# D4.2 Optimized finescreen operation

Co-funded by the Eco-innovation
Initiative of the European Union

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| **Grant agreement no:** | 630492 |
| **Deliverable number:** | D4.2 |
| **Partner responsible:** | WAM |
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| **Planned delivery date:** | 30 June 2016 |
| **Actual delivery date:** | 5 October 2017 |
| **Dissemination level:** | PU = Public |

# Table of contents

# Executive summary

This report is a summary of the results and conclusions of the first 2.5 months of the Screencap research, from period October 13$^{th}$ to December 31$^{th}$ 2016. A few times some observations after this period are already mentioned.

The Screencap monitoring research will be executed for one year, and will continue until November 2017. So the results and conclusions in this report are preliminary and can change during the continuation of the monitoring research.

Realisation of the project and start-up of the Screencap research:

The realisation of the fine screen installation started at January 2016 at the waste water treatment plant (wwtp) Aarle-Rixtel.

In September/October 2016 the equipment and the control system were tested, after which at October 13$^{th}$ 2016 the official start-up of the fine screen installation took place. Since October 13$^{th}$ 2016 the fine screen is continuously in operation at waste water treatment lane 1, and the Screencap monitoring research was started. The Screencap monitoring research focusses both on the performance of the fine screens and on the impact of the fine screens on the wwtp process.

In advance of the Screencap monitoring research, zero-measurements were executed, which are reported in the report "zero-measurement" (D4.1).

Monitoring plan:

The research is executed conform the monitoring plan. Initially sampling and analyses were done at high frequency, later the sampling schedule was adjusted based on the results. The samples are taken by the personnel of the wwtp, the analyses are executed by both the wwtp personnel and the accredited laboratory Aquon. The data from the in-line analysers of the wwtp are used in the research as well.

Initially not all sampling locations and automatic samplers were available, and frequent failures of the automatic samplers took place. In that case alternative samples were used, for instance a grab sample instead of a composite sample, another sampling location, or the sample was skipped.

# 1 Operation

## 1.1 Fine screen operation:

From October 13th to December 13th 2016 only minimal disturbances appeared to the fine screen installation. The minor disturbances were for instance a failure of a valve, a defect in a motor etcetera, but these minor disturbances have not impacted the operation of the fine screen installation. The results over these first two months are representative for normal operation.

In the last weeks of December there were issues with the fine screens itself, as the belts broke and the soap cleaning was not effective. These issues resulted in a less efficient operation and a lot of maintenance work. After 3 á 4 months, problems with the presses for dewatering of the screened material (screenings) appeared (beginning of 2017).

In May 2017 in collaboration with the supplier (BWA) modifications/optimizations to the fine screens and the cleaning installation (nozzles) were made to prevent these problems.

## 1.2 WWTP operation:

During the first months of fine screen operation no effect on maintenance work of the wwtp was observed yet. Less maintenance work at the wwtp is expected due to the fact that the fine screens remove also hairs and other cloggy material from the waste water, which will no longer clog to (measuring) equipment.

## 2 Performance of the fine screens

Based on the composition of the feed and effluent flows of the fine screens, the following removal efficiencies and standard deviations are calculated (average of Aquon and wwtp results):

| | **Removal efficiency** (%) | **Standard deviation** (estimated, %) |
|---|---|---|
| Suspended solids (SS) | 26 | 26 |
| COD | 18 | 18 |
| BOD | 24 | 20 |
| N | 10 | 10+ |
| P | 5 | 20 |

**Expansion wwtp capacity:**

With these removal efficiencies, it is calculated that about 15% of the waste load (pollution equivalents) (st.dev. 15%) is removed by the fine screens.

**Waste load in return flow from drain and dewatering:**

The percolate water of the dewatering presses and the drainage water of the fine screen compartments that is released during (soap) cleaning, are discharged to the drain pit. From the drain pit, the water is returned to the sand trap, specifically to the compartment from which the supply pumps suck water to be pumped to the according fine screen. The waste load in this return flow is considerable: for suspended solids (SS) it is 6% in comparison to the influent load, and for COD it is 1%.

Composition of the screenings:

| | **Component (%)** | **% of fibres** |
|---|---|---|
| Dry weight (DW) | 29 | - |
| Fibres | 69 | - |
| Cellulose | 55 | 80 |
| Hemicellulose | 9 | 13 |
| Lignin | 5 | 7 |
| Ash | 11 | - |
| Grease | 7 | - |
| Protein | 10 | - |

# 3 Impact on wwtp process:

After the first 2.5 months of fine screen operation the following conclusions are drawn about the effect of the fine screens on the wwtp process:

## 3.1 Effluent:

The effluent concentrations ($NH_4$, $NO_3$, $PO_4$) stay similar. This is proved by both the results of the analytical analysis and by the trends of the in-line analysers.
Remark: see recommendation for nitrate.

## 3.2 Activated sludge:

- The settlability of the sludge (sludge volume index, SVI) stays the same.
- Dewatering of the sludge mixture from the fine screen lane and the conventional lane stays the same (dry weight (DW%), polymer (PE)-consumption).
- Microscopic: flock structure and bio-composition stay the same.
- Microscopic: fibre content in the fine screen lane is “halved”.

## 3.3 Energy:

- Aeration energy is decreased in the fine screen lane (approx. 12%, 400 kWh/day).
- Effect on energy consumption for sludge dewatering is not determined yet.
- Energy consumption for the fine screen installation (lane 1): 1400 kWh/dag.
  - ➔ Net effect: significant increase in energy consumption (approx. 1000 kWh/day), mainly because of the specific design in which pumping of the waste water is needed to implement the fine screen installation into the wwtp.

# 4 Recommendations:

### 4.1 Nitrate in effluent:

- The results of lab-analyses of the fine screen lane (24h composite sample) are higher than the results of grab samples of one secondary clarifier of the conventional lane. This is probably due to the sampling method because the in-line analysers of both lanes have equal trends and the composite sample "total effluent" is equal to the composite sample of the effluent of the fine screen line. Consider to install an automatic sampler on the effluent of one of the clarifiers of the conventional lane, so that for both wwtp lanes composite samples can be compared. Before doing that, determine first that the effluent quality of all clarifiers of the conventional lane is equal.
- An attention point for a good denitrification process is the lower BOD / N (=3.1) ratio in the waste water of the fine-screen lane, approaching the critical limit (theoretical 2.86).

### 4.2 Analytical methods:

- *SS-analysis:* There are differences between the results of Aquon and the wwtp. This is due to the fact that both laboratories use different filters with different pore sizes. This results in differences in the calculated removal efficiencies. It is recommended to determine the differences and to decide which filters will be used in the continuation of the research.
- *COD-analysis*: When analysing COD in effluent, there are differences between the results of Aquon and the wwtp. The wwtp uses cuvettes with a broad range (20-1500 mg / l) for the COD analyses. The COD concentration in the effluent is at the bottom of this range, where the reliability is relatively low. It is recommended to execute the analysis on the wwtp with lower range COD cuvette and compare the results.
- *Cellulose (NDF, ADF, ADL) analysis at Masterlab laboratory*: This method is commonly used in animal feeds production, but seems unreliable for analysis of cellulose in sludge. It’s recommended to investigate the reliability of the method for sludge samples.
- *Sludge activity tests:* There are only a few results yet. Intensify the investigation of this parameter.

### 4.3 Balances, loads … etc.:

Attention points are:

- Activated sludge tank: waste sludge flow vs. sludge concentration (MLSS).
- Screenings production vs. waste sludge production.
- The difference in influent composition of both lanes is lower than expected. This should be investigated.

**Sludge dewatering:** Test the dewatering of sludge of both wwtp lanes separately.

**Energy:** Determine the energy consumption for sludge dewatering.