Department of Chemical Engineering Design
Chalmers University of Technology
Gothenburg, Sweden 2005

Screening Efficiency of Step Screens

Department of Chemical Engineering Design
Chalmers University of Technology
Gothenburg, Sweden 2005

Extraction from Thesis Work
Ola Andersson
Niklas Larsson

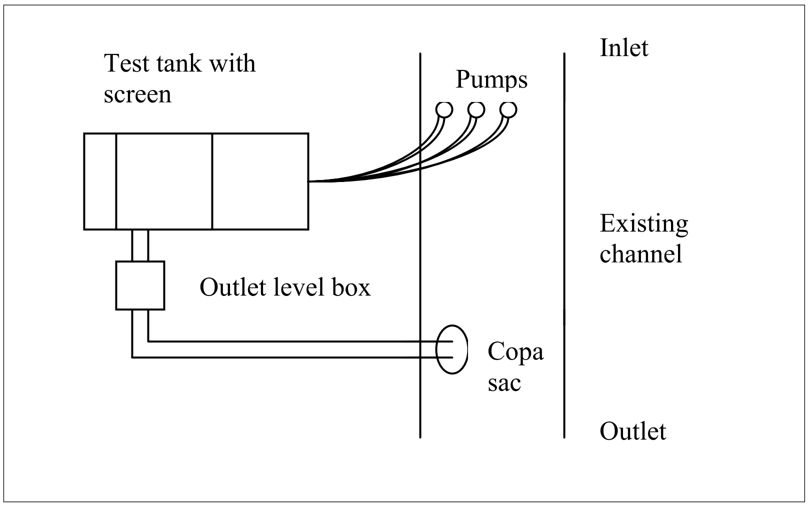
CHALMERS

Introduction

This report contains a test evaluating the screening efficiency of two different step screens produced by MEVA Nordic Water AB. The report constitutes part of a thesis work conducted at Chalmers University of Technology, Gothenburg, Sweden.

The measurements were performed at a Wastewater Treatment Plant located in Floda, Sweden and the purpose of the study is to attain credible values of the screening efficiency when the screen is operated at proper and genuine conditions. The screens tested in the study were; RSM 15-50-3 Monoscreen and RS 10-40-3 Rotoscreen, thus a comparison of a Monoscreen to a traditional step screen were made. Furthermore the thesis work aims at gaining a greater understanding concerning the effect on the screening efficiency of a number of external parameters.

The test system



The screens were evaluated one at a time and were placed in a test tank for the measurements. Raw sewage water from the inlet to Floda Wastewater Treatment Plant was pumped up to the test box using one, two or three pumps with a capacity of 12.5 l/s each.

The water level in front of the screen was controlled by an ultrasonic level detector, which was connected to the screen and made it possible to start the screen automatically at a fixed water level.

The screenings load removed from the sewage flow by the screen was obtained by inserting a collection tray below the screen discharge at the top of the screen. This was made from a 3 mm diameter perforated plate to permit drainage of excess liquid.

The water level behind the screen was set by putting steal sheets of different heights in the outlet after the screen, thereby damming the outlet to the appropriate water level. The sheets were put in a box directly connected to the big tank containing the screen.

The screened sewage was led from the box in plastic pipes, of sewerage type, back to the existing channel at the water treatment plant. The solids still present in the water were collected in a copasac, a meshed disposable sack fabricated of fixed weave of polypropylene with mesh sizes of 4-6 mm, which was applied at the end of the sewerage pipe.

Methodology

In the study a number of parameters were varied to investigate their influence on the screening capacity. The parameters are:

- the screen
- the flow
- the pressure drop over the screen
- the dimensioned maximal flow
- the operational mode of the screen

One of the main issues of the test was to evaluate the difference in separation effectiveness of the Monoscreen versus the Rotoscreen. Therefore a Monoscreen with slot width 3 mm and a Rotoscreen with slot width 3 mm were used.

In order to evaluate the impact of pressure drop over the screen two different pressure drops were used in the tests. This was achieved by using steal sheets of different heights as mentioned above. The difference between the upstream and downstream water level were set to 200 mm or 400 mm.

When designing the screen and deciding its correct dimensions the demanded maximum capacity of the screen is of importance. The screen is rarely operated at this state but it needs to be regarded in the dimensioning process so that it can manage extreme conditions with great water flow. In this measurement the screen hence was tested at three different dimensioned maximal flows to illustrate its influence on the screening effect. These flows were normal flow times two, four and eight.

It is of interest to observe the difference in performance of the screen when operated at step mode compared to pulse mode. Hence the Monoscreens were tested in pulse- and step mode.

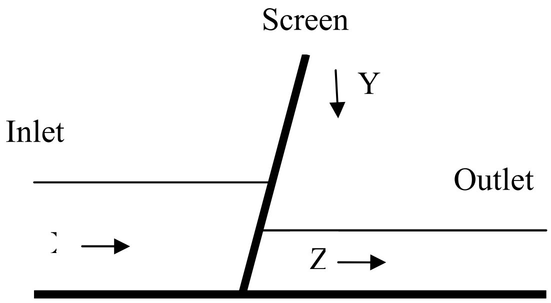
When performing the tests the screen was evaluated during a time interval of 15 to 120 min, depending on external circumstances. The most commonly used measuring time was 60 min. This was in most cases a sufficient period of time to achieve an adequate pre-coat on the screen and short enough to keep a uniform waterflow through the sack, which were the limiting factors influencing the measuring time.

After completing the test the solids in the tray, discharged by the screen, and the copasac were let to dry for 30 min and thereafter weighted. Finally the Screen Capture Ratio (SCR) was calculated according to the principle below.

Department of Chemical Engineering Design
Chalmers University of Technology
Gothenburg, Sweden 2005

Screen Capture Ratio (SCR)

A line diagram of the screening process is shown below:



Where:

X is the screenings load in the raw sewage, i.e. the amount of particles in the inlet.
Y is the screenings removed from the flow by the screen
Z is the screenings load in the screened sewage, i.e. the amount of particles that are not collected on the screen.

All values are absolute and expressed in units of g/m^3.

The process effectiveness of the screen is expressed as the Screen Capture Ratio (SCR) and is defined as:

$$SCR = \frac{Y}{X} \cdot 100\%$$

When performing the measurements it is not practical to sample X simultaneously with Y and Z as all solids would be removed at X and it is combined with practical difficulties to measure the greatly diluted particles in the inlet. Given in theory that X=Y+Z, the formula can be revised to:

$$SCR = \frac{Y}{Y+Z} \cdot 100\%$$

This removes the requirements for upstream sampling at X.

Results and discussion

The results of the SCR measurements are visualized in two diagrams, showing the results of the tests at a pressure drop of 200 mm (Chart 1) and 400 mm (Chart 2). In the diagrams the SCR values are presented in three groups; the results from the measurements of Rotoscreen, Monoscreen operated at step mode and Monoscreen operated at pulse mode. The diagrams show the range and average value of the results, i.e. the lowest, highest and average SCR value of all measurements in each group. In the charts the SCR value are represented on the y-axis.

Monoscreen versus Rotoscreen

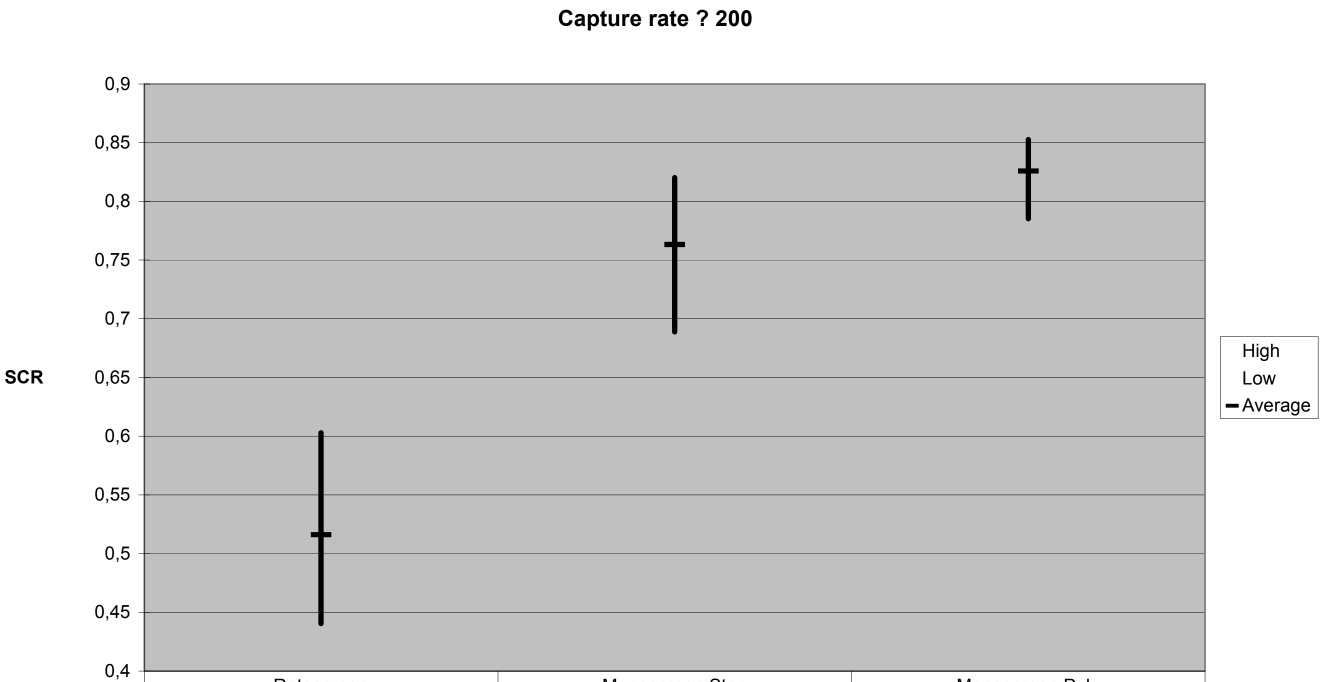
It can be seen from studying Chart 1 (showing the results at 200 mm pressure drop) that Monscreen represents the highest mean value with the SCR varying from 0.69 to 0.82 operated at stepmode and 0.79 to 85 at pulsemode. The Rotoscreen yields significantly lower results with SCR results between 0.44 and 0.6. The measurements at 400 mm pressure drop show the same tendency with considerable higher SCR values of the Monoscreen than the Rotoscreen.

The conclusion to be made is that the Monoscreens operated at pulse mode have approximatly 54-60% more efficient screening capacity than the Rotoscreen.

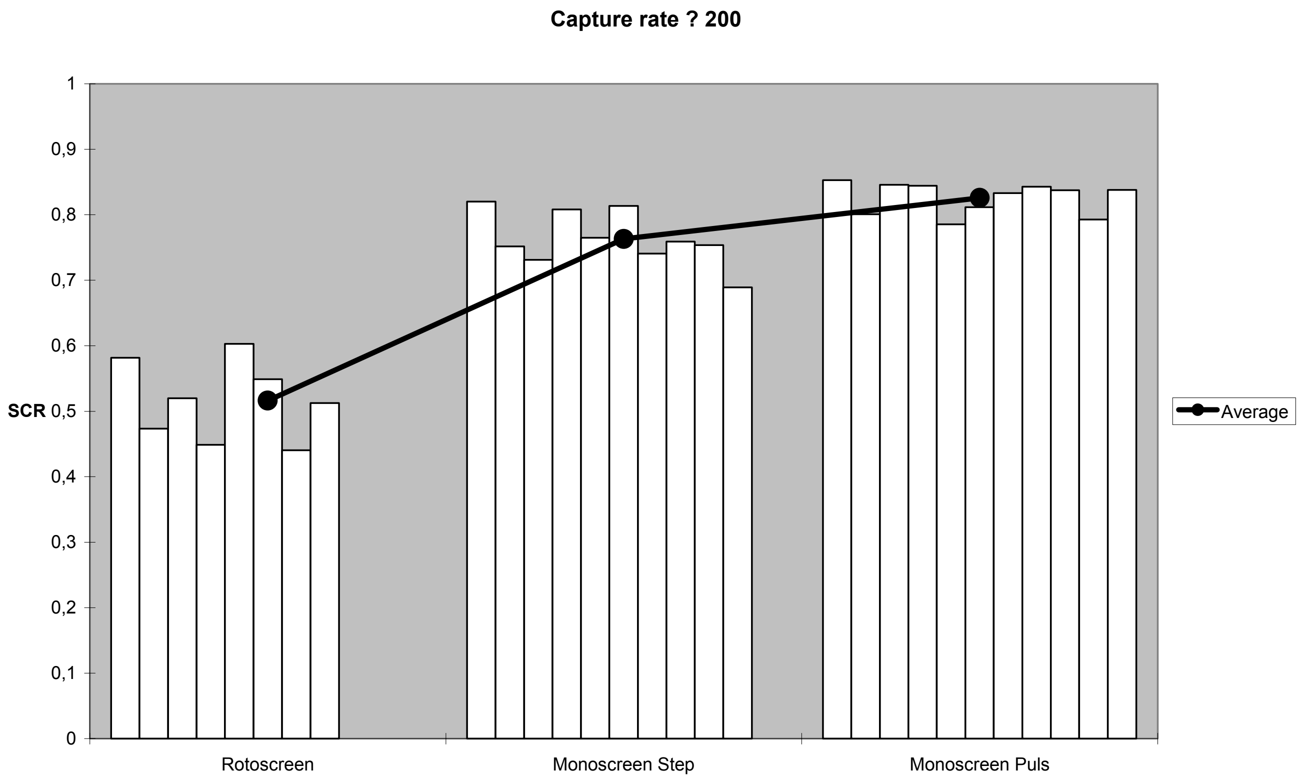
Pulse- versus step mode

In the diagram showing the capture rate at 200 mm pressure drop it can be seen that the screen run in pulse mode results in somewhat higher screening efficiency. The SCR range from 0.69 to 0.82 with an average of 0.76 in step mode compared to 0.79 to 0.85 with an average of 0.83 in pulse mode. In the 400 mm pressure drop diagram this effect appears even better, with the step measurements results ranging from 0.65 to 0.77 (average: 0.71) and the pulse results from 0.75 to 0.86 (average: 0.80).

It can be concluded that the Monoscreen operated at pulse mode yields approximately 9-12% more favourable screening efficiency than when run in step mode.



	Rotoscreen	Monoscreen Step	Monoscreen Puls
High	0,602803738	0,82010582	0,852686308
Low	0,440443213	0,688953488	0,78528827
Average	0,516035965	0,763200373	0,825887899



Capture rate ? 400

	Rotoscreen	Monoscreen Step	Monoscreen Puls
High	0,570977918	0,766233766	0,858849888
Low	0,480300188	0,65470852	0,745814307
Average	0,5238054	0,711113306	0,802506021

Capture rate ? 400