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Case Study

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OPTIMIZATION OF COMBINED SEWER OVERFLOW (CSO) ENHANCED PRIMARY TREATMENT BY USING DIFFERENT COAGULANTS

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1 Overview

Wet weather flows (WWFs) are caused by heavy rains and more frequent snowmelt conditions causing the influent flow out of the combined sewer system (CSS) to exceed the wastewater treatment plant (WWTP) capacity. WWFs are usually diverted to the North Saskatchewan River when this occurs, resulting in the release of large quantities of untreated pathogens and waste to the natural river ecosystem. WWFs out of CSSs consist of a wide range of physical, chemical and microbiological pollutants. In order to better treat WWFs before discharge, a system known as Enhanced Primary Treatment (EPT) has been initiated at a local WWTP whereof upwards of 1,200 MLD of CSO wastewater flow would undergo primary treatment before discharge. This EPT system has its drawbacks, since it does not treat the influent wastewater for pathogens, only enhancing the settling characteristics via the addition of polymer and alum coagulant. Coagulants such as Alum, polyaluminium chloride (PACl) and ferric chloride ($FeCl_3$) may help to achieve lower pathogen counts in the EPT effluent, thereby protecting the receiving river environment and meeting regulatory discharge limits. The coagulants and coagulant aid would assist in the removal of solids as well any biological pollution adsorbed on the solids via flocculation (Metcalfe & Eddy, fifth edition).

The objectives of this study are: (1) to determine the optimum mixing conditions that achieve maximum removal efficiency for important parameters such as chemical oxygen demand (COD), pH, turbidity, alkalinity, total suspended solids (TSS), total volatile suspended solids (TVSS), ortho-phosphate, coliforms and E. Coli colony counts, and (2) to qualitatively determine the best performing coagulant out of the three mentioned by observing the effect on the parameters mentioned above.

2 Methodology

A two-level factorial design was developed and implemented between the months of May 2016 and March 2017. Jar Test apparatus were used to implement the factorial design.

3 Results

The results obtained from the final sampling campaign are shown below in Figure 1.

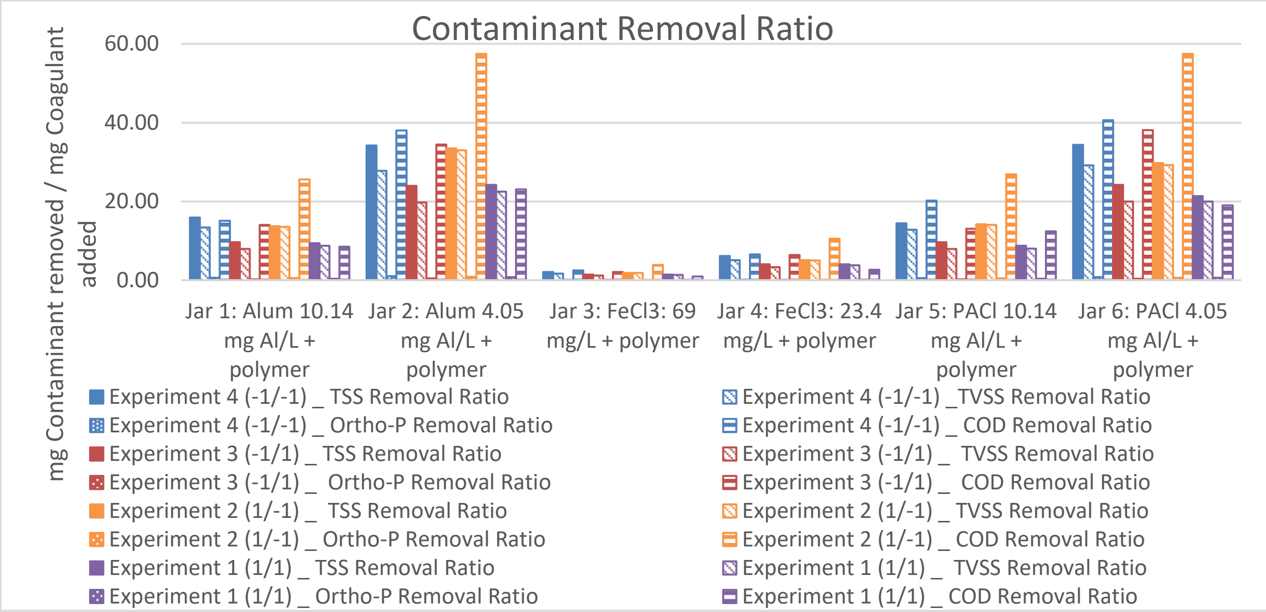

Figure 1: Contaminant Removal Ratio for final sampling campaign

Figure 1 is a representation of the four major parameters that were observed during the final sampling campaign, namely TSS, ortho-phosphate, TVSS and COD. The contaminant removal ratio was calculated based on how many mgs of contaminant was removed for every 1 mg of coagulant added. It was observed that the Alum and PACl low doses were most efficient at reducing each contaminant per mg of coagulant used. The $FeCl_3$, in comparison, was not effective. pH levels did not vary significantly throughout the campaigns and thus have been left out. Turbidity was mirrored effectively by TSS and has been left out for brevity. Nitrate, nitrite and the microbiological tests were inconclusive and have been left out for brevity.

4 Conclusions

It was concluded that the $FeCl_3$ was not an effective coagulant where as the Alum and PACl were most effective at lower doses. Out of the two, Alum is likely the most cost effective due to the relatively high price per ton of PACl.

5 Lessons Learned

During the course of the second set of experiments, it was observed that the high dose of PACl was too high when compared to the Alum dose range with respect to active Al species. The PACl doses were adjusted to match the Alum dose in regards to active Al species for the final sampling campaign.

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References

Metcalf & Eddy. 2014. Wastewater Engineering, Treatment And Resource Recovery. *Fifth edition*, AECOM.