Understanding how smaller batch sizes can improve production associated with an ultrafiltration process at the Hanford D.O.E facility.

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Summary

As known, the U.S. Department of Energy contracted Betchel National, Inc. to build the world's largest waste treatment plant (WTP). See [1] for more details. The performance of this facility in terms of solids and sodium production is still in question and a pinch-point of the WTP is an ultrafiltration process where the intended **goal of this study was to determine if treating with smaller batch volumes can improve the production rates of both sodium and solids**. This study included considerations of the effects of changing viscosity due to changing concentrations of sodium and an appropriate model for permeate rates. The findings of this study are that smaller batch sizes do increase production of both sodium and solids irregardless of end point concentration of solids or sodium. But there is a trade-off condition between solids and sodium production.

Problem Statement

The benefit of this research was to increase the mass rates of solids and sodium and this was achieved by using smaller batches of slurry. Some of this research was based on work by Duignan et al. and Peterson et al.[2, 3]. From Geeting et al., that there is a trade-off relationship between solids and sodium. This means that as the sodium to solids ratio increases, the gap between the optimal conditions for supernate production and wash sludge widens. Duignan's research provided us with data from his pilot scale system that could be compared with our empirical data. Given all this information, is it possible to say that there is an inverse relationship between the mass rates and the volume of feed.

Results

Various parameters for the research were collected from the experimental results of Duignan's pilot scale system to compare with the developed model. Using the developed model, six conditions associated with Duignan's study were matched:

1. Permeate rates of empirical data:
2. Wash rates of empirical data:
   Wash rate from the empirical data did not match with our model
3. Permeate volume, which was 900 ml
4. Wash volume which was 116% of 140 L
5. Time for dewatering, 12 hours
6. Time for washing, 12 hours.

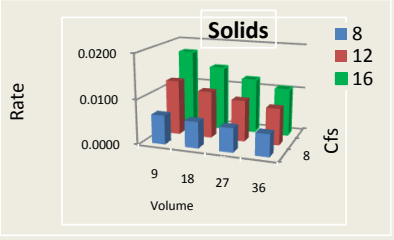

Figure 1: Mass rate of solid Vs. volume at various solid concentrations.

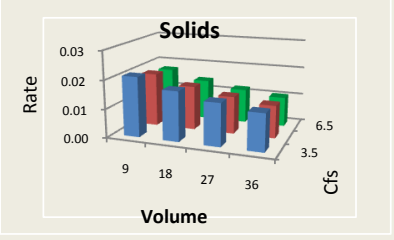

Figure 2:Mass rate of solid Vs. volume at various sodium concentrations.

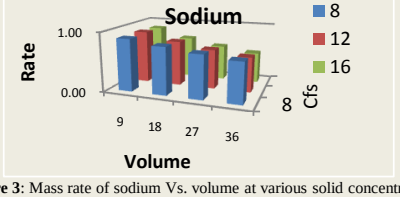

Figure 3: Mass rate of sodium Vs. volume at various solid concentrations.

Figures 1-4 give examples of how mass rates are affected with varying solid and sodium concentrations along with varying volumes.

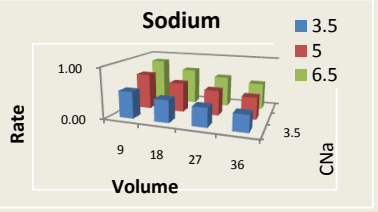

Figure 4: Mass rate of sodium Vs. volume at various sodium concentrations.

Discussion/Conclusions

The main point of this work was the development of models for sodium and solids production that allowed for changes in endpoint concentration of solids, sodium, and different batch volumes. A sensitivity analysis, which is shown as Figures 1 to 4, was then conducted. The results of this sensitivity analysis show the following:

1. Smaller batch volumes and higher end point concentration of solids maximized solids production rates, but reduces sodium production rates.
2. Smaller batch volumes and higher end point concentration of sodium maximizes sodium production rates, but reduces solid production rates.
3. An obvious trade-off condition exists between sodium and solid production and has been previously observed by Geeting et al**.** [2].

Acknowledgement

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