Experience with Overflow Measurements

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INTRODUCTION

Storm overflows are an emergency valve for the common sewer system. When there is heavy rain, some of the diluted wastewater is directed into the recipient and the rest runs to the wastewater treatment plant (WWTP). The sewer cannot always transport all the water during rain because of the limited capacity both in the sewer and at the WWTP. Storm overflows prevents wastewater from entering basements or sewer covers from being pushed aside.
Recently, there has been a lot of focus on this issue in the Danish media. But there has been no reliable data on what concentration has been led out to the recipient.
Since 2018, Billund Biorefinery has measured water volumes that run through storm overflows throughout Billund municipality. In 2021, Billund Biorefinery began a project focusing on measuring the concentrations of ammonium, total phosphorus, total nitrogen, total COD and suspended solids in the overflow water. The initial stage of the project was to procure reliable representative samples and thus investigate the hurdles in procuring them.

During the course of the experiment with concentration measurements, there were several challenges that needed to be solved to ensure representative samples. Factors including backflow from the recipient, the measuring equipment and sampling impurities. This poster aims at sharing the experiences gathered from 6 months of measuring overflow concentrations and flow. The key factors are the placement of the flow sensor, backflow from the recipient and the settings on the sampler.

The results presented on this poster is the ammonium and total phosphorus concentration and loads from several overflows.

METHODS

For the experiment, a novel sampling equipment was specifically built including a programmable sampler equipped with 16 containers. The sampler was programed to collect a sample every 5 minutes in a container when the flow sensor registered flow. After 5 minutes the sample was collected in the next container and so on. The main focus was documenting the change in concentrations at the start of the overflow, also called the first flush, as it is expected that there will be a high concentration during this period.

The flow sensor was located at the overflow weir edge, this gave issues in the flow measured because the water was too turbulent going over the edge. Moving the flow sensor down into the outlet pipe solved this issue.

The placement of the sampler's suction head should not be too low because of the risk of collecting impurities already in the tubes and not so high that the suction head cannot reach the water if the flow is low.

The picture on the left shows the inside of the sampler. The picture on the right is a view looking down into the pipe transporting the wastewater from the overflow to the recipient.

RESULTS - AMMONIUM

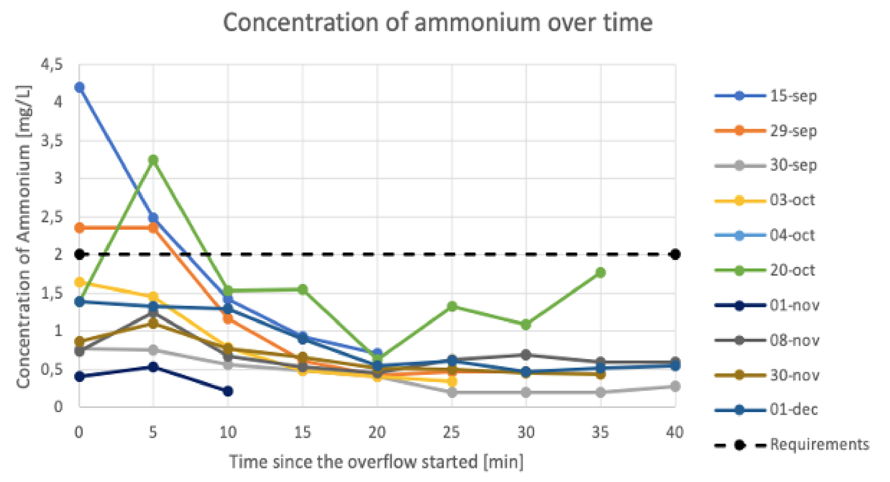

Figure 1 This graph shows the concentration of ammonium in overflows over time. The black striped line is the emission requirements from the WWTP.

It is worth noting that although some of the concentrations start at a high concentration, they become measurably less within the time frame analyzed.

Note that some data points are missing. The reason for this is that sometimes concentrations was too low to measure. The reason why 15. September and 3. October have missing data points point to a short overflow time

Generally, the loads are low. However, there are some overflow loads that are high since both the concentration and volume are substantial.

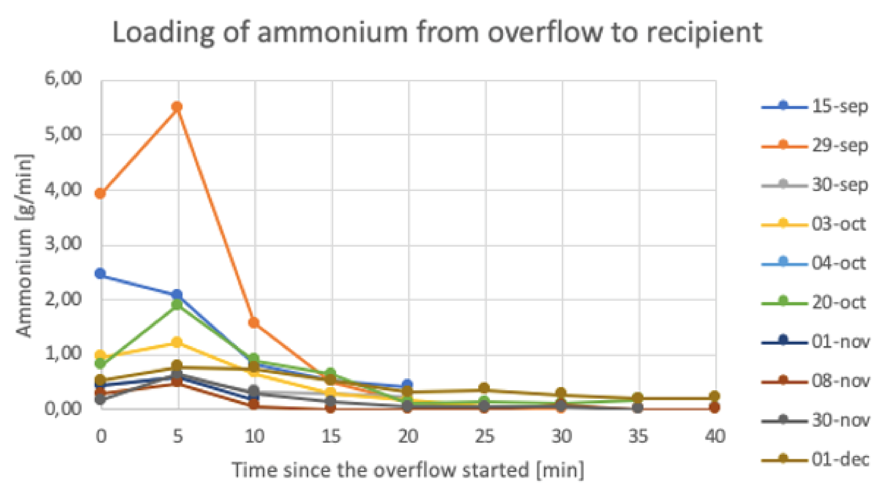

Figure 2 This graph shows the loading of ammonium from overflows over time.

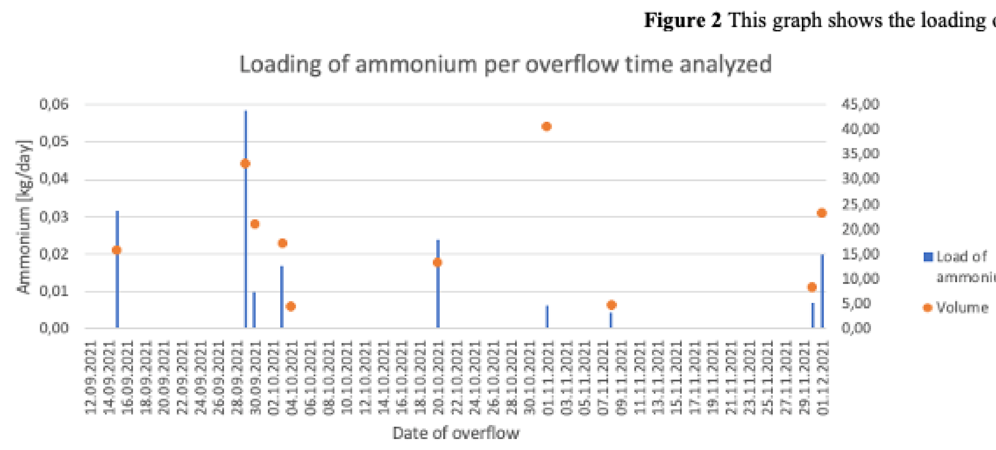

Figure 3 This graph shows the load of ammonium compared with the volume of overflow water. Furthermore, is the date between overflows visualized.

Fig 3 shows that the previous occurrence of overflow has a huge effect on the concentration.

Highlighting the period between the 29. September – 4. October.

RESULTS - PHOSPHORUS

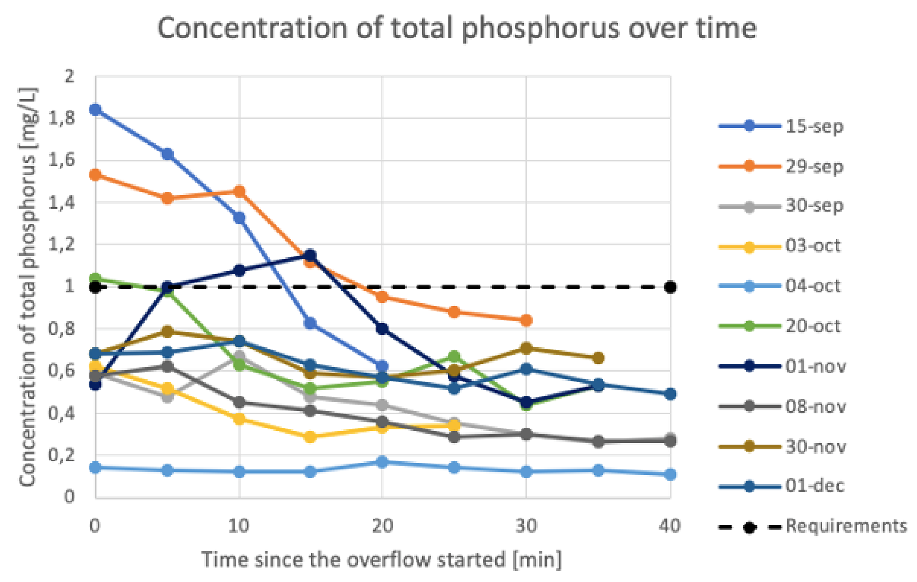

Figure 4 This graph shows the concentration of total phosphorus in overflows over time. The black striped line is the emission requirements from the WWTP.

It is worth noting that although some of the concentrations start at a high concentration, they become measurably less within the time frame analyzed.

Note that some data points are missing. The reason for this is that sometimes the overflow has stopped.

Generally, the loads are low. However, there is one overflow load that is high since the concentration and volume are substantial higher than what was measured in the other overflows.

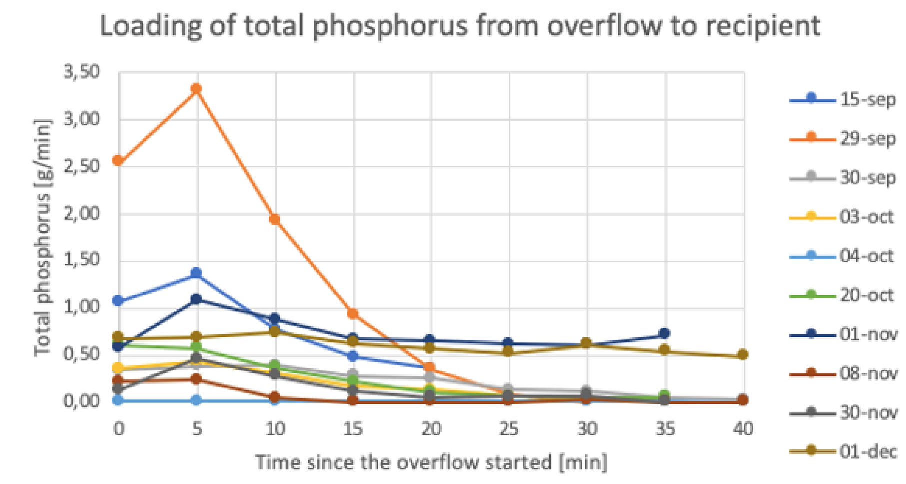

Figure 5 This graph shows the loading of total phosphorus from overflows over time.

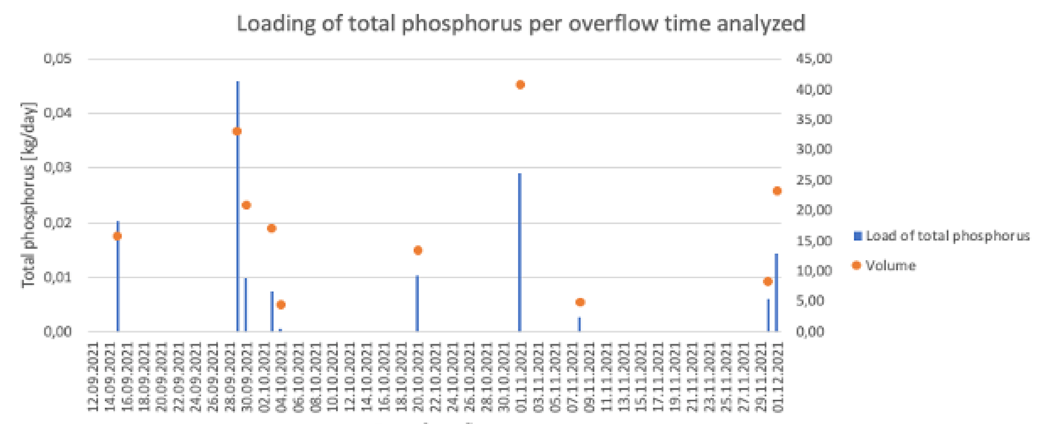

Figure 6 This graph shows the load of total phosphorus compared with the volume of overflow water. Furthermore, is the date between overflows visualized.

Fig 6 shows that the previous occurrence of overflow has a huge effect on the concentration.

Highlighting the period between the 29. September – 4. October.

CONCLUSIONS

It is observed that the change in concentration happens quickly over time – here within minutes. It is also very dependent on the time since the last overflow. This too is true with a high starting concentration.

The positioning of the flow sensor is of extreme importance. If moving the flow sensor to the outlet pipe is considered, contemplate the possibility of backflow. We experienced backflow from the recipient back into the sewers due to the level of the recipient after rain. This simulated an overflow and gave a false positive, as the flow sensor measures the height of the water level. Backflow from the recipient typically takes a long time to recede because of the large volume that comes through. We found two measures without rebuild that helped in this. The first is be aware of the season. The groundwater is higher in winter compared with summer, which makes the recipient rise, which increases the probability of backflow. The second advise is setting up a rain gauge in the immediate vicinity to compare the precipitation with the overflow. If it has rained heavily shortly before a recorded overflow it is a sign that it is a true overflow.

Regardless the volume passing through the storm overflow, the sampler must be able to collect a representative sample. From our experiment we could see that the concentration of all parameters, as expected falls with time. In our case this was within the first 30 minutes, this time will be specific to each sewer system and could possibly be determined by the method we have used in this study. The time period between overflows, and the flow during the previous overflow has a noticeable influence on the concentration during the current overflow. For the reason that the sewage pipe accumulate deposits, which is flushed away doing the first flush.

REFERENCES

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