The Effects of Organics Removal on the Methylene Blue Index (MBI)

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Agenda

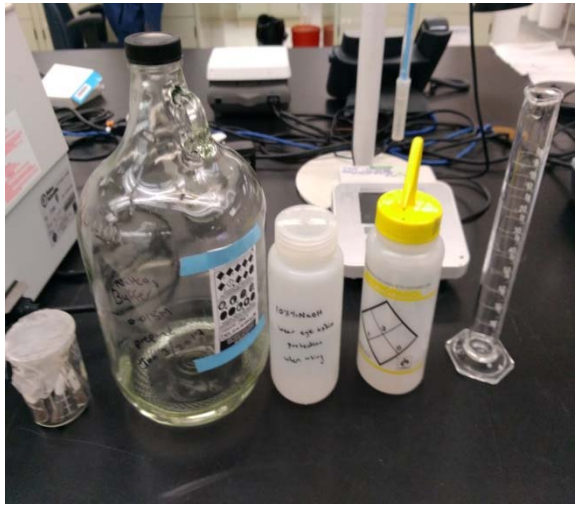
- Introduction
- Objectives
- Experimental Process
- Results & Discussion
- Conclusions
- Recommendations

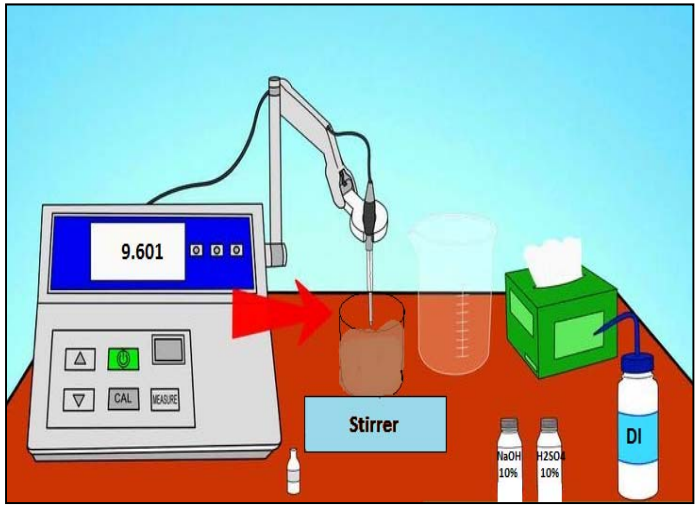
Introduction

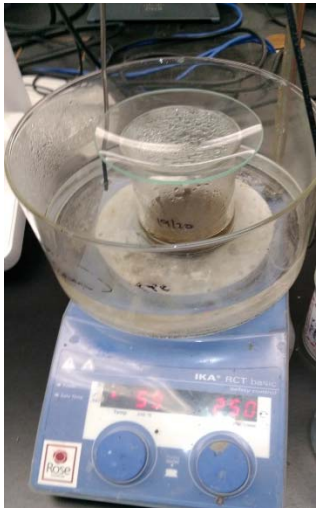
- Methylene Blue Index is used for monitoring clay activity.
- [1]MBI has been correlated with oil sands processing issues.
- Four key steps in the process:
  1. Dispersing the clay so it is accessible to the MB dye
  2. Acidification of the slurry
  3. Gradual addition of the MB dye to the clay slurry
  4. Endpoint detection via halo detection

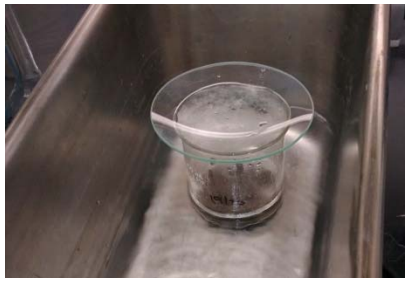
[1] Kaminsky, H.A.W (2014) Demystifying the Methylene Blue Index, *Proceedings of the 4th International oil sands tailings conference*, Banff AB.

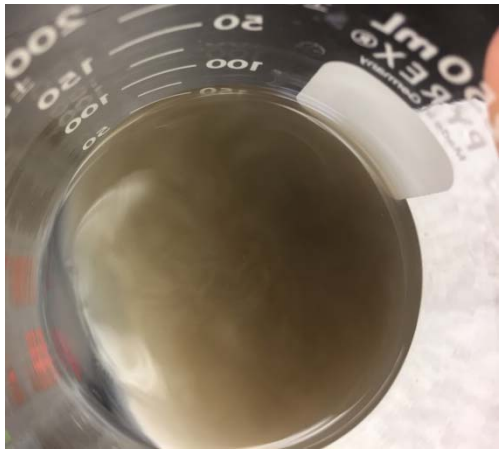
Clay Dispersion

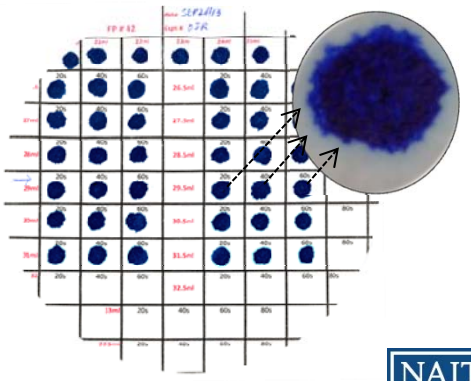












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MBI Calculation

- The results of the Methylene Blue Index test are reported in several ways but we will just report it as MBI.

$$MBI\left(\frac{meq}{100g}\right) = \frac{mls\ \ MB \times Normality\ of\ MB}{mass\ of\ dried\ sample\ (g)} \times 100$$

Objectives

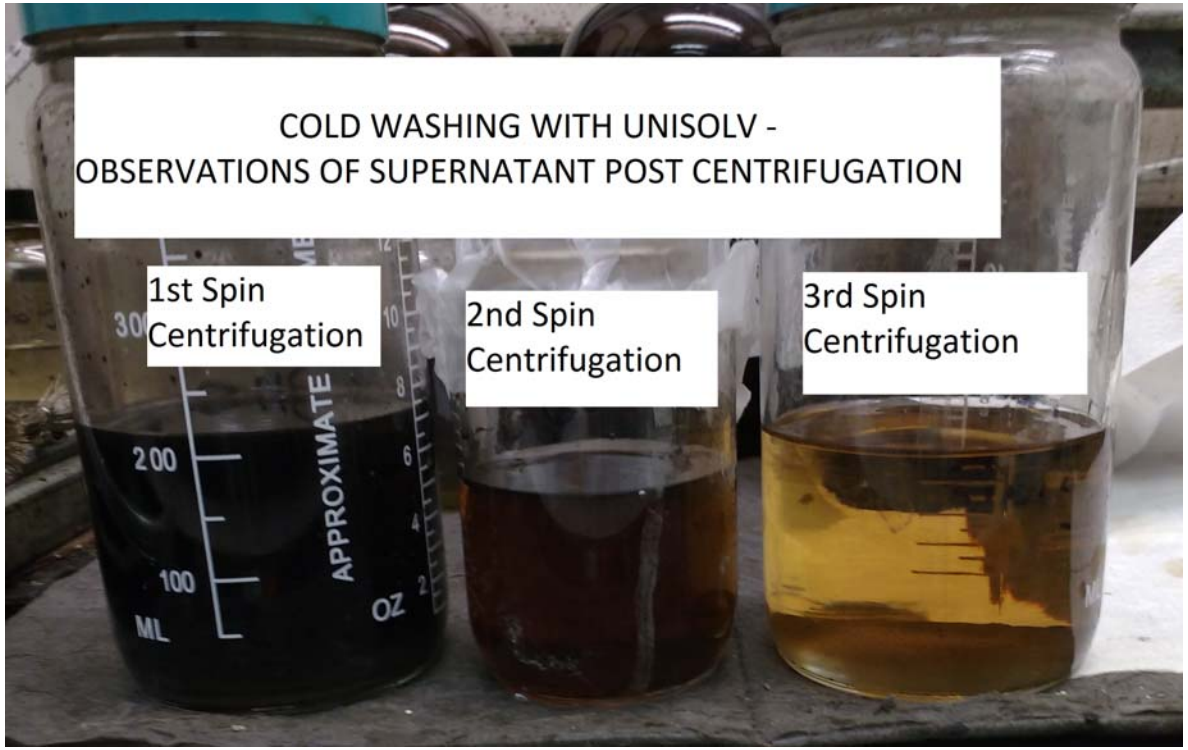
- To evaluate organics removal effects on dispersion of clays.
- To investigate which method is best at removing organics.

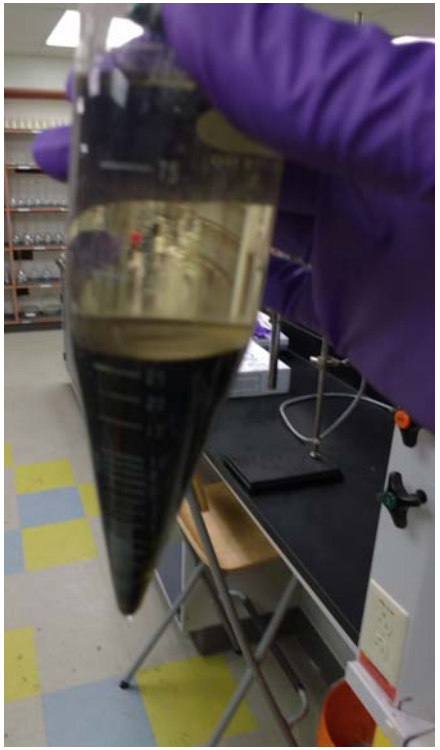
EXPERIMENTAL PROCESS

Methods tested for organics removal from MFT

- Dean and Stark Extraction (D&S)
- D&S + H_2O_2
- Cold wash Slurry MFT with toluene: isopropanol in 76:24 proportion (also known as Unisolv)
- Cold wash Slurry MFT with Tetrahydrofuran (THF)

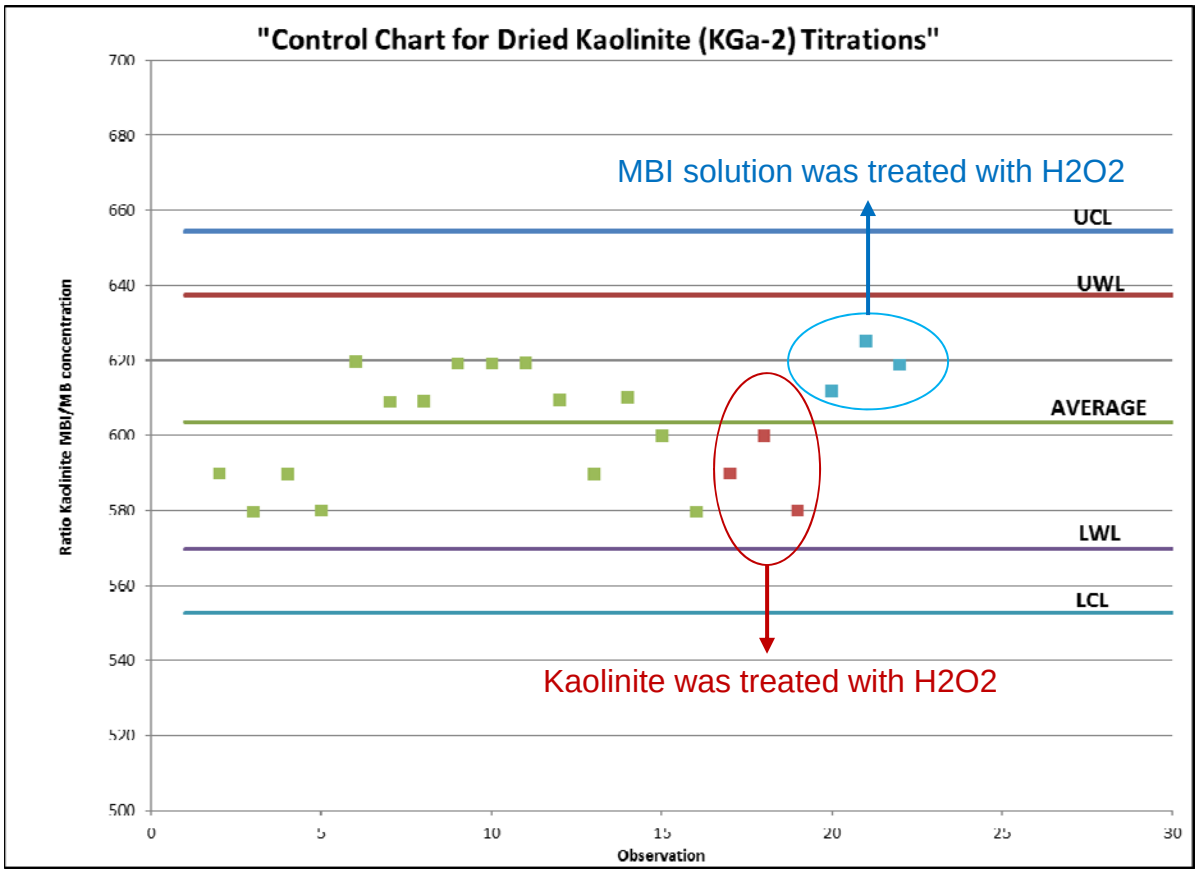
Cleaning through Cold-Wash Methods





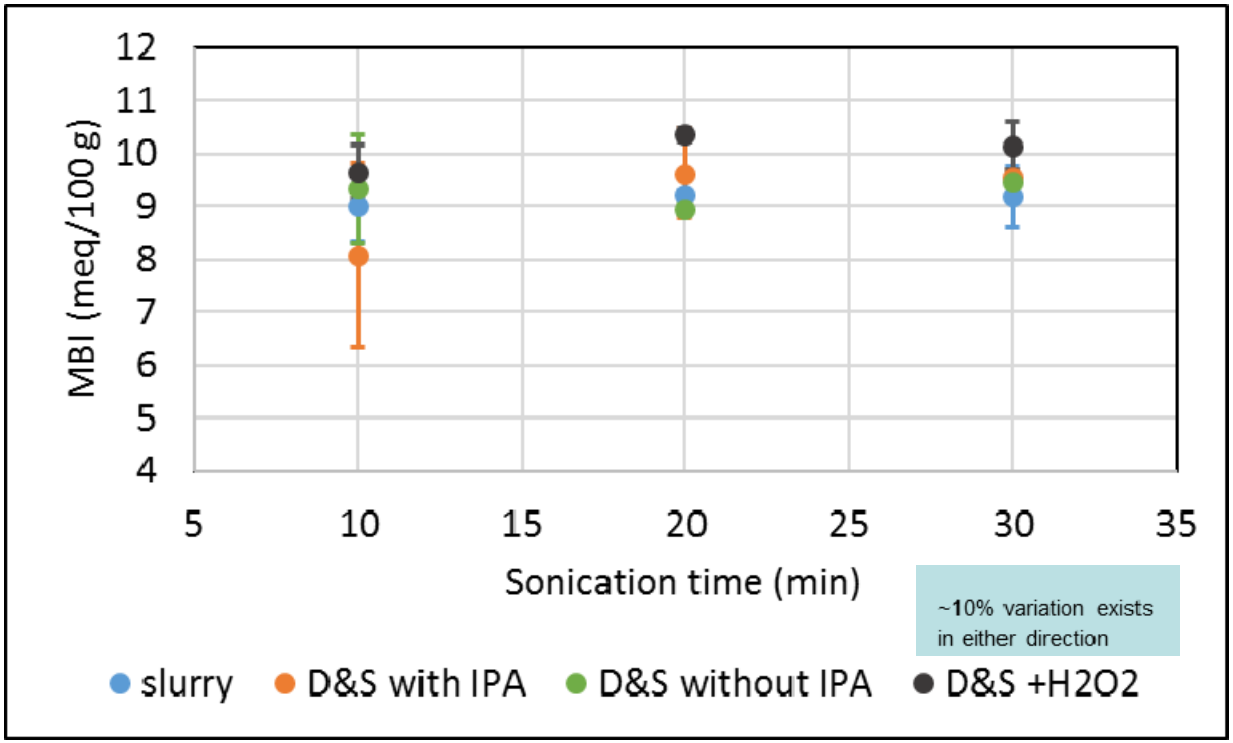
RESULTS & DISCUSSION

Does Hydrogen Peroxide affect MB solution?



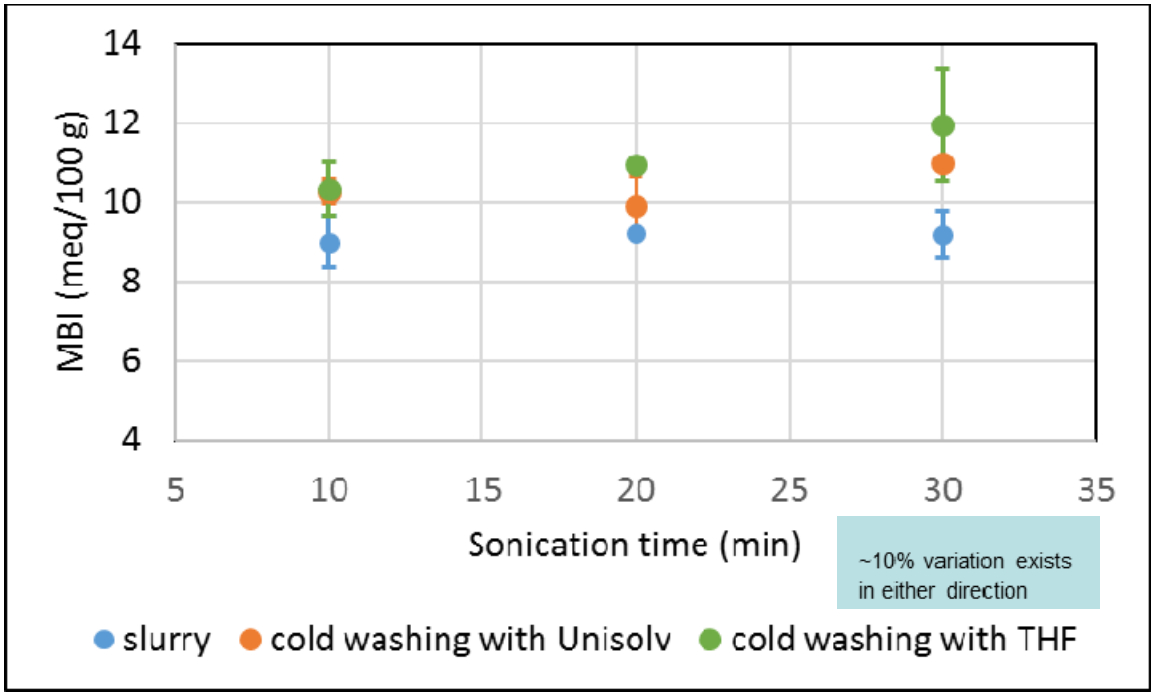
- The H_2O_2 cleaning study did not detect a statistically significant effect on MBI solution or check standard clay MB titration.
- UV-vis cannot detect differences between the MBI solutions treated with/without H_2O_2.

Comparison of MB values for D&S vs. D&S+H_2O_2



All MBI data were corrected by Kaolinite MBI data.

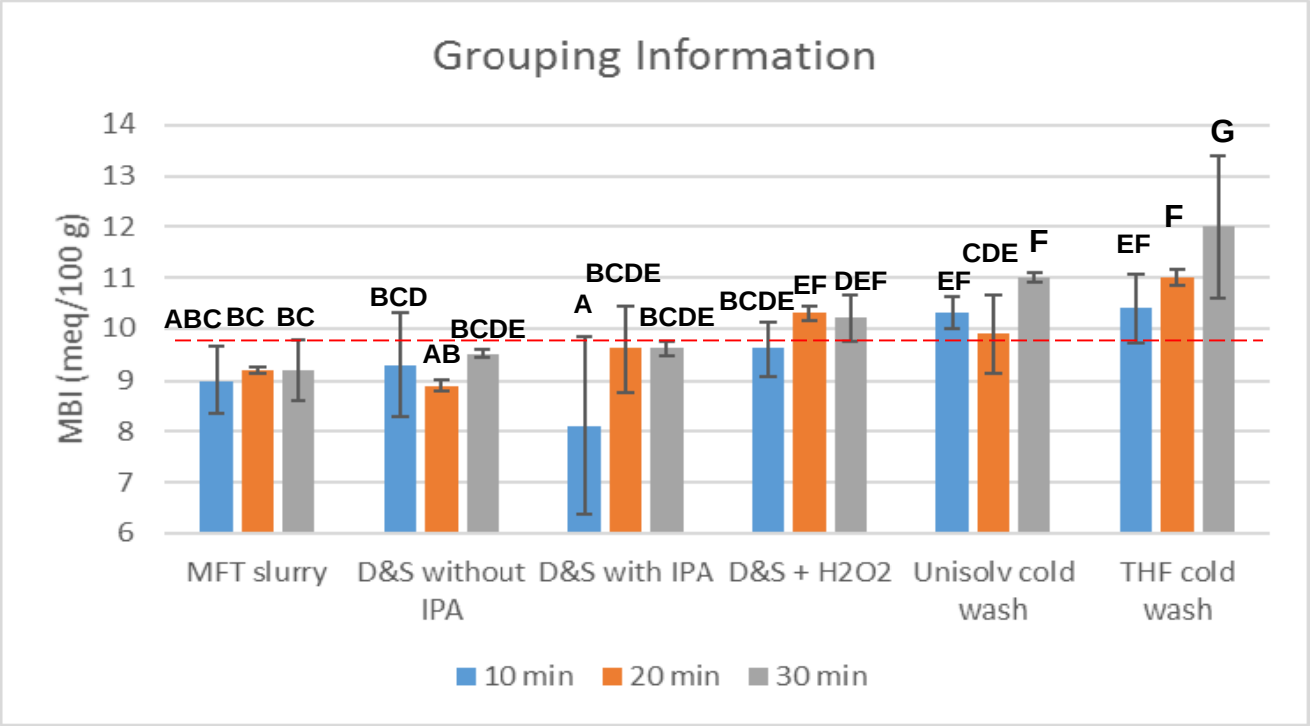
Bitumen and Organics were Removed by Unisolv and THF Cold Washing



Cleaning by THF cold washing method provides higher MBI values.

All MBI data were corrected by Kaolinite MBI data.

Bitumen and Organics were Removed by Different Methods-1



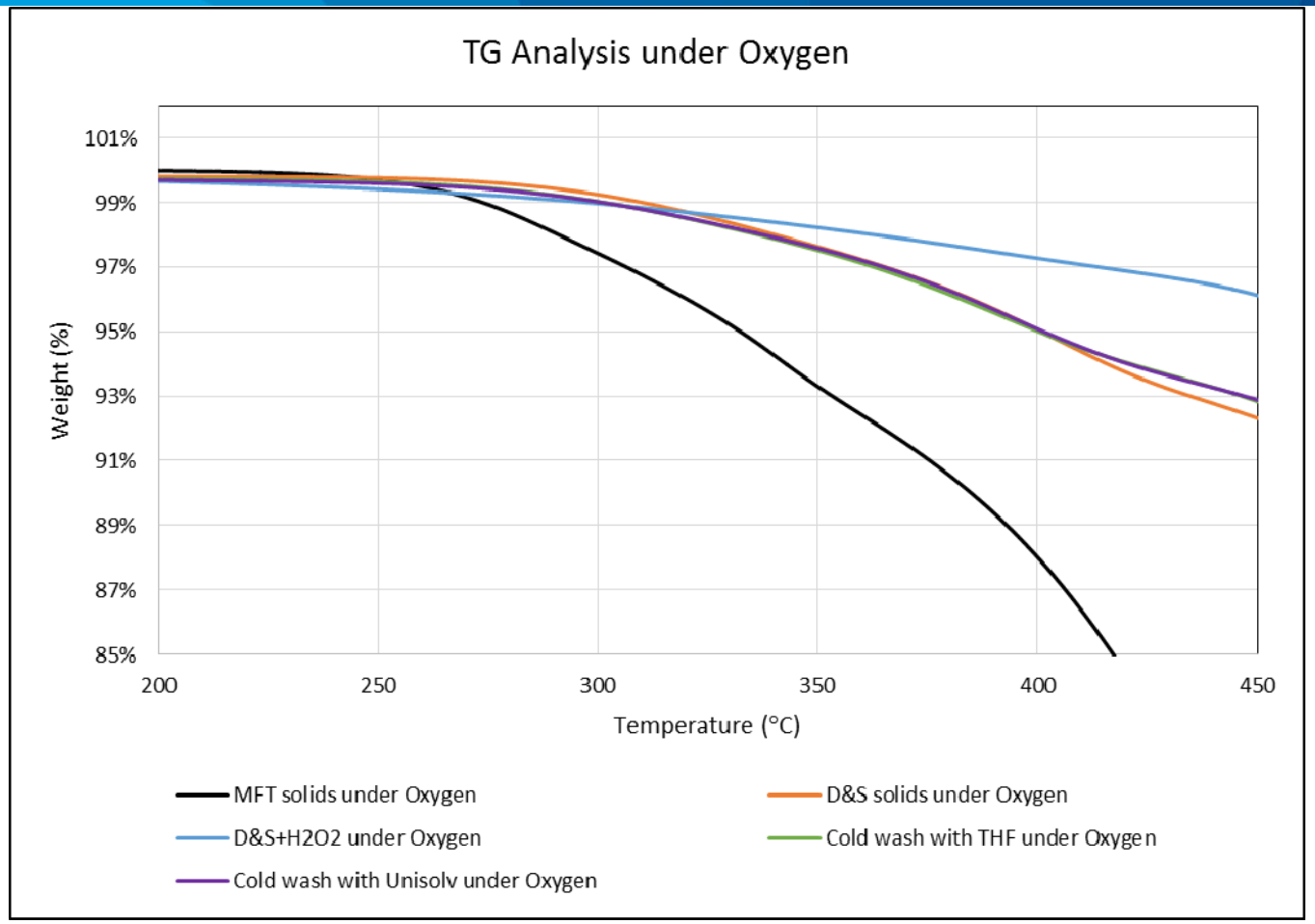
Sonication time (min)	Sonication Energy (Joule/mL)
10	1000
20	2000
30	3000

Grouping information for MFT slurry and cleaned MFT solids with different methods using the Fisher LSD method. Means that do not share a letter are significantly different.

Bitumen and Organics were Removed by Different Methods-2

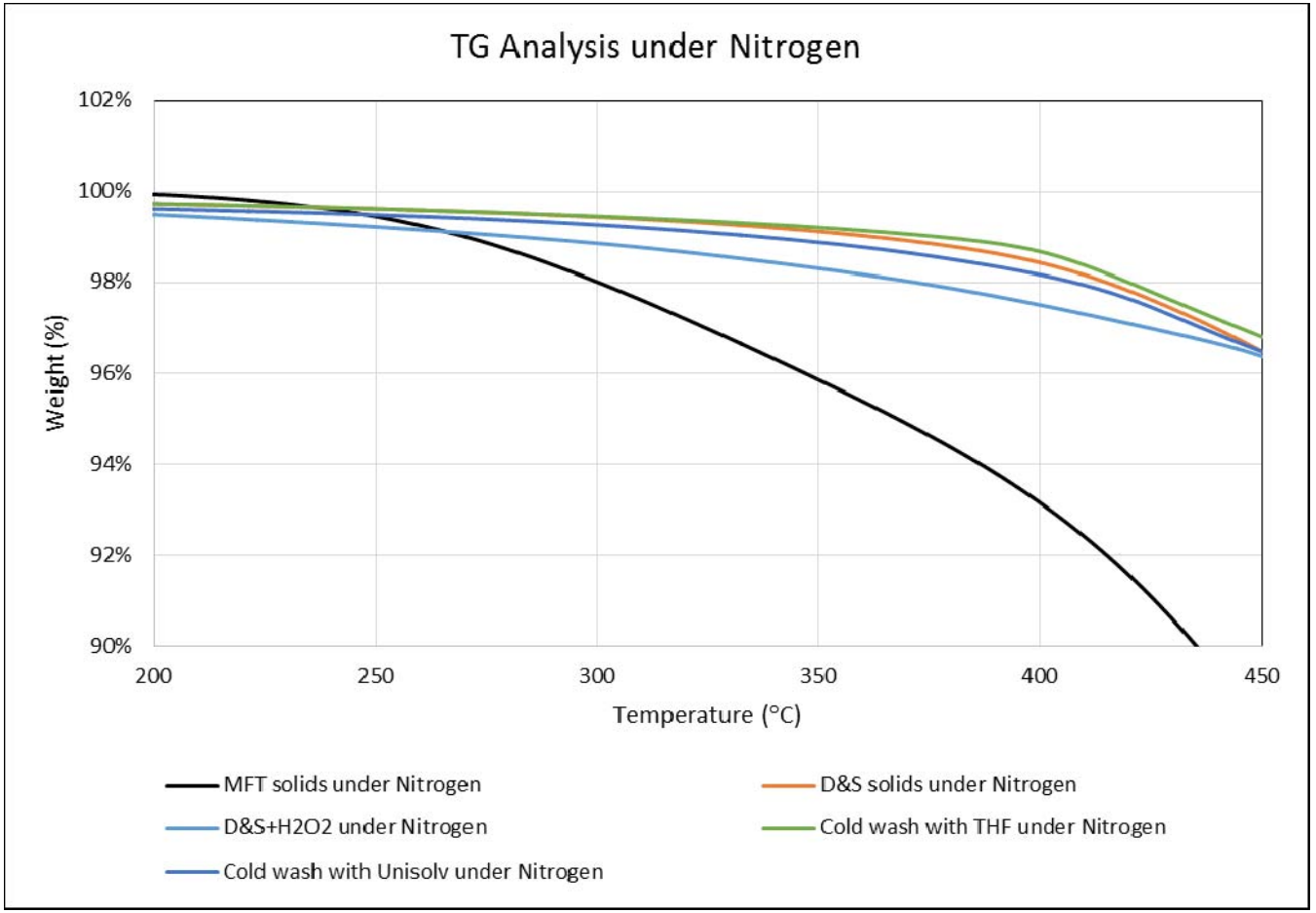
- Cold washing with toluene: isopropanol (Unisolv) and THF has resulted in an increased MBI value which could be due to:
    - Easier fines dispersion
    - Better fines/clays capture
    - Better organics removal
- With sonication energy of 1000 Joule/mL, cleaned MFT disperses more easily than MFT slurry.
- With sonication energy higher than 2000 Joule/mL, cleaned MFT via D&S cleaning only does not show a significant difference in MBI values compared to uncleaned MFT slurry.
- The MBI values of THF cold wash cleaned MFT increases with the increase of sonication energy.

TGA Results



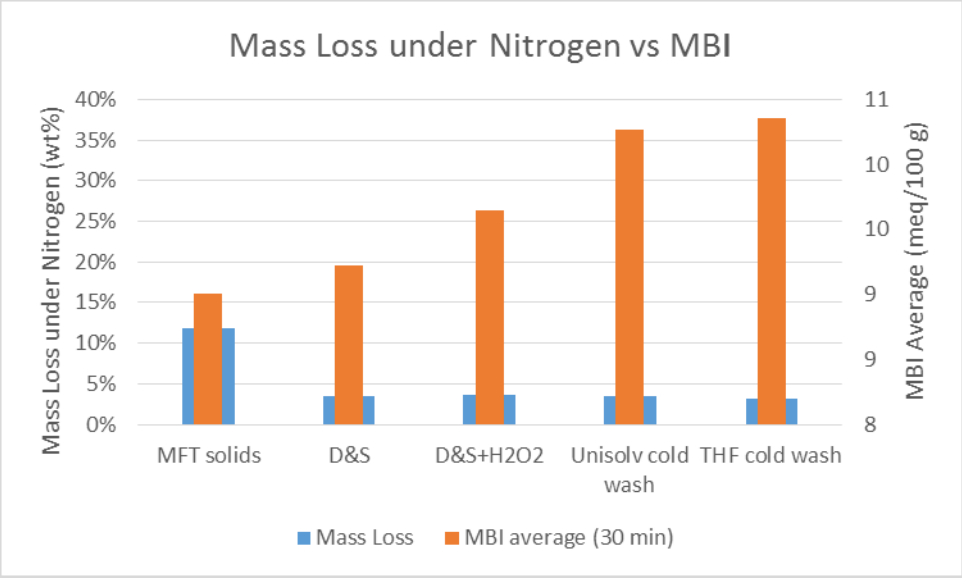
Under O_2, MFT solids cleaned by D&S + H_2O_2 have the least total organics.

TGA Results



Under N_2, MFT solids cleaned by THF cold wash have the least weakly bound organics.

TGA Results – Under Nitrogen



- The sample with higher mass loss (>10 wt%) produced lowest MBI values – more organics, worse dispersion.
- For the samples with low mass loss (<10 wt%), the MBI values are not related to the organic contents.

Conclusions

(1) MBI values of D&S cleaned MFT solids show no significant improvement on sample dispersion with the sonication energy higher than 2000 Joule/mL than MFT slurry.

(2) D&S treated with H_2O_2 cleaning method increased the MBI value as compared with no H_2O_2 cleaning step.

(3) H_2O_2 cleaning does not affect MBI solution or check standard clay MB titration.

(4) Cold washing with THF shows the highest MBI values.

(5) MBI values for D&S solids and uncleaned MFT were similar, this is promising for future online application.

Recommendations

(1) Further TGA analysis under both Nitrogen and Oxygen is required to have more statistical reliability.

(2) Further investigation is required to see whether D&S solids and raw MFT MBI values compare to operations organics removal or not.

References

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Li, Y., Currie, R., Kaminsky, H., Sedgwick, A., & Qureshi, T. (2016). The effects of flocculation on the Methylene Blue Index, *Proceedings of the 5th International oil sands tailings conference*, Banff AB: NAIT's Centre for Oil Sands Sustainability.

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Acknowledgements

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Questions?