Optimizing the Dewatering of Sludge Obtained from Different Treatment Processes along with the Full Scale Application

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Introduction

The wide application and utilization of the waste activated sludge (WAS) process in the wastewater treatment plant generates a serious disposal problem due to the excess sludge. Many resources have been devoted to reduce the cost of treatment and disposal by decreasing the sludge production, and improving the dewatering process. In most cases, the cost of excess sludge management and handling, including dewatering as well as transportation, drying and incineration, comprises a significant fraction of operational costs for the wastewater treatment plants (Mikkelsen and Keilding, 2002).

In this study, dewatering was performed on sludge from different treatment processes. This study will get more comprehensive insights into dewatering mechanisms of different sludge with individual characteristics. Therefore, the inner correlation between sludge characterizations with optimum polymer dose and cake TS% will be investigated. Another focus was be on the role of thermal hydrolysis process (THP) in changing the sludge dewaterability in a mechanistic view. Sludge dewatering also depend on the operational conditions. So the role of operational parameters on the dewatering process was also investigated in this study.

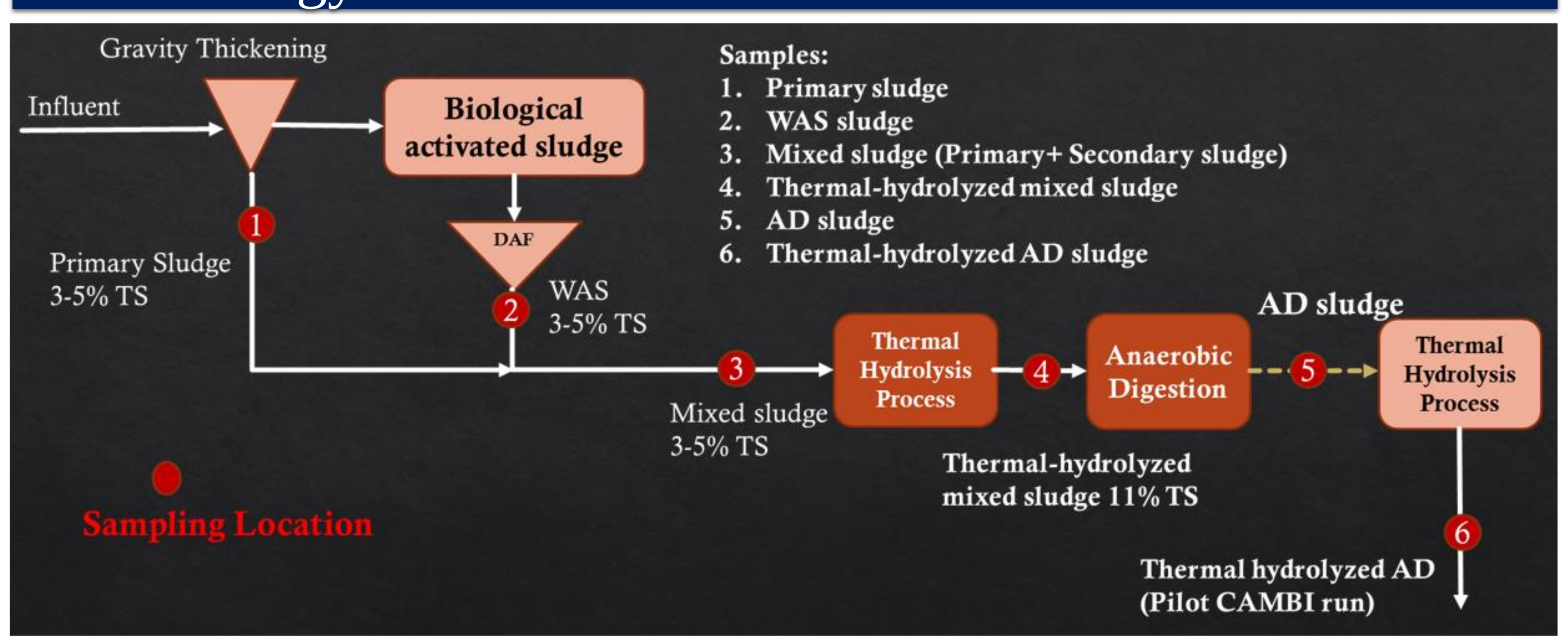
What is Dewatering?

It is basically a process of separating the solid waste matter from the sludge and converting into a dried filter cake.

Why Dewatering is necessary?

Dewatering not only saves water but also helps in reducing the amount of waste to be disposed of, reducing the transportation costs, labor, and time.

Methodology



The whole experiments are divided by two parts.

1. Batch Scale experiment
2. Full scale application

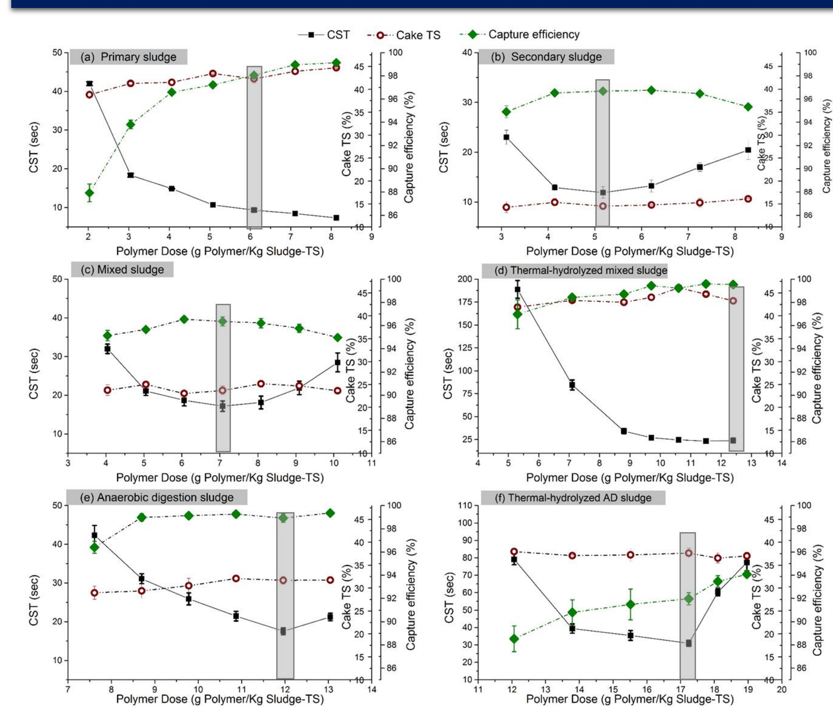
Lab-scale dewatering tests were performed following the methodology described by Higgins et al. (2014) Filtrate were analyzed for Total Suspended Solids (TSS), Volatile Suspended Solids (VSS), total Chemical Oxygen Demand (total COD), particulate COD, colloidal COD, soluble COD, NH3-N, Protein, Polysaccharide and surface charge. The optimum polymer dose range was determined by evaluating the CST.

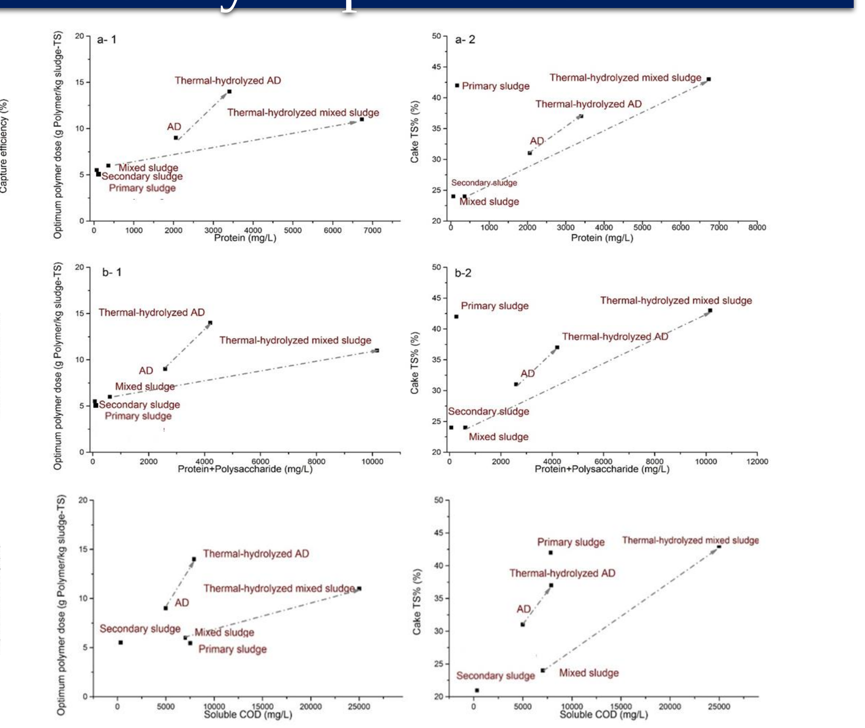
Sixteen belt filter press dewatering (Winklepress, Ashbrook) have been installed at the Blue Plains facility for a design load of 1000 lbs/m/h and peak load of 1500 lbs/m/h. The Full scale experiments were done for three different operational parameters- Polymer load, belt speed and the Floc mixing rate. Feed and filtrate from the belt filter presses were analyzed for TS, VS, TSS, VSS and ammonium and phosphorus.

Objective

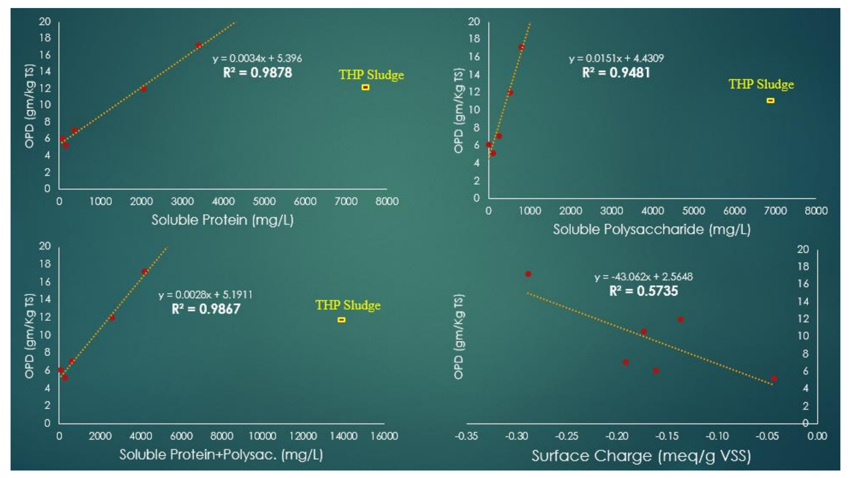
The objectives of the study are mechanistically understanding of dewatering fundamentals on sludge from different treatment processes and investigating the role of operational parameters on sludge dewaterability.

Results: Part A- Batch Scale Laboratory Experiment

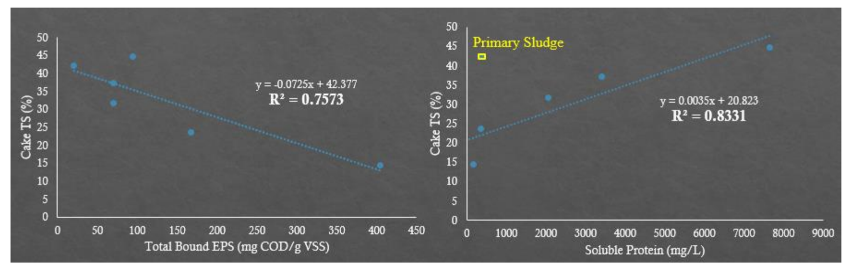




Type of Sludge	Soluble Protein (mg/L)	Soluble Polysaccharide (mg/L)	Total Bound EPS (mg COD/g VSS)	Total Surface Charge m eq/gm TS	Total COD (mg/L)	Soluble COD (mg/L)	NH3-N (mg/L)	Optimum Polymer Dose g Polymer/kg sludge-TS	Cake TS %	Capture Efficiency %
Primary Sludge	69±3	4±0	20.7	-0.16±0.008	75500 ±707	7850 ±354	147 ±2.8	6.1	42	99
Secondary Sludge	167 ±1	102±17	404.2	-0.04±0.014	36600±1131	320±28	89±4	5.2	15	97
Mixed Sludge	361±3	252±1	167.5	-0.19±0.056	69500 ±707	7050 ±71	261 ±2.8	7.1	24	97
THP+Supernatent	7650±49	7155±67	94.3	-0.17±0.01	86300±1556	38650±919	740±14	10.6	45	99
AD sludge	2059±24	532±17	70.5	-0.14 ±0.04	50650 ±71	5000 ±0	2990 ±14.1	12	32	99
Thermal-hydrolyzed AD	3404±7	796±12	70.7	-0.29 ±0.024	34000 ±1414	7900 ±424	1220 ±14.1	17.2	38	92



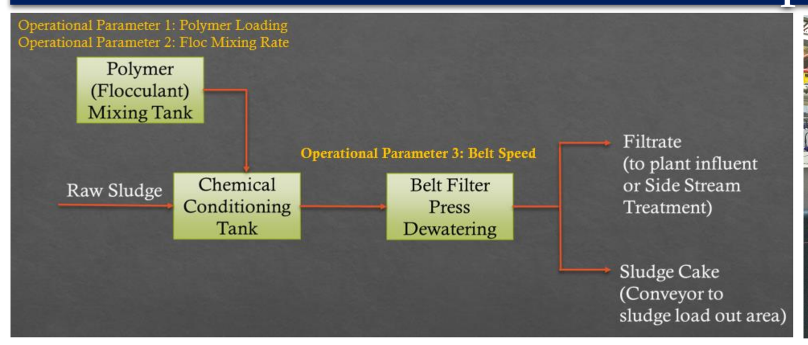
Optimum polymer dose (OPD) is strongly correlated with soluble protein, and soluble polysaccharide, where THP sludge is the outlier due to the release of excessive amount of protein and polysaccharide. Besides, OPD is moderately correlated with surface charge.

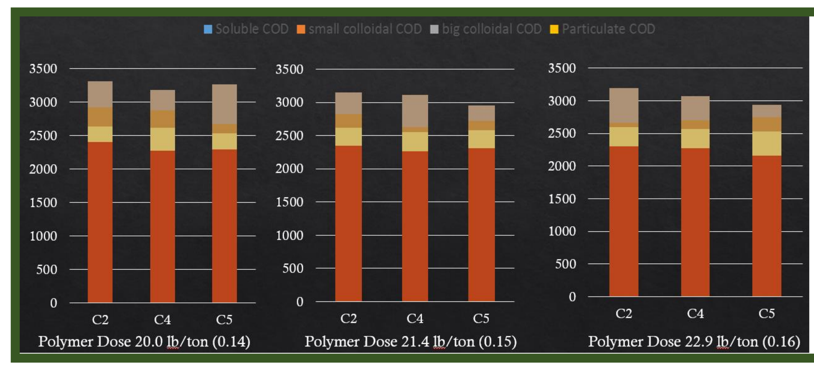


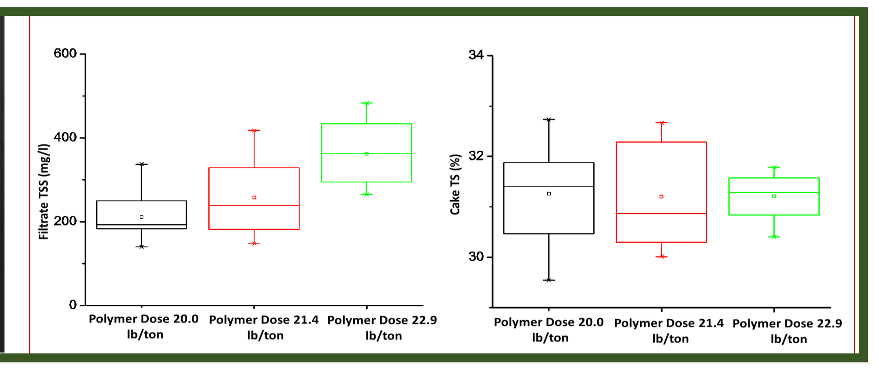
A good correlation was found between Cake TS and soluble protein. Primary sludge is an outlier on that graph due to the presence of very low bound EPS.

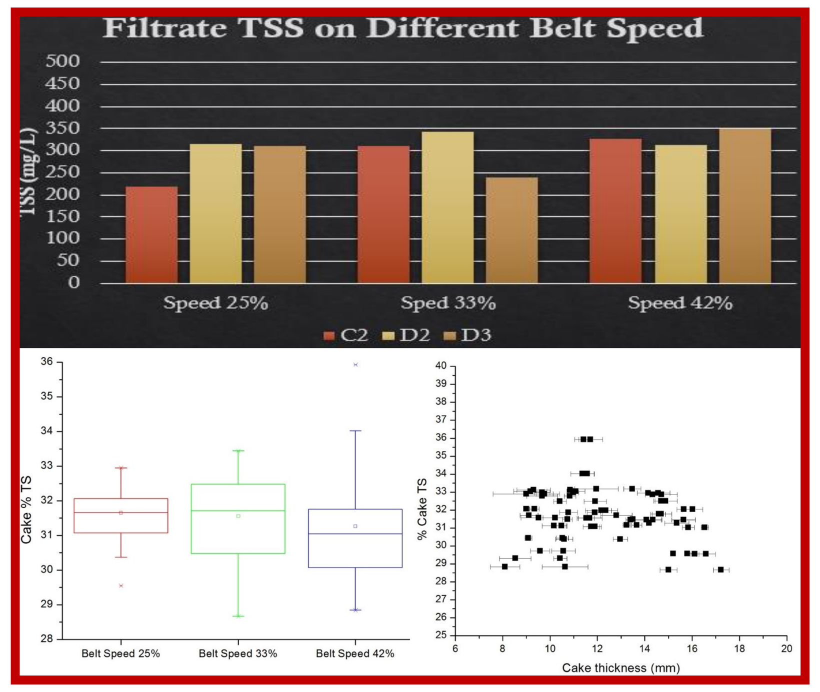
The batch scale test proves that sludge composition has a major role in optimum polymer dose and Cake TS.

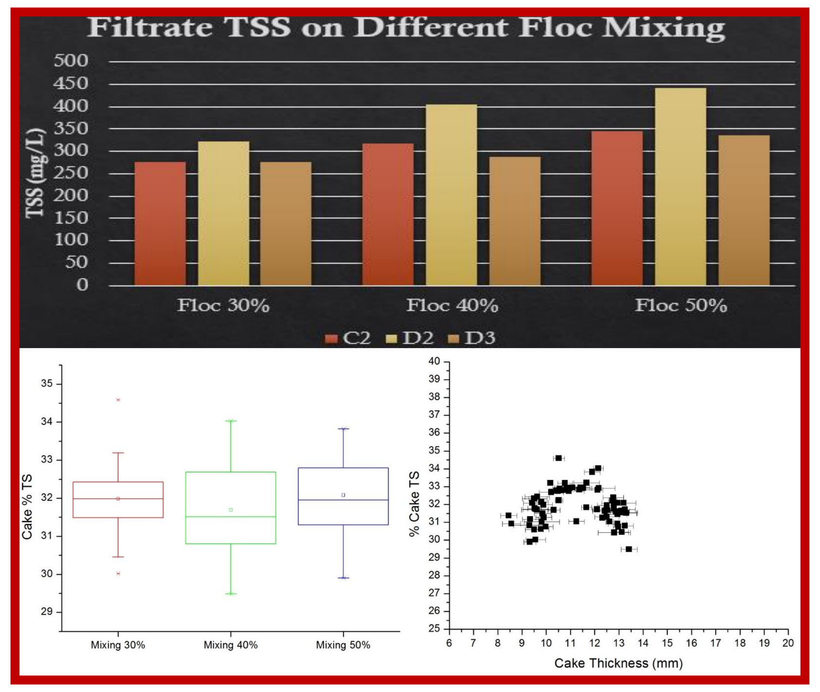
Results: Part B- Full Scale Application

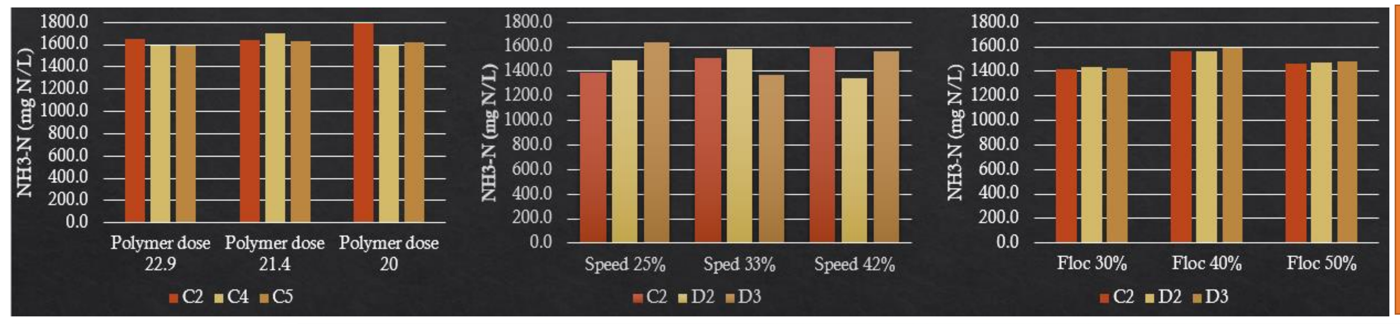




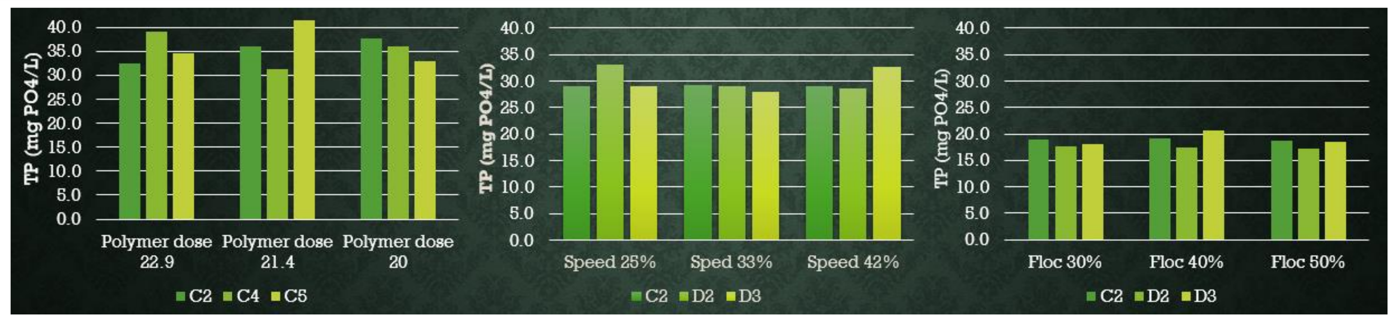








NH_3-N in the filtrate was stable for different operational parameters.



Total Phosphorous in the filtrate doesn't vary significantly

Conclusion

- The activated sludge has lower dewaterability, which was due to the high content of bound water within biomass, by comparing the secondary sludge with primary sludge, and thermal-hydrolyzed mixed sludge with THP-AD sludge.
- The improvement in sludge dewatering could be achieved by the thermal hydrolyzed process, for the lysis of the cell and free of the bound water.

- In Fill scale experiment, Cake thickness largely varied for different belt speed. High belt speed (lower loading rate) causes lower cake thickness. But there is no visible change of dewaterability for different floc mixing rate.

Acknowledgement

Funding for this research was provided by the District of Columbia Water and Sewer Authority (DC Water). Special thanks to Haydee De Clippeleir, Ahmed Al-Omari and Qi Zhang.