BIO-CEL® MBR Modules Use of Cationic Polymers in MBR Filtration

THE USE OF CATIONIC POLYMERS FOR DEWATERING AND ITS EFFECTS ON BIO-CEL MBR MODULES

INTRODUCTION

This technical bulletin will provide some technical background as well as practical suggestions that can be followed in order to prevent membrane fouling when using these types of polymers. This document merely focuses on cationic polymer application for clients who choose to use it over other polymer types for dewatering.

MECHANISM OF CATIONIC POLYMER

Municipal wastewater is often negatively charged and because of this is electrostatically dispersive. A cationic flocculant has multiple positive charges on the unraveled polymer chain which allows the collecting and binding of the sludge. This creates larger flocs and aids in dewatering. The polyelectrolyte comes wound up and needs some reaction time to open (unwind) to be effective in the flocculation process. The general reaction is to aid in filterability (dewatering) but also reduction in SMP (soluble microbial products) and ECP (extra-cellular products) from the biological step. The ECP and SMP are considered to be major contributors to membrane fouling and have been found to be bound up by the cationic polymers, thus reducing the fouling effect. Reported optimal doses were between 100–150 mg/L for cationic polymers but this depends on the specific wastewater and product used. Optimization of dosing can be established for specific treatment plants using a trial method.

FILTERABILITY

There is better filterability with cationic then with anionic or non-ionic because of electrostatic attraction of the polymer to the wastewater. The larger the average particle size distribution is, the better the dewaterability becomes. Filterability decreases as particle size approaches the selectivity / pore size of the membrane so increasing the flock size will naturally increase filterability. Performance of cationic polymers is not affected much by small variations in dosing control whereas small changes in anionic concentrations have larger impacts on filterability performance. The anionic and non-ionic polymers presented reduced filterability when either overdosed or under-dosed.

FOULING EFFECTS

Membrane fouling is found to be worse without the dosing of polyelectrolytes. The cationic polymers will trap the ECP and SMP in flocs and therefore there is less interaction with the membrane surface and pores, resulting in less reversible and irreversible fouling.

WARNINGS

Uncoiling of the polymer chains takes some time. This means that the polymer addition needs be done early in the process in a well-mixed area with some retention time prior to entering into the filtration tanks. Preferentially dosing can take place in its own mixing tank with some permeate to allow for the full uncoiling effect to take place.

MANN+HUMMEL

Care needs to be taken when combining cationic polymers with an anti-scalant (which is often a negative charge profile) because then the cationic polymers are ineffective for dewatering and cause further membrane fouling.

COUNTER ARGUMENTS

Some papers suggest that high molecular weight anionic polymers are better performing then cationic ones because they claimed that charge density has a small effect on the dewatering process. They also make claims that less dosing is required for anionic polymer compared to cationic which means a reduced cost, better fouling reduction and better phosphorous removal. It is also found that higher molecular weight is more important to dewatering then charge density.

CONCLUSION

Cationic polymers can be used in certain applications when anionic polymers are not available commercially. They need to have enough time to activate before being exposed to the membranes in the filtration step. This activation time needs to be confirmed with the polymer supplier/manufacturer. A dosing scheme needs to be followed and optimized for the specific wastewater treatment facility.

REFERENCES:

Chesters, S.P et al. (2009). The safe use of cationic flocculants with reverse osmosis membranes.

Wang S, et al. (2011). Fouling of microfiltration membranes by organic polymer coagulants and flocculants; controlling factors and mechanisms, PubMed

Dizge N. (2011). Effects of cationic polyelectrolyte on filterability and fouling reduction of submerged membrane bioreactor (MBR), Elsevier

Gkotsis P. (2020). Using additives for fouling control in a Lab-scale MBR; Comparing Anti-fouling potential of coagulants, PAC and Bio-film carriers. MDPI

Nevzat O. (2010). Filterability of membrane bioreactor (MBR) sludge: impacts of polyelectrolytes and mixing with conventional activated sludge. Water Science Technology

Koseoglu H. et al. (2008). Effects of several different flux enhancing chemical on filterability and fouling reductions of membrane bioreactor (MBR) mixed liquors. Elsevier

Melin E. et al. (2013). Improving MBR sludge filterability by combination of inorganic coagulant and anionic flocculant. Researchgate.

Zang D. (2017) Study of polymers for Membrane and for flocculation/dewatering of Mature fine tailings. University of Alberta.
Gkotsis P. et al. (2014). Fouling issues in Membrane Bioreactors (MBRs) for Wastewater treatment: Major Mechanisms, Prevention and Control Strategies. MDPI

Gkotsis P. et al. (2017). Wastewater treatment in Membrane Bioreactors: the use of polyelectrolytes to control membrane fouling. Springer.

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