direct contact when using the toilet reduces the impact of disease transmission on society.

2. Principle of modern toilet

2.1. Straight-up toilet

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Defecate out of the toilet. The pool walls are steeper, and the water storage area is smaller, so the

hydraThe principle of the Straight-up toilet is using the momentum generated by the water to make the ulic power is concentrated. The force of the water was thereby able to become stronger. Meanwhile, the toilet will become cleaner [6]. Because of this principle, compared with siphon toilets, there are several advantages. Like it cannot be prone to blockage, it can save more water. However, there are still some disadvantages. It will cause more noise, and it will become dirty easier.



Figure 1. Appearance of vertical toilet [3]



Figure 2. Internal water flow of vertical toilet [3]

2.1.2. The current situation of Straight-up toilet

Nowadays, people prefer using the Siphon toilet, not the Straight-up toilet. There are several reasons for this. First, Straight-up toilets do not have the deodorant ability. Second, when using the Straight-up toilet, there is more noise than the Siphon toilet. Third, compared with the Siphon toilet, a Straight-up toilet is easier to block. Last, all intelligent closetools are Siphon toilets because they have the deodorant ability. Because the price of intelligent closetools is more significant than other toilets, the designer wants to give the best experience of going to the toilet customers. For this several reasons, Siphon toilets are widely used in our daily life [7].

All in all, Siphon toilets are better than the Straight-up toilet. Because of this, we do not experiment with how different liquids used in toilets influent the clean effect and how different speeds of the water influent the clean effect [8].

2.2. Siphonic toilet

2.2.1. Siphon principle

Siphon is a typical physical phenomenon, which can draw water without a water suction pump. It is quite common in people's everyday life. The principle of siphon is exactly same as that of communicating vessels. Communicating vessels are the containers that the upper ends are open and not connected, and the lower parts are all connected. For example, the U-shape container is a typical communicating vessel [9]. When a flexible liquid is poured into the communicating vessel, the liquid will become stable at the same level when it stops flowing. Because the liquid pressure is all the same at the same depth.

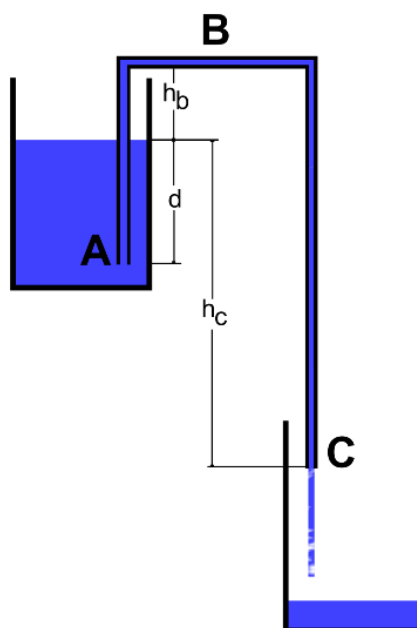


Figure 3. Siphon principle

Figure 3 is a simple siphon demonstration diagram. At the opening of the upper end of the siphon (A), the pressure into the tube is the container hydraulic pressure formed by the upper end water pushed by gravity to the position where the tube mouth is immersed; The outward pressure is the pressure generated by the liquid column in the uphill section. When the former is greater than the latter, the liquid is pushed from the upper container to the lower container, forming a siphon [1]. The liquid pressure difference is caused by the liquid falling to the outlet end, that is, the gravity downward at point C leads to the negative pressure at point B, and then the hydraulic pressure difference is combined with the atmospheric pressure to promote the liquid flow. Under normal circumstances, the driving force for siphoning is atmospheric pressure; But other principles can also be the driving force in special circumstances [10]. Under laboratory conditions, some siphons have been used for demonstration under vacuum, indicating a contribution of the tensile strength of the liquid.

How to stop siphon: The siphon ascending phase works similarly to a barometer, where air pressure pushes the liquid upward into the lower tip of the tube. Due to the similar principle, the maximum height that the liquid inside the siphon can rise is consistent with the barometer. With the increase of uphill height, the outward pressure of the pipe mouth also increases. By the time of hydraulic equilibrium with the container generated by gravity, a partial vacuum will be generated at the top of the siphon, which further causes the collapse of the liquid column and the siphon phenomenon to stop.

In addition, if the liquid level of the container at both ends of the siphon reaches the same height, the siphon phenomenon will also stop.

2.2.2. The influence of toilet bowl cleaners

To make the cleaning effect better, toilet bowl cleaners could probably be used in the flushing system. Toilet cleaners are chemical solutions designed specifically for cleaning a toilet bowl, usually in conjunction with a toilet brush.

Before using the toilet brush, spray the toilet cleaner around the edges and into the bowl of the toilet. Toilet brushes are used to scrub toilets to remove stubborn stains and biological debris. More recently, automatic toilet cleaners that clip to the edge of the toilet and clean with each flush have also become common.

Toilet cleaners are often toxic because they contain disinfectants that can cause skin irritation. "Heavy" formulations often include different amounts of hydrochloric acid (HCl), which require care when handling and storing, and adequate ventilation when used.

Toilet cleaner has the function of automatic cleaning, toilet cleaner is used when there is visible dirt. Because the toilet treasure is a neutral product, its cleaning effect on scale, urine scale and other

alkaline dirt is weak, the latter will still be slowly deposited on the toilet, so it is still necessary to use toilet cleaners regularly for more thorough cleaning. The cleaning cycle depends on the quality of different brand products, such as some toilet treasures may be cleaned for a few days, and some may be cleaned for 2 to 3 weeks, or even longer.



Figure 4. Toilet cleaner [3]



Figure 5. After using toilet cleaner [2]

3. The suggestions to improve toilets

3.1. How to choose the flushing liquid?

In different situations, there will be different options for flushing liquid. In normal conditions, the density of excrement is not that high, so the ordinary tap water can clean up very well. However, when you need to flush a high-density object, like the metal lead, you will find normal tap water does not work at all. Because the contact force on the metal from water cannot move the metal at all. In this situation, a more powerful toilet is needed. Mercury is an ideal liquid for these high-density objects. Because mercury owns an incredibly high density, most objects can be flushed away easily. So, the suggestion of improving flushing liquid is to make the water tank containing two different flushing liquid, and add an extra button to switch the flushing liquid depend on the conditions.



Figure 6. After using toilet cleaner [6]



Figure 7. A toilet tank filled with mercury [2]



Figure 8. A toilet tank filled with mercury [8]



Figure 9. Lead is flushed away [1]

4. Conclusion

For most of the daily use of toilets, inline toilets undoubtedly provide most of the basic flushing functions can also directly achieve the purpose, but with the passage of time people still invented siphon toilets, the main reason is because inline toilets are easier to clog than siphon toilets, blockage needs to consume most of the manpower maintenance, and even cost additional costs to clean up professionals, some cases may lead to direct complete damage, its benefits are far less than siphon toilets. People use the principle of siphon to create a siphon toilet, whose physical characteristics are very suitable for the toilet, although it has been greatly improved in flush cleaning, but also has problems in noise, external cleaning, and blockage. External cleaning refers to the inability to clean those stubborn stains that stick to the walls of the toilet, so in the extra way we can use toilet cleaners, which are chemical cleaners that make toilet flush cleaning the icing on the cake. When encountering some additional situations when using the toilet, such as flushing not feces but some high-density objects, we propose that mercury, a liquid metal, can be used to replace tap water, and for different situations it is recommended to add an additional tank of different flushing liquid on the basis of the original water tank, and add buttons to facilitate switching. Mercury is not particularly ideal for a material and is not practical to use in large quantities, so we need to find some more ideal high-density mixtures to replace mercury.

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