WATERLESS URINAL TECHNOLOGY: CASE STUDY

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Abstract

The perception of Hydraulic Resources scarcity has caused the development of technological and cultural actions improving water use by means of reduction of water consumption, maintaining the same activities that were previously performed by man and keeping the same quality. There is no way to practice Sustainable Development if the sectors of our society do not consider the Rational Use of Water. In Civil Construction, specially for building activities, sanitary fixtures are responsible for significant water use. – Urinal is an example of hydraulic equipment that has been wasting water through the years. Based on this fact and according to world water scarcity situation, new technologies have been developed for reducing the use of water in this sanitary fixture. This study presents not only the waterless urinal technology, but also its components and its operation characteristics. It presents also labor data collected, under controlled exposition conditions, and a practical case study that shows the application of waterless urinal in two– different restrooms in a University in Brazil. This case study presents information about system performance, its limitations and factors that interfere directly in the sanitary fixture performance. In laboratory, performance was evaluated by means of durability of components that needed to be replaced due to system use frequency. The objective of this study is to present a new technology that is growing worldwide to improve Civil Construction in order to get Sustainable Development.

Keywords

Waterless Urinal, water economy, Sustainable Development.

Introduction

Civil Construction supplies built environment for men. By means of sustainable construction principles it is possible to evaluate not only the impacts of plumbing systems for human life but also its importance.

This scenery creates expectation towards new products and new technologies not only to be employed in new buildings but also to improve the performance of old buildings. New technologies are developed to ensure this demand. Professionals are entitled to evaluate different products for the same purpose but with different operations to identify which technology is more adequate to the users needs.

The objective of this study is to present a new technology – Waterless Urinal System that is growing worldwide to improve the performance of the plumbing fixtures in order to achieve a sustainable development. This case study presents information about the Waterless Urinal System's performance, the factors that interfere directly in its performance its limitations.

Waterless Urinal

According to VICKERS(1), Waterless Urinal System appeared in Switzerland in 1890 and several different types of this system have been used in Europe since 1960. Since the early 1990's this system is being commercially used in USA. Nowadays, this system is found in many countries in its individual unit, but in the United Kingdom this system can also be found in collective units. Waterless urinal system is composed by the following components:

- Vitreous china (urinal fixture): receives and conducts by means of gravity the urine to the cartridge orifice. It has an appropriate internal curve in order to avoid urine to adhere to the china surface and also to help cleaning activities;
- Housing: plastic component that constitutes the transition between the urinal fixture and the cartridge. It receives the urine from the cartridge and conducts it to drainage system;
- Cartridge: plastic component that works as the system's trap. It is installed in the housing. The cartridge has two chambers linked to each other: one that communicates with the environment and other that accesses the drainage system.
- Sealant Liquid: fluid composed by a mixture of alcohols, biocide and dye. It is less dense than water and urine to remain in suspension within the cartridge;
- Appropriate tool for changing cartridge: plastic component used to remove or to install the cartridge in the housing;
- Optional component to cartridge protection: plastic circular shape cap, installed over the cartridge that enhances sealant liquid durability and protects the plastic surface of the cartridge.

Figure 1 shows the components of the system. Urine flows through vitreous china, passing through the sealant liquid to the drainage piping.

In the first chamber of the cartridge the sealant liquid is in suspension over the urine. Urine passes through the sealant liquid. The urine inside the cartridge ends up deteriorating. The sealant liquid prevents any odors resulted from this decomposition from escaping the cartridge. With the use, the urine may carry a small quantity of sealant liquid. The cartridge works also as a seal trap.

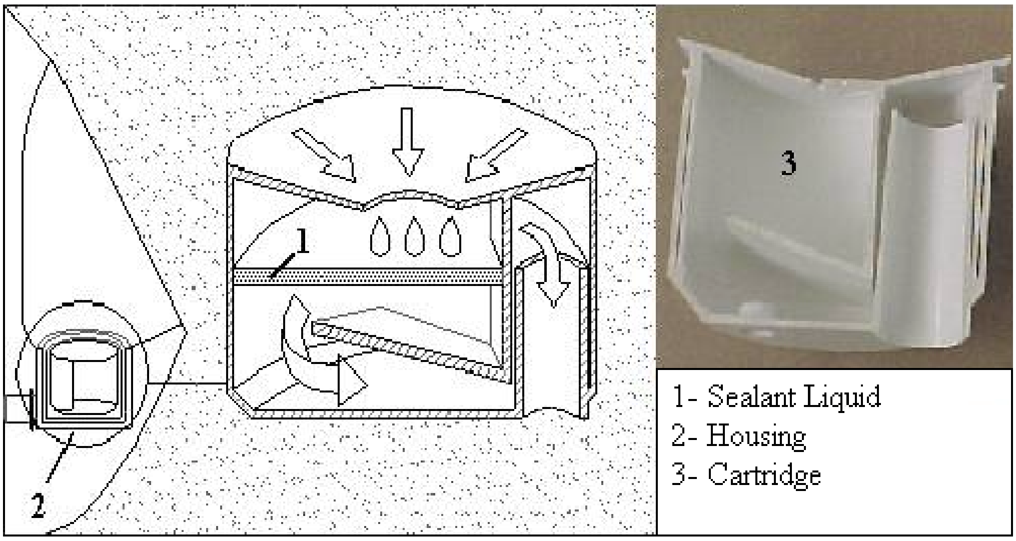

Figure 1 – Waterless Urinal System Components

The cartridge must be replaced when:

1. there is no more sealant liquid inside it; this can be noticed when odors escape from the cartridge; or
2. when urine does not easily flows through it, due to biochemical obstruction.

Waterless Urinal System requires proper cleaning procedures, their frequency depending on the number of users per day. The cleaning procedures of the urinal are:

- Remove all debris from the surface of the urinal;
- Spray urinal surface with a general cleaner purpose liquid;
- Wipe surface with a soft cloth or sponge until clean.

Some aggressive detergents should not be used because of the deterioration of the sealant liquid.

Water should not intervene in the cleaning procedures. Buckets of water should not be dumped into the urinals.

Methodology applied to evaluate Waterless Urinal Technology in Brazil

A methodology was developed in order to evaluate this technology according to Brazilian requirements. This methodology can be applied in any kind of sanitary fixture. The methodology was developed in four steps:

- Documental analysis and research;
- On site study;
- Laboratory studies and tests;
- Evaluation of results.

During the development of this methodology, many performance requirements were evaluated, which enabled to characterize Waterless Urinal System use in Brazil.

This paper will present the description and the results of the field tests.

Waterless Urinal Case Study

For the development of this study two restrooms were selected in the Civil Engineering Building - University of São Paulo. The characteristics of these restrooms are described below:

- Students' restroom: about 950 users/day;
- Professor's restroom: about 130 users/day.

Prior to the installation of the waterless urinal, the students' restroom had four collective urinals. After the intervention, five individual Waterless Urinals were installed. A horizontal branch was installed in order to collect urine from these five urinals and conduct it to an outlet. Figure 2 shows the mentioned configuration.

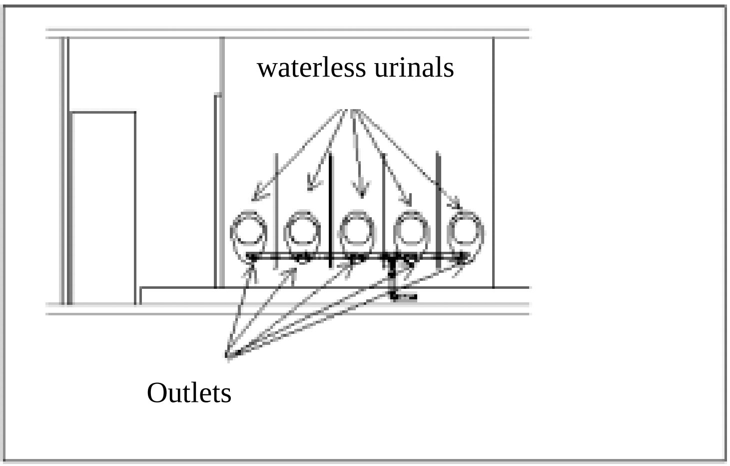

Figure 2 – Waterless Urinals installed in students restrooms

Prior to the installation of the waterless urinal, the professor's restroom had six individual urinals. Three waterless urinals replaced the old urinals. The discharge branch solution used was: vertical 50mm piping for each unit. Figure 3 shows this solution.

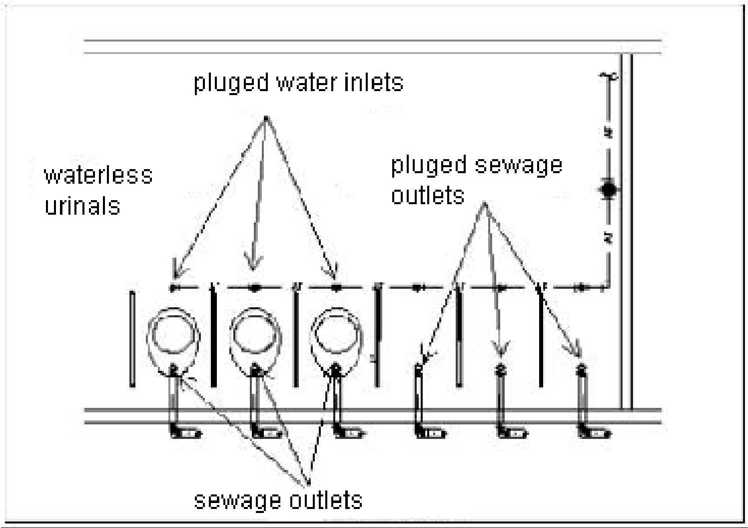

Figure 3 – Waterless Urinal in Teachers Restroom

A measurement system of urinal's uses was created in both restrooms. Metallic platforms with contact sensors were installed on the restrooms floor, in front of each urinal, according to Figure 4. The sensors were connected to a panel which registered each use.

Figure 4 – Measurement system - platforms with sensors

Results

By means of the measurement system, it was possible to quantify the lifetime of each cartridge in each individual urinal. In other words, it was possible to verify the cartridge's durability and performance.

The waterless urinal system has to have periodic maintenance, which includes the cleaning procedures and the replacement of the cartridges

Table 1 shows the summary of cartridges replacement occurred during the field study, in the student's restroom. The date of replacement of the cartridges and the number of uses in each urinal are presented below.

Date	Urinal 1	Urinal 2	Urinal 3	Urinal 4	Urinal 5
08/04/02	0	0	0	0	0
27/06/02	3471	3261	-	4089	-
27/09/02	2606	1379	-	-	-
04/11/02	-	-	8302	-	-
22/11/02	-	-	-	-	5741
06/12/02	-	-	-	5600	-
13/01/03	3116	1942	2296	341	561

Table 1 - Summary of cartridges replacement in student's restroom.

All replacements presented in Table 1 occurred due to a difficult flow through the cartridge, resulting in urine accumulation in the waterless urinal bowl. The measurement period began in April 8th, 2002 and finished in January 13th, 2003.

When the cartridges were removed, there was a formation of a big amount of a whitish paste, apparently abrasive, that adhered to the cartridge outlet and to the inside of the housing. This paste, called "biofilm", was a biochemical material which jeopardizes the performance of the system, creating the necessity of cartridge replacement.

The cartridges that were replaced on June 27th, 2002 presented a clogging due to "biofilm" on the horizontal discharge branch. The blockage removal was obtained by the means of the disposal of a big amount of water, which allowed the "biofilm" removal.

Table 2 shows the summary of cartridge replacements that occurred during the field study, in the teachers' restroom.

Date	Urinal 1	Urinal 2	Urinal 3
25/03/02	0	0	0
27/09/02	-	-	4049
04/11/02	-	3289	-
13/01/03	6644	993	1600

Table 2 –Summary of cartridge replacements in teacher's restroom

In April 2002, the cartridge of urinal two was removed in order to undergo a chemical analysis of its "biofilm". In September 27th, 2002 the cartridge of urinal 3 was replaced due to a complete obstruction by its "biofilm". During the field study, no operational and/or vandalism problems were verified in the system.

Results Evaluation

Anti-vandalism is an important characteristic of Waterless urinal. No parts can be damaged without contacting the urine.

The field study in student's restroom was significant for the system's understanding and for the measurement of some installation restrictions.

The student's restroom presented clogging of some cartridges which caused urine accumulation, due to a "biofilm" formation inside the cartridge or inside the outlet, resulting in precocious cartridge replacements if compared to the cartridge performance in other countries.

Two hypotheses were considered for the formation of this "biofilm". The first one was related to the flow of the sealant liquid and consequently the flow of the existing biocide that inhibited the proliferation of biological cultures. Such flow must have been occurred due to inadequate cleaning processes. The second one is related to urine velocity through waterless urinal and also through drainage branches of sewer system. Student's restroom had a drainage branch installed without proper declivity that prevented the urine of having the adequate velocity.

The drainage branch of the professor's restroom presented a vertical installation solution, which enabled the urine to flow adequately. Waterless urinal system showed better performance in the second type of installation, but a new case study to collect data during a longer period of time would be necessary to obtain better conclusions.

It is important to notice that the "biofilm" formation can also occur in other types of urinals, according to its characteristics of operation and water discharge. This problem is not exclusive to this system, but it can occur more intensively in this system due to its installation and operation characteristics.

The urinal of the student's restroom showed, after use, not only spots on the housing plastic borders that were attributed to inadequate cleaning procedures but also chemical deposits due to lack of adequate cleaning frequency. In the professors' restroom, where cleaning procedures occurred properly, these problems did not occur.

In order to avoid the problem of spots, the housing's rims are now manufactured in stainless steel. Another improvement is the increase of the declivity between the housing and the drainage branch, allowing a higher velocity of the flow. After these changes, the system is still being tested under the same installation conditions of the case showed in this study in order that the resultant effects can be evaluated.

This study did not evidenced problems related to significant odors inside of the restrooms.

Conclusion

The technological advances for reduction of water and energy consumption must be continuously evaluated. Waterless Urinal technology is another step towards water conservation. Although it may seem a radical solution, this field study indicated that eliminating water for urine conduction to drainage system does not affect the performance of the sanitary room.

In this case study, the application of the methodology presented a complex evaluation which considered not only the performance requirements but also the potential of economy of the system.

The professors' restroom involved in this study had plumbing installations in more favorable conditions to the application of waterless urinal. Thus, it is important to notice that the plumbing system design plays an important role in the operation of the sanitary room in order to obtain not only the correct application of the technology but the evaluation of the plumbing system as well. The study showed that parameters such as pipe slope greatly influence in the results of system performance - the declivity next to zero, as it occurred in the students' restroom gave support to the development of "biofilm". The Waterless Urinal System is still under study in Brazil so as to achieve other adjustments needed in order to reach the performance indicators that occur in other countries all over the world.

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