

# THE DESIGN AND INSTALLATION OF AN AUTOMATED FLUSHING SYSTEM

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## ABSTRACT

This paper describes how it is possible to design and install an automated vacuum flushing system into sewers and storm tanks be they rectangular or circular.

Although relatively new to the UK the system has been installed on applications throughout mainland Europe since 1992 with more than 50 systems installed to date. The vacuum flushing system is marketed in the UK under the name "Vacflush".

The vacflush system provides specific benefits over other tank or sewer flushing systems as all of the maintenance can be carried out above ground.

Southern Water recently became the first company in the world to install and commission a vacuum flushing system for circular tanks and was the first company in the UK to use the system for rectangular tanks. All of the initial schemes have been part of Southern Water's Bathing Water Improvements scheme at Bexhill, East Sussex.

## INTRODUCTION

In order to meet bathing water legislation the UK Water companies have been investing in additional storm water storage capacity to prevent premature discharge of untreated sewage contaminated storm water.

Storage is generally provided by oversized tunnel sewers or purpose built storm water retention tanks. Once the storm has passed and the flow diminishes the retained water can be released to the sewage works for treatment prior to discharge.

Once the storm storage system is empty the floor will be covered in sludge caused by particulant settlement. The sludge is highly odourous and a potential odour nuisance as defined in the 1990 Environmental Protection Act. Furthermore a build up of sludge in the system reduces its effectiveness. Manual cleaning is fraught with health and safety concerns apart from being an inefficient use of manpower.

## FLUSHING OPTIONS

Essentially there are three different methods used in the UK for maintaining clean storm storage chambers; namely:

- **"Jet Pumps"** which operate by introducing turbulence into the system to prevent settlement
- **Flushing systems** using storm, secondary effluent or potable water to flush the debris from the tank floor after a storm.
- **Self cleaning gradients.**

## VACFLUSH SYSTEM DESCRIPTION.

The Vacflush system is a flushing system that uses storm water as the flushing media to clean the tank/sewer. A separate Flushing chamber is built within the Tank/sewer to accommodate the storm water flushing media. As the storm tank begins to fill and covers the syphon at the bottom of the flushing chamber an ultrasonic level detector sends a signal to the vacuum pump to switch on. The pump evacuates air from the flushing chamber using some of the air to inflate the diaphragm, which seals the top of the chamber. Water from the base of the chamber is drawn up, by the vacuum pumps to a pre-set height controlled by a

float switch. Once reached the vacuum pump is switched off and the head within the flushing chamber is held by the diaphragm valve. Once the level in the storm tank/sewer has subsided the sump mounted ultrasonic sensor sends a signal to the ball valve mounted on the diaphragm valve assembly. This releases the air within the diaphragm, which in turn deflates rapidly allowing a large volume of air to replace the vacuum within the flushing chamber. Once the vacuum is released the high volume and head forces the flushing media from the chamber and the tank is flushed clean. The system resets itself ready for the next storm event.

## **DESIGN CONSIDERATIONS**

Under CDM regulations design engineers have a responsibility to ensure, so far as is reasonably practicable, that any design either avoids foreseeable risks or includes control measures for reducing that risk at source in a way that will protect anyone subsequently carrying out the work. This is of particular importance when designing underground storm water storage systems due to the risk of toxic and inflammable gasses being present. Until recently it has not been possible to specify a flushing system that did not require below ground maintenance or that had moving parts within the storage chamber.

The introduction of the “Vacflush” vacuum flushing system has provided the design engineer with a solution that avoids the foreseeable risk of man entry into the chamber for maintenance as it can be maintained from above ground. The system has no moving parts within the chamber.

Having established that the “Vacflush” system can satisfy CDM design requirements, the design of the system can begin in earnest.

There are three different applications for the system: -

- Rectangular storm water retention tanks
- Circular storm water retention tanks
- Oversized Sewers

### **Rectangular Tanks.**

Each flushing chamber/diaphragm valve assembly can deal with a maximum width of 10m. Tanks wider than this should be divided into cells of 10m or less. The longest tank flushed to date is 160m, although it is possible to flush greater distances. It is also possible to flush tanks with gradients as small as 0.1%

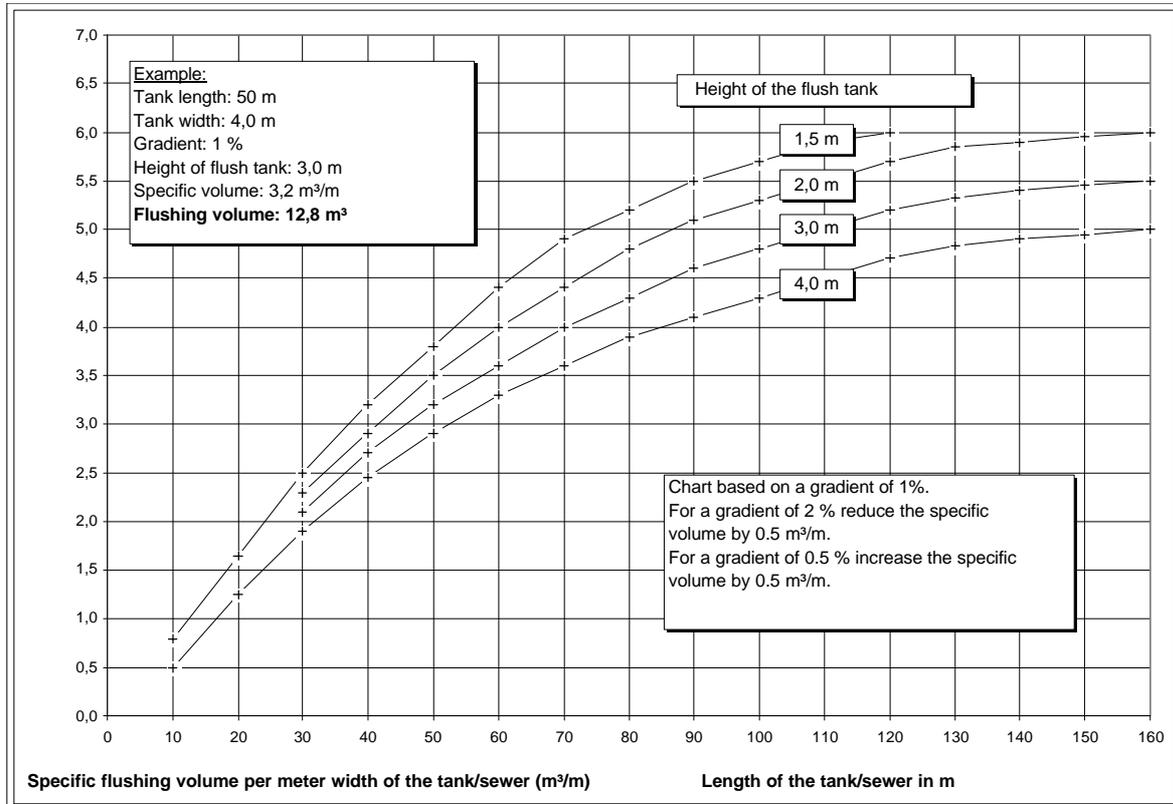
In order to size the flushing chamber volume you will need the following information.

- Length of tank
- Height of tank
- Width of tank
- Gradient

To calculate the flushing chamber volumes please see the graph.

1. Take the length of your tank/sewer
2. Find the intersecting point with the curve of the flush chamber with the corresponding height required
3. Move horizontally across to the flush axis to determine the specific volume.
4. For gradients in excess or less than 1 % the specific volume should be reduced/increased in accordance with the insert panel (see chart).

- Multiply the specific volume by metre width of the tank/sewer to establish volume needed.



### Circular Tanks

Circular storm water tanks offer significant civil engineering savings over rectangular tanks and can provide environmental benefits during the construction phase.

The benefits of circular storm tanks over rectangular tanks are as follows: -

- Significantly cheaper as no temporary works required to construct cofferdam
- Less land area is required as they can be deeper
- The vacuum cleaning system allows for deeper construction of the tank as no access will be required for maintenance crews

We have recently installed two Vacflush system's into two 20m-diameter tanks for Southern Water at Bexhill. These two circular tanks were the first in the world to be completed using the vacflush system.

The flushing chamber is constructed as the central supporting column of the tank with the receiving sump running around the periphery of the tanks circumference. The tank flushes radially in all directions. As with the rectangular tanks the sump volume should be equal to the volume of the flushing chamber contents plus 10%.

The largest circular tank project being undertaken is currently 30m in diameter.

### Oversized Sewers.

Numerous projects have been undertaken to flush oversized or tunnel sewers where the sewer is used to store storm water prior to treatment.

