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Effect of the Specific Combination of the Applied Voltage and Substrate Gap of Electrophoretic Deposition EPD on the Yield and Purity of Montmorillonite

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INTRODUCTION & AIM

Cloisite Na-Montmorillonite (CNa-MMT) is a montmorillonite powder available in the market which contains other silicates such as beidellite, quartz, cristobalite and tridymite. Previous attempt [1] to improve quality of silicates via electrophoresis failed. Thus, Electrophoretic Deposition (EPD) is explored to improve the yield as well as PURITY of CNa-MMT which is an important filler in composites as well as nanocomposites for construction application, food packaging, sports gears, wound management and environmental remediation.

METHOD

CNa-MMT powder was added to water as clay slurry for EPD. NOVA software was used to develop program of voltammetry procedures to operate AUTOLAB PGSTAT 302n for the conduct of EPD. Two levels of applied voltage were employed: high voltage (HV) and low voltage (LV). Substrate gaps (sG) were also at two levels: high substrate gap (HsG) and low substrate gap (LsG). EPD was done for 20 minutes. Two Stainless Steel strips were used as planar electrodes (WE-S // CE-RE) as shown in Figure.1.

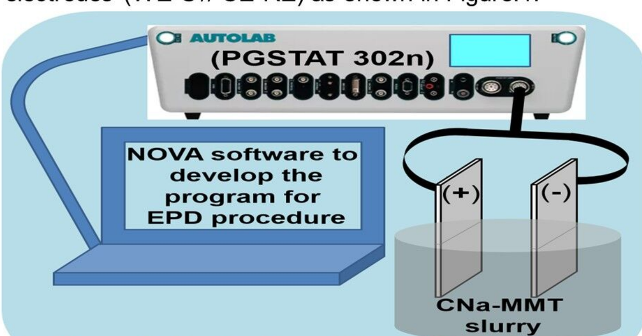

Figure 1. Illustration of the EPD system

Wet EPD deposits were dried in a vacuum oven at 60 °C. ANOVA for the two-factor fixed effect model was performed to determine the effects of the applied voltage, sG and their interaction on the yield of Na-MMT at 95% confidence level.

RESULTS & DISCUSSION

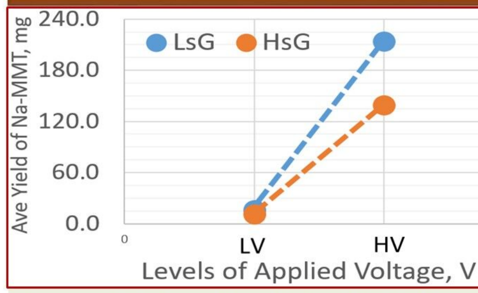

Figure 3. Interaction Plot of A. Voltage and sG for the Ave. Na-MMT yield

Figure 3 shows the Interaction plot of factors that LsG has a higher slope than the HsG, suggesting that a slight increase in the applied voltage at LsG will result to a higher yield than with the same level of voltage at HsG. Although HV-HsG and LV-LsG experienced the same effect of the electric field, HV-HsG resulted to a higher yield than LV-LsG.

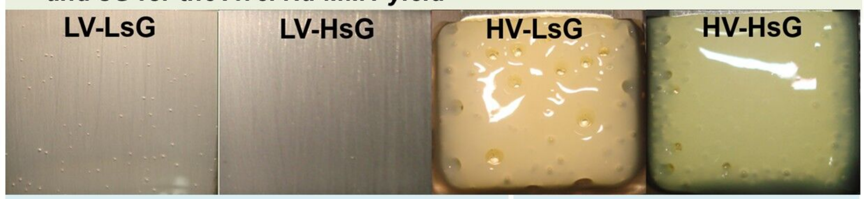

Figure 4. Wet Na-MMT deposits after EPD

Figure 4 shows the thin wet Na-MMT deposits from LV and thick wet deposits from HV. Bubbles were formed due to oxygen gas produced from electrolysis of water of the clay slurry. Tiny bubbles formed from LV, and big open and trapped bubbles from HV.

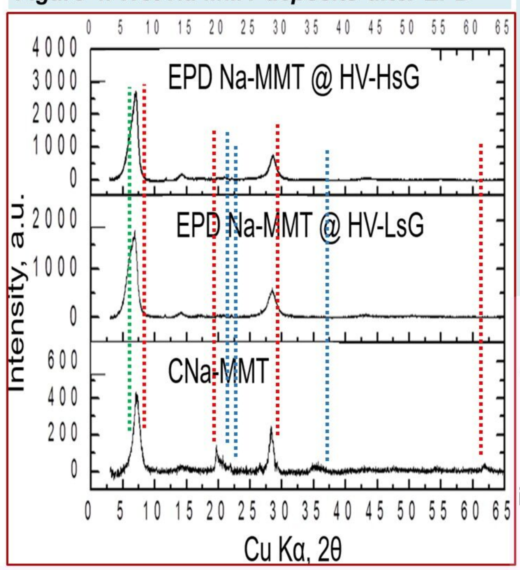

Figure 5. XRD of Na-MMT powders after EPD

Figure 5 showed that **Na-MMT** [2] from HV EPD were found to be swelled. Reduced relative intensities of the peaks of **beidellite** [2] and **silica** [2] resulted to an increased in purity of Na-MMT from HV EPD than the commercially available CNa-MMT.

RESULTS & DISCUSSION

Significant effects of applied voltage, sG and their interaction were found on the yield and purity of Na-MMT. The specific combination of HV-LsG resulted to the highest yield of Na-MMT deposits while EPD at low voltage levels at any sG had low yields as shown in Figure 2.

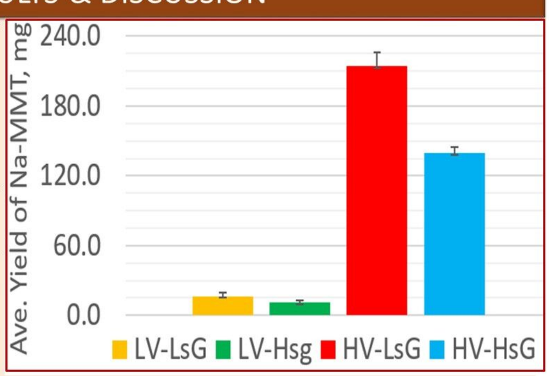

Figure 2. Ave.Yield of Na-MMT from EPD

CONCLUSION

HV-LsG resulted to highest yield of Na-MMT deposits. The Na-MMT from EPD at high level of voltage had attained higher purity than the commercially available Cloisite Na-MMT by the removal of some beidellite and silica through EPD.

FUTURE WORK / REFERENCES

The EPD system will be explored on the separation of specific silicates from natural sources of minerals.

[1] Drever, J., *The separation of clay minerals by continuous particle electrophoresis,* The American Mineralogist, 1969
[2] Nickel, E.H. and Nichols, M.C., Mineral Database, Materials Data, Inc.