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Optimised CSO screening: A UK perspective

Dégrillage optimisé aux déversoirs d'orage: une perspective au Royaume Uni

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RÉSUMÉ

Les dirèctives du Royaumme Uni sur le traitement des eaux d' égouts qui sont d'origine des réseaux unitaires et des deversements et des debits des eaux de crues pluvialles sont concentrèes sur l' élimination des polluants solides en utilisant des systèmes de degrillage (screening).

La majorite des systèmes disponibles dans le marché utilisent des téchniques électro-méchaniques, qui, dans les dificutès du millieu des égouts, ne sont pas idèales.

Ce travail présent le système Hydro-Jet Screen™, un système auto-épuratif, qui fonctionne sans parties méchaniques mobiles et n'a pas besoin de l' énergie électrique. Le système utilise seulement une cycle de 'lavage inverse' (backwashing) et par consèquence est idèal pour l' environment des egouts.

ABSTRACT

UK environmental guidelines relating to the treatment of flows from CSOs and other intermittent wet weather discharges have focussed on the removal of aesthetic pollutants. This has dictated widespread adoption of screening systems.

The majority of screening systems currently on the market employ electro-mechanical components to prevent blinding. However, given the harsh environment of the sewer, this is clearly not ideal.

The paper describes the Hydro-Jet Screen™, a self-cleansing CSO screening system that has no moving parts and no power requirements. Utilising a purely hydraulic cyclic backwashing mechanism, the system is well suited for use in a sewer environment.

KEYWORDS

Combined sewer overflow, Screening, Stormwater treatment

1. INTRODUCTION

As part of the AMP3 (3rd Asset Management Plan) programme in England and Wales, there is a requirement for the Water Service Companies to rectify 85 percent of the identified 5,500 unsatisfactory intermittent wet-weather discharges by the year 2005 (Morris, 1999).

The current standard for Combined Sewer Overflows (CSOs) and other intermittent wet-weather discharges is based around the removal of aesthetic pollutants and the reduction of spill frequency (NRA, 1993). The most stringent consent standards require "separation, from the effluent, of a significant quantity of persistent material and faecal/organic solids greater than 6 mm in any two dimensions". It is generally recognised that the most effective way of guaranteeing compliance with the requirements is with a screening system.

Experience has shown that screens placed in combined sewer environments are prone to blinding unless some form of 'screen cleansing' mechanism is used. Most 'conventional' screening systems utilise electro-mechanical components to facilitate such a process. However, given the harsh environment of the sewer, this is clearly not ideal. Problems such as seizure or jamming of moving parts and electrical failure will dictate an onerous maintenance commitment in many cases.

In response to the industry requirement for an effective, reliable and low maintenance screening system, the Hydro-Jet Screen™ was developed. It is interesting to note that, of 15 proprietary screen types evaluated by the UK CSO Research Group as part of their 1996-1999 programme (UKWIR, 2000), eleven had moving parts and nine required an external power source. Four of the remaining systems had no moving parts and no power requirements. Two of these were static screens. The other two systems included both linear and rotary versions of the Hydro-Jet Screen™. As the only system that had no moving parts and no power requirements while maintaining an active self-cleansing mechanism, the Hydro-Jet Screen™ is evidently unique.

Many of the ten water companies in England and Wales are considering granting 'preferred suppliers status' to screen manufacturers through Framework Agreements. To date, only one Framework Agreement has been finalised through which Yorkshire Water Services, who have the largest improvement programme, have granted HRD Ltd (UK subsidiary of Hydro International) 'primary screen supplier' status for the next 3 years. Further similar agreements are expected.

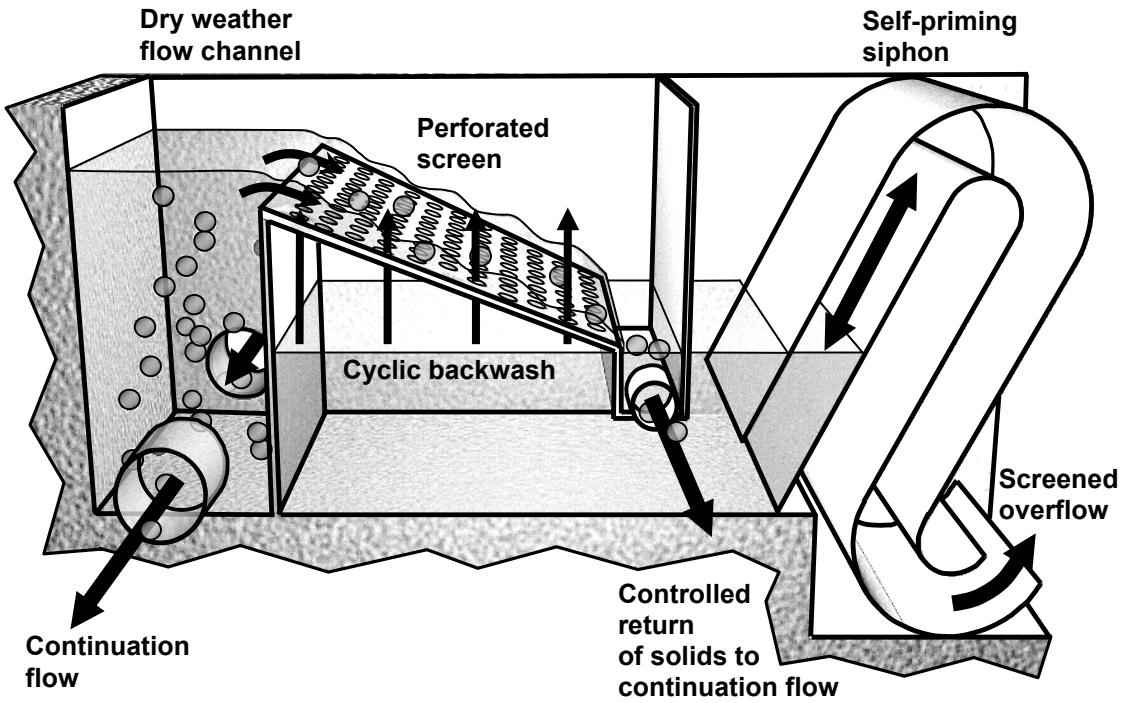
2. THE HYDRO-JET SCREEN™

2.1 Operating Principles

A schematic representation of a single-sided linear Hydro-Jet Screen™ is shown in Figure 1. During a storm event, the dry weather channel fills up, causing flows to spill over the perforated screen, just as a high-sided weir chamber would overflow. By means of a unique cyclic hydraulic backwashing process, solid debris collected on the screen is continually concentrated and flushed out of the chamber. The key element responsible for this is the novel patented self-priming siphon.

As the spill commences, water is initially held back by the siphon, causing the level beneath the screen to rise. As the water level reaches the top edge of the screen, the siphon primes, discharging the screened effluent from the chamber. Once the water level has fallen to a point corresponding to the bottom edge of the screen, the siphon breaks, allowing water to build up again. This cyclic process continues, causing water and air to be repeatedly forced upwards through the screen, dislodging collected

Figure 1 Schematic Representation of the Hydro-Jet Screen™



material. Flow of water over the surface of the screen washes the debris towards a collection trough, from which it is introduced back into the continuation flow.

A rotary version of the system also exists, which can be used in combination with a Storm King® hydrodynamic separator.

2.2 Performance and Operational Issues

The Hydro-Jet Screen™ has been subject to rigorous testing, undertaken by both Hydro International, and also by independent parties (Andoh *et al.*, 1999; CSORG, 2000; Andoh & Saul, 2000; Faram & Andoh, 2000). To ensure that screened solids are efficiently flushed from the system during the draindown stage of the cycle, the system has also been optimised using CFD fluid flow simulation (Faram & Andoh, 1999).

In addition to having no moving parts and no power requirements, the Hydro-Jet Screen™ has the following demonstrated performance attributes;

- Solids removal efficiencies can be relatively high. This can be explained by the fact that solids are 'lifted', rather than 'scraped' from the screen surface. Additional removal of solids, particularly sediments, is possible via use of a rotary Hydro-Jet Screen™ combined with a hydrodynamic separator.

- The head loss through the Hydro-Jet Screen™ is minimal and steady during normal operation, since the screen is below, rather than above the level of the overflow weir. For other screen types where the screen is mounted on top of the weir, head loss becomes a direct function of the screen resistance.

- Accumulation of screened solids is minimised as screened material is re-introduced to the continuation flow via a downstream mixing chamber. On some other screening systems, collected solids are introduced directly back into the dry weather flow channel. Flow patterns within such channels have been known to cause recirculation and subsequent re-presentation of solids back to the screen.

2.3 Installation Experience

Since its launch, over 50 Hydro-Jet Screens™ have been installed in the UK, with screened flowrates ranging from 15 to 2200 l/s. Units have also been installed in the USA, Australia and mainland Europe, and a market has been identified in Japan, which is being actively pursued by NKK Corporation via a licensing agreement.

Between July 2000 and February 2001, as part of a monitoring programme, inspection visits were made on a monthly basis to 6 Hydro-Jet Screen™ installations in two adjacent catchments in South Wales, most of which were fitted with instrumentation and telemetry facilities. Maintenance reports from the Sewer Maintenance Contractor were also obtained to augment the visual and photographic data collected. At two sites, no maintenance was required at all over the 7 month period. Out of the 60 visits made, maintenance of the remaining systems was required on 8 occasions. However, in all cases this was directly associated with blockages of the sewerage system.

Available telemetry data suggested that over 300 spill events had occurred during the period, spread between the 6 installations, indicating a reactive maintenance rate of less than 3 % per storm event. This is significantly lower than the maintenance commitment that would be imposed by a screen without a cleansing mechanism.

3. CONCLUSIONS

The Hydro-Jet Screen™ is a self-cleansing screening system that has no moving parts and no power requirements. Independent evaluation of the system alongside other systems has indicated it to be highly effective and able to meet current regulatory requirements.

Feedback from field installations, including that from clients, has been extremely positive. With one 'primary screen supplier' agreement in place, and further similar agreements anticipated, the Hydro-Jet Screen™ represents a preferred solution to the problem of storm overflow screening.

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