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DEVELOPMENT OF A USER FRIENDLY MECHANICAL SEAL TRAP FOR SANITARY LATRINES

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Abstract

The new mechanical seal trap is devised by attaching a flap hinged at the top of the outlet of the trap. The outlet shall remain almost vertical. The vertically suspended flap will keep the outlet end always closed and thus prevent ingress of foul gases in the latrine. Flowing excreta waste will push the flap to pass through and the flap will automatically get back to its original position afterwards. Three types of such trap have been developed for fitting with vertical, horizontal and 45° draining outlets. To fit with vertical draining outlet, the mechanical seal trap is developed by fixing the hinged flap at the outlet of a 45° elbow. For fitting with horizontal drainage outlet the trap has been developed by fixing the hinged flap at the outlet end of a short piece of pipe having an inlet bell only and for fitting with 45° draining outlet the trap is made having the outlet at an angle of 45°. This idea of mechanical seal trap instead of water seal trap will help achieve the desired sanitation, particularly in pour flush latrine. These types of mechanical trap can also be used in mobile toilets, bus toilets etc. where flushing is limited.

Key words: Sanitary latrine, Sanitation, Water seal trap, Mechanical seal trap, O-ring joint.

1. Introduction

In developing countries sanitation is an important and big issue. Achieving sanitation in holistic aspect is a great challenge even in developed countries. In developing countries sanitation coverage is widened mostly through improving and increasing number of sanitary latrine usage, where sanitation can hardly be achieved due to lack of development and maintenance of perfect sanitary latrines.

Generally water seal trap is used in fixture drainage, primarily to prevent ingress of foul sewage gases into the latrine compartment from pit and entering vermin and rodent into the pit. One of the vital aspects of maintaining sanitation in latrines is to maintain full water seal in the trap attached with the closet bowl or pan and in the drainage piping. For proper functioning 50 mm water seal is generally recommended in 100 mm drainage fixture traps (Haq 2006). To push out the excrement matters in the pan through the water seal in the trap, it needs sufficient pressure and about 6 to 10 liter water which is generally developed through flushing water from a flushing tank. In sanitary latrines particularly in developing countries flushing tank is seldom used and so pour flush latrines are commonly used. Sufficient water for flushing and ablution after defecation may not be easily available in many areas of the country. To make flushing easy the water seal in these types of hand-pour flushed latrines is maintained about 20 mm. About 3 to 4 liters of water is required to flush these latrines (Haq, 2003). This volume of water, in addition to water needed for cleansing purposes, may not be carried at a time. Users, finding these traps difficult in flushing the latrine completely with their carried water, used to break the trap or use pan and draining pipe without incorporating any water seal trap, thus make the latrine unsanitary in various respects.

To overcome the water related problems of water seal trap, use of mechanical seal trap in latrines would be the appropriate option. This paper describes the development of a mechanical seal trap in details, which will require no water for the purpose. This mechanical trap will work automatically. No extra water for flushing will be required if this mechanical seal trap is used in the sanitary latrines.

2. Trap and Its Function

The dictionary meaning of a trap is a device or tactic intended to catch an intruder or any substance. Usually traps, in sanitary drainage, are pipes made P-, U-, S-, Q- or J- shaped (Wikipedia 2011) curved pipe down and

then back up. It has to contain a small amount of water to create a water seal between the ambient air space and the inside of the drain system. This water seal actually prevents sewer gas from passing from the drain pipes back into the occupied space of the latrine. The common gases that are produced in a sanitary drainage piping system are Methane, Hydrogen-Sulfide, Nitrogen, Carbon-Monoxide etc. These gases produce foul odors and are not good for health.

Fixture traps must be self-cleaning by nature (Deolalikar 2010). Meaning that with each use wastes such as lint, hair must be able to flush away unhindered. Traps shall not be depended on any moving parts to retain its seal. Generally trap ventilation is provided for retaining water seal. Trap outlet cannot be made larger than the fixture drain to which it is connected.

3. Limitations Of Water Seal Trap

The water seal traps are functionless unless they retain their water seals at all times. So water seal traps shall have to be kept charged full with water into it. The seal may be broken due to air compressor, momentum, evaporation and siphonic action. In latrines water seal may be broken due to momentum during pour flushing and evaporation if the latrines are not in use for about one month or more.

In water scarce areas and in extreme climatic conditions sufficient water required for ablution and flushing is not generally carried at a time while going for using a latrine. Mostly water for ablution is carried and while abluting excrement wastes on pan is driven out by ablution water and falls on water in trap. Additional about 3 to 4 liters of water is needed to be poured to flush out those excrements on trap water, which is seldom made available by the users.

The accumulated excrement on trap water creates nuisance by emitting bad smell and makes the latrine unsanitary. Flies and other vermin can easily reach the excrements which is a carrier of many diseases (VITA 1973). To get rid of such problem the trap is excluded by breaking off trap portion of a pan having integral trap. This integral water seal trap often breaks down also (Ahmed and Rahman, 2000). When this was found to be a general phenomenon, the manufacturer used to make the pan without integral trap as shown in Figure 1. Presently majority of the users uses pan having no trap though there is scope of installing water seal trap of 20 mm water seal at the pan outlet (Shital Ceramic Works).

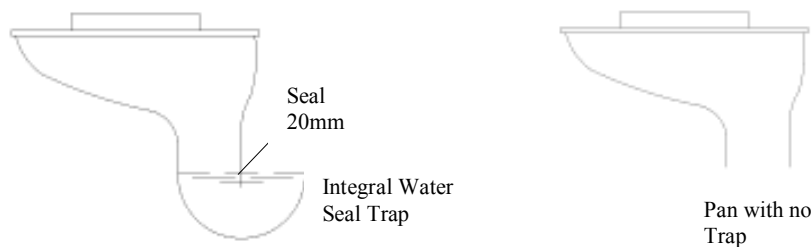


Figure 1: Pan with integral water seal trap and without trap

4. Development Of Mechanical Seal Trap

With a view to overcoming the problems regarding water seal trap delineated earlier, a mechanical seal trap has been designed. This innovative mechanical seal trap eliminates the use of water to make the seal in the trap. The trap works automatically and makes the seal mechanically. Basically this mechanical seal trap has been devised by attaching a flap hinged at the top of outlet end of a small piece of a pipe having other end a bell mouth.

The inlet bell mouth is provided with O-ring for facilitating easy jointing just by pushing through the outlet of any pipe or fixture of various materials (Treloar, 2009). To make the fixture comparatively lighter Acrylonitrile-Butadiene-tyrene (ABS) plastic material has been chosen as because it will be mostly used in drainage pipes or fixtures (Harris 1991).

To ensure the return of flap to its original closing position automatically by dropping back from its maximum opening position, a stopper has been incorporated at the top of hinge so that the maximum opening area is made restricted to not more than the cross sectional area of the trap end.

To make the flap operation almost frictionless sufficient clearance has been kept in the hinge arrangements of the flap.

To fit with drainage outlets at three inclinations, three types of Mechanical Seal Traps have been designed, which are named differently as follows.

1. Straight MS (Mechanical Seal) trap, to fit with horizontal outlets

2. Inclined MS (Mechanical Seal) trap, to fit with 45° outlets and
3. Bent MS (Mechanical Seal) trap, to fit with vertical outlets

The features of these traps are described below.

4.1 *Straight MS (Mechanical Seal) trap*

For fitting with a horizontal drainage pipe or outlet, the trap has been developed by fixing the hinged flap at the outlet end of a short piece of pipe having an inlet bell only as shown in the Figure 2. The maximum slope of 100mm draining pipe is about 5.6 : 1 (BIS 2005), which makes an angle 10.12° with horizontal. So the squarely cut end of a pipe sloped at a ratio 5.6:1 will make the same angle with a vertical line. So when a straight MS trap, having inlet and outlet end truly parallel, will be fitted with a sloped pipe at an angle 10.12° the flap will be remaining suspended truly vertical and will make an opening at the trap outlet. To overcome this problem the outlet end shall have to be made inclined by at least 10.12° from its vertical section. For ensuring the effectiveness, the outlet end of the straight MS trap outlet is made at an angle 15° from its vertical section, which is shown in the Figure 2.

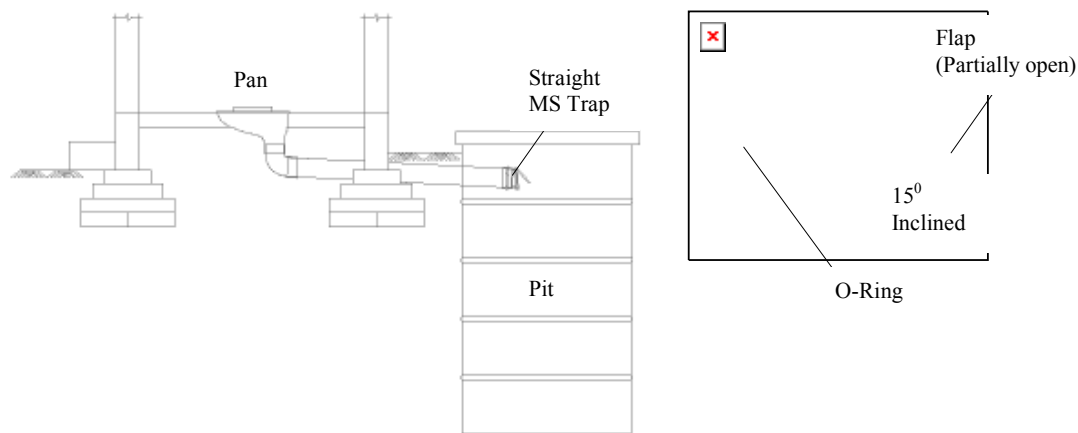


Figure 2: Straight MS (Mechanical Seal) trap fitted at the end of a drainage pipe and its detail.

4.2 *Inclined MS (Mechanical Seal) trap*

For fitting with an inclined drainage pipe or outlet at an angle 45° , the inclined MS trap has been developed by fixing the hinged flap at the outlet end of a short piece of pipe having an inlet bell only as done in case of straight MS trap. Since the drainage pipe will be remaining at an angle of 45° to keep the installed trap end closed by the flap the end of the trap shall be made at least at an angle 45° with the vertical section of trap. Again to ensure the effectiveness the outlet end of the inclined MS trap outlet is made at an angle 50° from its vertical section, as shown in the Figure 3.

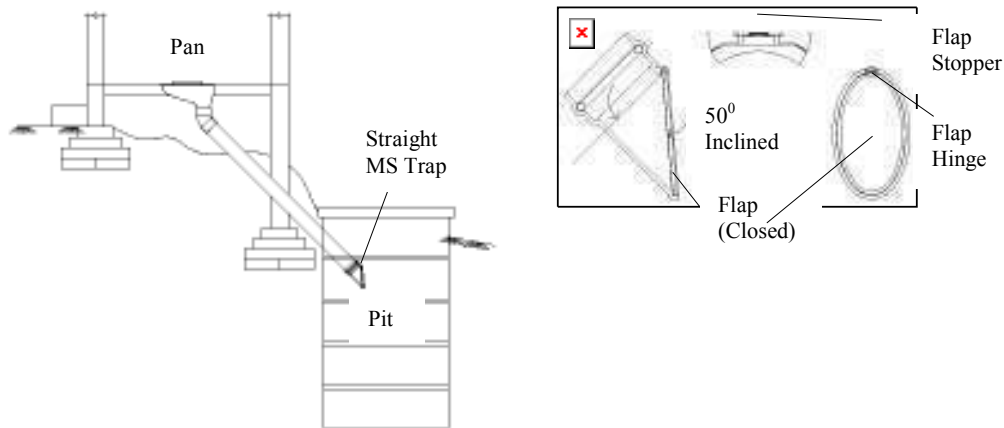


Figure 3: Inclined MS (Mechanical Seal) trap fitted at the end of a 45° inclined drainage pipe and its detail.

4.3 Bent MS (Mechanical Seal) trap

For fitting with a truly vertical drainage pipe or outlet, the bent MS trap has been developed by fixing the hinged flap at the outlet end of a 45° elbow having an inlet bell. Since the drainage outlet end of the trap will be remaining at an angle of 45° to keep the installed trap end closed by the flap the end of the trap shall be made at least at an angle 45° with the vertical section of trap as in the case of inclined MS trap. Again to ensure the effectiveness the outlet end of the bent MS trap outlet is made at an angle 50° from its vertical section and 5° from vertical line as shown in the Figure 4.

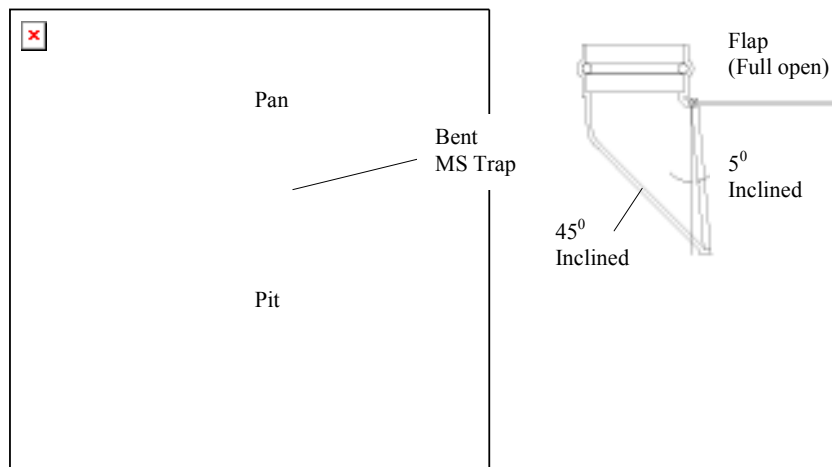


Figure 4: Bent MS (Mechanical Seal) trap fitted under a pan of a latrine and its detail.

5. Advantages Of Ms Traps

This newly developed mechanical seal trap has many advantages over the conventionally used water seal traps as mentioned below.

1. Eliminates use of excess flushing water.
2. Diversified uses, such as in pour flush latrines, mobile and bus toilets etc.
3. A water saving fitting.
4. Avoid tortuous passage, so makes easy flow through the trap.
5. Simple and easily installable with fixtures and pipes of various material.

6. Limitations Of Ms Traps

Though the newly developed MS trap is advantageous in many respects as mentioned, it has few limitations as well. These are as follows.

1. These traps are workable for deviations of fixture and pipe drainage outlets by an angle not more than 5° from its vertical position.
2. These traps are installable only at the outlet end of a fixture or pipe.

The limitations mentioned can also be eliminated by making some modification in the feature of the developed MS traps.

7. Concluding Remarks

In sanitary drainage every fixtures are to be supported by a trap for achieving sanitation. Mostly water seal trap is used in sanitary drainage. In water scarce area pans in latrines are seldom made supported by any water seal trap. In such case use of mechanical seal trap would be the best option. The newly developed Mechanical seal trap of various designs to fit with various draining outlets will solve the persisting problem in this regard.

References

- Ahmed M. Feroze and Rahman M. Mujibur (2000). *Water Supply and Sanitation*: ITN-Bangladesh, Bangladesh University of Engineering and Technology, Dhaka.
- Bureau of Indian Standards (BIS) (2005). *National Building Code of India*: Ics 0.120; 91.040.01, ISBN 81-7061 -026-5.
- Deolalikar, S.G (2010). *Plumbing Design and Practice*: Tata McGraw-Hill Education Private Limited, India, New Delhi.
- Haq, Syed Azizul (2003). *Rural Sanitation: Problem and Proposed Remedies*: Proceedings Second International Paper Meet, IEB and BUET, Dhaka.
- Haq, Syed Azizul (2006). *Plumbing Practices*: Syeda Masuda Khatoon, House 18, Uttara, Dhaka.
- Harris, Cyril M. (1991). *Practical Plumbing Engineering*: McGraw-Hill Inc. USA.
- Shital Ceramic Works. *20 mm Water Seal Trap*: http://ruralsanitation.net/water_seal_trap.htm.
- Treloar, R.D. (2009). *Plumbing Encyclopedia* Fourth Edition, Wiley-Blackwell, UK.
- Volunteers in Technical Assistance (VITA) (1973). *Village Technology Handbook*: 3706 Rhode Island Avenue, Mt. Rainier, Md. 20822, USA.
- Wikipedia (2011). *Trap (plumbing)*: [http://en.wikipedia.org/wiki/Trap\(plumbing\)](http://en.wikipedia.org/wiki/Trap(plumbing))