

## Research Project SanitaryRecycling Eschborn (SANIRESCH) Project component: Sanitary and In-house Installations

### 1. Background

The SANIRESCH project was designed to demonstrate and investigate the possibilities of a source-oriented wastewater separation and its reuse. For this purpose 50 RoeVac® NoMix toilets, urine-diversion flush toilets, and 23 waterless urinals of Keramag were installed at GIZ headquarters in Eschborn in 2007. At this time the urine-diversion toilets of Roediger Vacuum were five years on the market but only in small numbers. Therefore there was only very limited data available concerning their operational performance. Within this project the operation and maintenance of this toilet type was investigated and the design was further adjusted.

### 2. Material and methods

The operational performances of the NoMix toilets and waterless urinals were monitored regularly in a logbook. Monthly routine controls of the toilets and urinals have been executed as well as biannually preventive maintenance for the toilets. The results have been recorded in the log book to illustrate the operating conditions and evaluation process. Logbook entries for toilets were taken in the period from August 2010 till April 2012 while urinals were recorded from October 2009 till to date. The evaluation helps to draw conclusions about quality improvements, the liability of the different components as well as the quality of maintenance services.

The analysis for the NoMix toilets was specifically focused at the aspects of number and nature of disorders, performance and service life of the integrated urine valves and other spare parts. The urinal testing was focused on the cleanliness as well as on their functionality by a monthly routine check. After a time period of 6 to 12 months (depending on the number of uses) the rubber tube seals get porous, tend to stick together or are not closing anymore. This malfunction leads either to stagnant urine in the toilets or smells leaving the urine piping system.

However, smell issues were not only reported in relation to the urinals. Also toilet malfunctions provoked odour nuisances. Due to urine scale deposits the urine diverting valves integrated into the NoMix toilets stop closing effectively and again smells from the urine piping system can enter the toilet room. To prevent the deposition of urine scale monthly cleaning routines were established. Citric acid of 10% concentration was filled into the urine valves of the NoMix toilets and washed out

afterwards to prevent damage of the valves through the acid. The rubber tube seals of the urinals are checked and exchanged weekly. If the rubber tube seal is inoperative it is removed instantly or washed under running water using a brush.

### 3. Results and discussion

#### 3.1 NoMix toilets

The interior of the NoMix toilets allows the separation of urine and faeces. A crucial component enabling this separation is a urine diverting valve. After several months of operation it became obvious that the valve is susceptible to failures due to depositions of urine scale. As a result a total of 221 disorders were recorded in the report period of 20 months. The most sensitive spare part exchanged most often was the bowden cable, followed by the urine valve itself (for details see Figure 1).

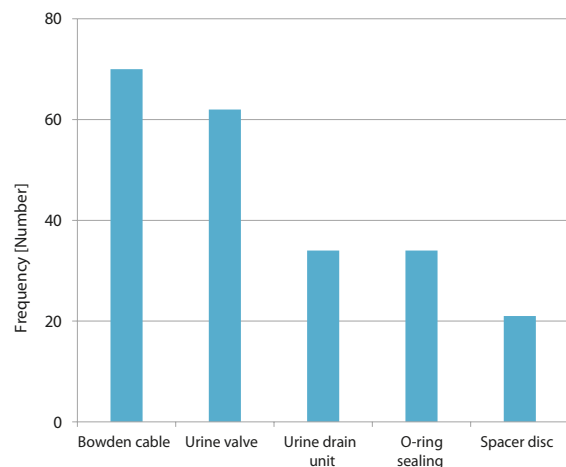


Figure 1: Exchange rate of NoMix toilet's spare parts within the project.

During the operation time several optimisations of the technical components of the NoMix toilets were conducted and applied in the existing system.

- The bowden cable that opens and closes the urine valve was extended by 20 mm.
- The holder unit of the bowden cable was re-designed. Both interventions eased the process of joining and fixation of the bowden cable.
- The edges within the urine valve were smoothed to improve the flow velocity and prevent the precipitation of urine scale.
- The sealings of the urine drainpipe unit were optimised with two O-rings to reduce the number of leakages between the inserted valve and the porcelain.

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Furthermore, the flushing performance of the NoMix toilets was not as efficient as desired. Therefore double or multiple flushings were required leading to increased water consumption. However, the solution of this problem would have required substantial modifications and re-design of the toilet bowls and could not be achieved within this project. The logbook data was used to calculate the service life of the different components. The technical improvements mentioned above were not regarded in this calculation. The service life of a urine valve is 495 days. For the other components the calculations led to a service life of 429 days for bowden cables, 776 days for wash pipe connections, 759 days for rubber rings and 945 days for distance washers.

### 3.2 Waterless urinals

The user's evaluation of the cleanliness of the urinals shows that they have a slightly worse impression towards conventional urinals (for details see also factsheet „Acceptance“). That made it necessary to focus on the cleaning routines performed by the cleaning personal, especially to guarantee a clean outlet (see Figure 2). It could be shown that instructing the cleaning staff in terms of the cleaning routines has a major effect on the successful operation. As already mentioned before the seals used in the urinals are more prone to malfunctions than regular urine siphons and need constant cleaning. In the beginning of the project, the maintenance staff took the seals out and while cleaning them, the access to the piping system remained open. This caused strong odour nuisances in the toilet room and the staff was very much hesitant to perform the cleaning procedure.

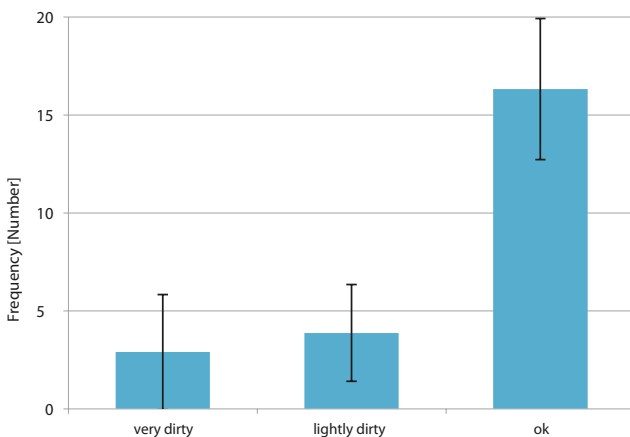


Figure 2: Overview of the level of cleanliness of the applied membrane seals.

## 4. Conclusion and outlook

With the end of the SANIRESCH project Roediger Vacuum will terminate the commercial marketing of the NoMix toilets.

This decision was inevitable due to several reasons:

- The design of the toilet bowl is complex which leads to high scrap rates during production. NoMix toilets are therefore unattractive for sanitation porcelain producers and no companies were found as production partners.
- The toilets require a high level of maintenance.
- Market segments that would allow higher maintenance efforts like public sanitation facilities will very likely result in a high misuse rate leading to a low efficiency in terms of urine diversion.

Roediger Vacuum will concentrate on the further development of the RoeVac® Vacuum - Sanitation System that also enables an efficient wastewater separation in black- and greywater in a larger scale. From the separated blackwater all valuable nutrients can be recovered for agricultural use additionally producing biogas.

To prevent user's refusal to waterless urinals it is very important to have a strict cleaning routine with short cleaning intervals adapted to the number of uses per day. Also the cleaning staff has to be instructed regarding the exact cleaning routines and has to be supplied with the necessary equipment. Since the waterless urinals can be operated cost efficient and are easy to install, especially buildings with high frequencies like roadhouses, airports or train stations are equipped with this technique.

## 5. Acknowledgements

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