The Effects of GAC in Anaerobic Treatment of Wastewater

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Introduction

Anaerobic digestion is a biological wastewater treatment process in which bacteria break down contaminants in water in the absence of oxygen. In this process, the addition of granular activated carbon (GAC) has been shown to improve anaerobic digestion treatment performance. GAC is an absorbent and conductive material that has a large surface area to volume ratio due to its small size and high porosity. This large surface area allows for more colonies of anaerobic bacteria to create larger biofilms for improving treatment performance inside the reactor. The conductivity of GAC also allows for increased activity of electroactive bacteria that have also been shown to increase treatment performance.

Objectives and Methods

Objectives

- To determine the effects of GAC on the performance of the methanogens in anaerobic digestion

Methods

- 500mL reactors were supplied with 20mL of sludge, 17mL of concentrated synthetic wastewater, and 363mL of water. Two reactors were also supplied with 2.5 g/L and 10g/L of GAC each
- Chemical Oxygen Demand (COD): 2ml of bulk solution was sampled once every seven days over the course of two weeks for COD tests
- Mixed Liquor Suspended Solids (MLSS): 1ml of bulk solution was sampled once every seven days over the course of two weeks for MLSS filtration

Skills Learned

- Mastered pipetting and filtering technique
- Expanded knowledge of reactor construction
- Reinforced data processing skills
- Learned instrumentation
- Managed anaerobic bioreactor operation

Results and Discussion

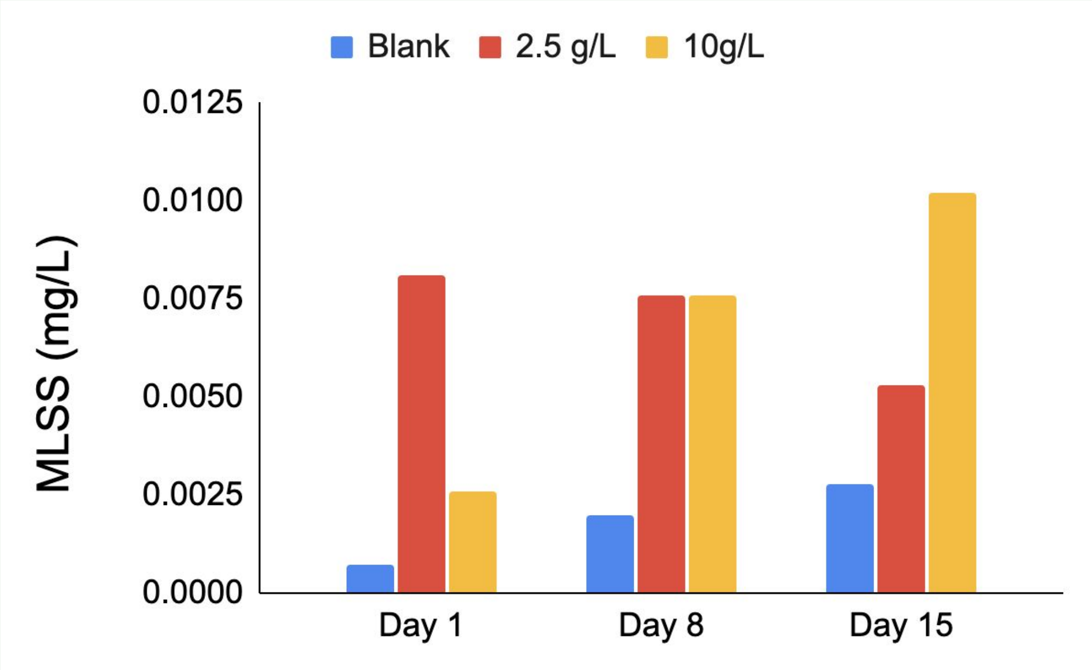

Figure 1: MLSS of the 3 reactors over two weeks

As seen in Figure 1, the MLSS of the control reactor shows an upward trend over the two weeks. The reactor with 10g/L of GAC shows a similar upward trend of MLSS increasing over time. These two trends imply a pattern of MLSS increasing over time and GAC helping to increase the rate of production of MLSS. This is due to the increased number of colonies of microbes that are able to form more biofilm in the reactor which contributes to the overall MLSS. Problems arise with an overall trend due to the reactor with 2.5 g/L GAC. The 2.5g/L reactor had a surprising surplus of MLSS early on and displayed a trend of decreasing MLSS. This trend is unexpected and likely due to a sampling error.

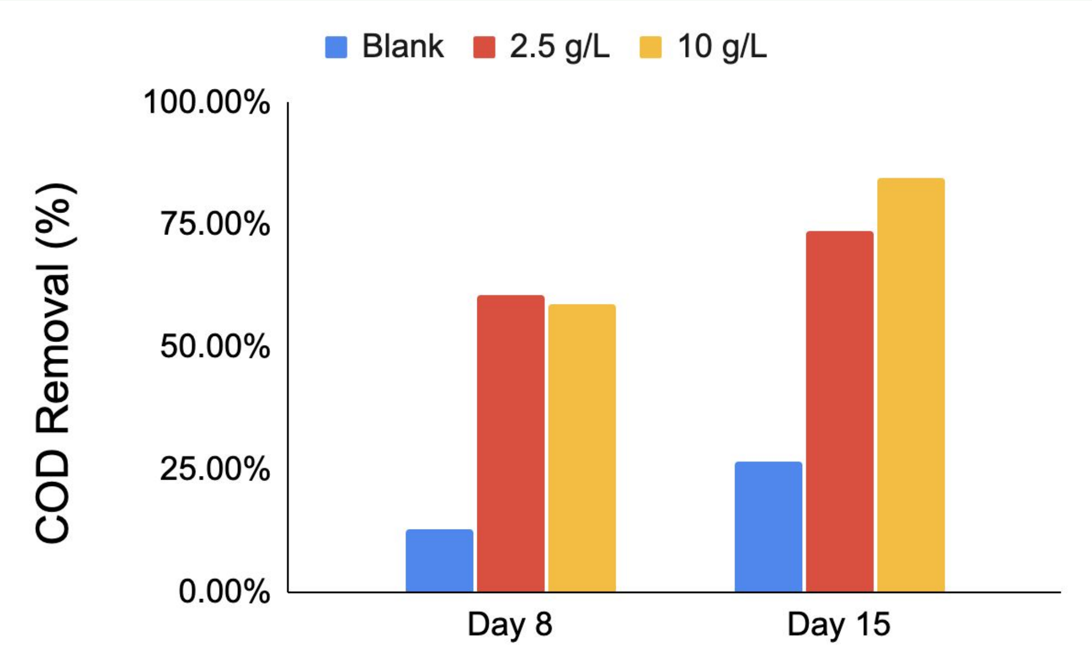

Figure 2: COD of the 3 reactors over two weeks

Figure 2 represents the removal of COD as the energy source from the reactors over time as the microbial community digests the wastewater. The control reactor had a small amount of removal over time, showing how naturally the microbes in the reactor will consume the COD and reproduce to remove the waste. We can see that in the presence of GAC the rate of COD removed is much larger than that of the control reactor. From this data we can conclude that GAC does help microbes digest the waste, as seen through the increased percentage of COD consumed.

Next Steps and Advice for Future SHINE Students

My Future Plans

To continue pursuing a career as an environmental engineer. During my college admission process I will apply to colleges with environmental science programs.

Advice for Future SHINE Students

Be all in with this program. During my time at SHINE, I suffered a broken wrist but did not allow myself to be sidelined by my injury. Taking SHINE seriously and savoring every moment helped fuel my desire to become an Environmental Engineer in the near future.

Acknowledgements

- Dr. Ellingson, my science teacher, for writing my letter of recommendation and fueling my love of science
- Prof. Smith for allowing me this opportunity
- My mentors, Raven Althouse, Bianca Costa, Harmita Golwala & Connor Sauceda for guiding me in my research
- My family, for their love and support

Citations

Zhang, J., Zhao, W., Zhang, H., Wang, Z., Fan, C., & Zang, L. (2018). Recent achievements in enhancing anaerobic digestion with carbon-based functional materials. *Bioresource technology*, *266*, 555-567.