H2020 Propelair Drain Survey

November 2019.

Contents

Executive Summary

121 Propelair WCs have been installed across 7 buildings at the University of Exeter (UoE).

257,925 flushes were recorded over a 6-month period (08/03/19 – 31/08/19).

Between 1,160,662.5 litres (based on a 6-litre flush) and 1,844,842.5 litres (based on a 9 litre flush) of water have been saved, This equates to a cost saving of £ 6,290.79 - £ 9,999.05 based on a water cost of @ £5.42 per M^3.

Water and cost savings included summer and Easter breaks which saw flush lower flush rates. Costs saving over a full year are estimated to be £13,707.36 - £21,787.55 p.a. (based on 535,979 flushes = 50,000 flushes per month except Dec = 40,000 flushes to allow for Christmas break).

CO^2 savings are estimated to be 2600 – 4,300 kg over the 6-month period (5,667 – 9,373 kg p.a.)

A report by Over the Air Analytics (OTA) indicated that *"there is no evidence that Propelair WC's increase risk of blockage in drain or sewers in or around the buildings"* when compared to existing WCs.

Introduction

In 2018 the University of Exeter (UOE) agreed to support Propelair with regard to a Horizon 2020 project to investigate whether their ultra-low flush toilet had a negative impact on drains.

Propelair engaged the services of OTA to support them with installation and monitoring at UOE.

Following a survey undertaken in January 2018 121 toilets were selected for conversation to Propelair toilets.

OTA proposed a method to monitor and capture data which included the installation of data logging equipment to monitor incoming water and toilet flushes, and regular drain surveys to assess the impact of the lower water usage.

UOE requested that an initial trial of 3 Propelair toilets be undertaken at Streatham Farm in July 2018. During the trial it was observed that our no-touch infra-red sensors could be operated by sunlight and or reflections from high visibility jackets. To resolve the issue the sensors were changed to push buttons. Reports of bad odours were investigated following the installation of the Propelair toilets. We found that that Propelair venting had been connected to the venting for the waterless urinals. Separating the two vent systems resolved the issue.

Following the initial trial, it was agreed to install a further 121 toilets. Installation took place between November 2018 and February 2019.

Data was monitored for a period of 6 months from 8th March to 31st August 2019 by OTA who produced a comprehensive report collating and assessing that data.

This report provides a brief overview of the project with a focus on installation, savings (water, $C0^2$, cost), drain surveys, maintenance issues, customer feedback and impact on drains.

1.0 Installation

All cubicles were surveyed prior to installation to identify suitability (size of cubical, size of void, ability to vent, need for boxing, need for electrical supply, etc), confirm work needed to be undertaken to enable the conversion to a Propelair WC and identify the condition of the drains.

Installation took place between November 2019 and February 2019. Shield and Max Electrical where engaged to undertake installation on behalf of Propelair with support from OTA and project management by Propelair.

Each toilet was commissioned within a week of installation allowing operation to be checked and inlet float valve levels to be adjusted if needed.

During February the data logging equipment was installed by OTA. There were a few instances where data logging equipment effected the operation of the Propelair WC's this was identified and rectified relatively quickly.

2.0 Water Savings, Carbon Footprint Reduction and Cost Savings.

257,925 flushes were recorded during the project (08/03/19 – 31/08/19) leading to a water saving of 1,160,662.5 litres - 1,844,842.5 litres (based on a 6-litre flush or 9 litre flush). This equates to a cost saving of £ 6,290.79 - £ 9,999.05 based on a water cost of @ £5.42 per M^3.

Water and cost savings included summer and Easter breaks which saw flush lower flush rates. Costs saving over a full year are estimated to be £13,707.36 - £21,787.55 p.a. (based on 535,979 flushes = 50,000 flushes per month except December which = 40,000 flushes to allow for Christmas break).

CO^2 savings are estimated to be 2600 – 4,300 kg over the 6-month period (5,667 – 9,373 kg p.a.)

3.0 Drain Surveys

Drain surveys where undertaken monthly by OTA (see appendix 2) to monitor the impact of reduce water flow. This included CCTV surveys of all sections of drains in April, June and August, visual checks of all inspection chambers in May and July. This data was compared with CCTV footage gained by UoE in 2018.

In February we noted a number of problem sites. We engaged the services of Pink Drainage to review and advise on suitable courses of action (see appendix 3). Observations and advise included:

HARRISON:

It was reported that one external inspection chamber blocked following the installation of Propelairs on more than one occasion. Investigation highlighted that this was a known issue. Pink Drainage identified a dead leg in the inspection chamber and recommended that this be

‘re benched’. The blockages at the inspection chamber also led to upstream issues, notably in a ladies washroom on the second floor. As a short-term measure Propelair have fitted a flush tank (this provides a 20 litre flush once a day to clear pipes) until the inspection chamber is re benched.

STREATHAM COURT:

Blockages in an internal inspection chamber in the female ground floor washroom were reported as were blocked in an external inspection chamber. Investigation highlighted the root cause being an old cast iron manifold with significant scale deposits (internal), and poor configuration of the external inspection chamber which accepts waste form a disabled toilet (it is the waste from the disabled toilet that is creating blockages externally). Pink Drainage have recommended descaling the drains and altering the external configuration. Propelair have fitted a flush tank as a short-term measure.

In April and June further blocks were reported at the external chamber. Investigation showed that this was due to the disabled toilet and not a Propelair related issue.

STREATHAM FARM:

Reports of blockages in Streatham Farm where made and root cause was identified as excessive scale build up (which had occurred prior to the installation of Propelair toilets). Pink Drainage recommended that the drains were descaled.

AMORY:

Blockages were reported in Amory at the start of the project. Root cause was identified as damaged drains (root ingress). We are led to believe this is a known issue and Amory has had a number of blockages in the past.

A further blockage was reported at the end of the project. Analysis of flush data showed that the flush rate was a is lowest point over the 6-month period.

To overcome this, we have recommended that addition of a flush tank.

LAVER:

No drain issues were reported in the Laver building.

KAY:

Reports of a blockage were received at the start of the project. Investigation showed that the configuration of the inspection chamber was not ideal. Pink Drainage recommended that the configuration be changed.

INNOVATION CENTRE:

No blocked drains were reported during the project, but one manhole chamber was to require repair to the concrete surroundings to prevent ingress of stones, and a second chamber was found to have a significant build up of scale.

Throughout the project the surveys noted that a number of sections of drain that had low flow and were partially blocked (see appendix 2), however the poor conditions of the drains did not prevent them from conveying waste water to the sewers. The OTA report identified that the low flow and partial blocks were not Propelair related and did not effect Propelair performance.

4.0 Maintenance

Review of the maintenance logs showed that during the project there where 41 blockages reported compared with 38 in the previous 6-month period.

Call logs in April 2018 (pre Propelair) and in April 2019 were also compared and showed 27 v 26 reports.

In total 95 reports where logged during the Propelair project (54 not due to blockages), these included:

SMELLS (x2)

These where due to faulty ventilation ducts and were not product issue (The Propelair toilet has seals on the lid and seat to ensure all air is flushed down the toilet, this prevents bad smells escaping form the toilet into the washroom).

DAMAGED UNITS (x8)

These where due to mis use and were not a product issue.

CONTINUOUS FLUSHING (x4)

This only occurs when the inlet valve is ‘stuck’ in position.

The Inlet valve used is a Thomas Dudley Valves used in many toilets in the UK.

Evidence suggests these issues happened when water logging sensors were installed / adjusted and that the issues were not product related.

FAILED TO FLUSH (x33)

This could be due to several reasons including a reduction of incoming water pressure, a faulty air pump, a faulty water pump, disconnection of power, a faulty PCB, or the reed switch not engaging.

Power had been switched off on at least two occasions. This is not a product issue.

1 water pump and 2 air pumps have failed during the project. They have been sent to the manufacturers for assessment.

A number of issues relating to the reed switch not engaging have been reported. During the flush cycle the seat latch can bounce out of position. If this happened 3 times in a row the Propelair needs to be reset (achieved by holding the flush button for 15 seconds).

A number of issues relating to water pressure were reporting during the project. The Propelair WC used a float operated inlet valve to control the incoming water and has a separate (electronic) float switch to confirm the cistern is full. Id water pressure drops the cistern will not fill to the top. As a result, the float switch will not engage, and the cistern will not flush. When this occurs the inlet-valve needs to be adjusted to ensure the cistern fills to the top.

During the project we recorded 257,925 flushes. Discounting the blockages and reports that were not product related leaves 31 which equates to 1 report per 8,320 flushes (0.5 reports per toilet per year).

The majority of reports occurred during the early stages of the project. In August Propelair visited site to check product performance. Each WC was flushed at the start of the day and at the end of the day for a week. Only one ‘non flush’ was noted that week: The power had been disconnected

6.0 Feedback

Throughout the project feedback was sought from various stakeholders across the campus.

The opinion of the maintenance engineers was mixed. Some liked the product and saw the benefits of the water saving. Some disliked the complexity of the product. We shared out findings with those who were sceptical (similar number of calls, similar number of blocks, reduced water), but found they preferred traditional toilets that they knew and understood.

The cleaners very positive. They stated that the toilets where generally cleaner. It had taken a while to get used to the product (which require the seals to be cleaned).

Building managers where generally positive. They commented that at the star of the project there had been a number of issues (as discussed above, but after a month or two the toilets had worked well, and they interested to learn about the water savings.

Academic staff commented that the toilets worked well, and they were interested to know how much water was being saved.

Some people commented that they didn't like touching the handle. We explained that the handle had an anti-microbial additive, and the seal prevented aerosol spray which meant our toilet was cleaner than traditional toilets. We also pointed out that studies show toilet doors are more dirty than toilet seats (as are shared keyboards!).

7.0 Problems and Solutions

The H2020 project has allowed Propelair to observe and understand real world problems with a view to developing and implementing solutions.

BLOCKAGES:

Evidence (form the H2020 project, in house laboratory tests, external laboratory tests and other real-world installations) shows that in the majority of cases 1.5 litres is sufficient to flush waste water and convey it to the sewer. Poor drain conditions will lead to blockages with both traditional and Propelair toilets, but in the case of Propelair the blockages may occur more quickly. These can be resolved by good drain design to prevent blockages from occurring (a building regulation requirement) and keeping drains in good condition and cleaning when needed (a building maintenance requirement). It is recognised that with older buildings this can be expensive, and in these circumstances a flush tank can be used.

We also noted that removal of paper towel dispensers (replacing with hand driers) had a significant impact during the project on reducing blockages.

WATER PRESSURE:

It is our intention to change to float operated inlet valve to a solenoid valve. This will overcome the issues relating to changes in water pressure and allow us to commission the toilets on the same day as the installation.

HYGIENE:

We are looking at ways to improve the communication of the hygienic benefits of the Propelair Toilets. We have independent studies which prove our product is one of (if not the) most hygenic toilet on the market today!

REED SWITCH:

We have made improvements to our manufacturing processes to improve the location of the read switch. We are also looking to add a spring to prevent movement of the latch during the flush cycle.

FAULT DETECTION:

Feedback from maintenance engineers has indicated that fault finding process (and reset process) is not intuitive. We have developed a new control PCB with improved fault detection and fault identification.

Conclusion

The project has delivered a significant water, CO^2 and cost saving for the UOE which will help it meet its environmental targets whilst reducing its water bill.

The project has shown (through independent analysis carried out by OTA) that the Propelair toilet has not had a negative impact on drain performance.

As a result of the project Propelair have developed solutions to overcome the problems identified including a new control PCB and solenoid inlet control. These improvements will be available early 2020.

The project has also identified a number of issues within the UOE drain network for UOE to act upon as and when able.

We have surveyed a further xx buildings at UOE and identitied a further xxx toilets which could be converted to Propelair WC's generating a further saving xxx saving

We would like to thank UOE (in particular Andy Seaman, Simon Tailford, Pete Melville Shree and Professor David Butler for their support during the project and hope to be in a position to work with UOE on future developments and environmental projects.

References

1. OTA Report 1 – Water Monitoring
2. OTA Report - Drain Surveys
3. Pink Drainage Report