Characterization of Liquid Smoke by Size Distribution and Kappa Values

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Overview

Biomass burning is an important part of our global carbon cycle and can affect our atmosphere, health and living conditions. There is no standard for the emissions of biomass burning experiments. Liquid smoke could become a standard for biomass burning in atmospheric aerosol research. Laboratory measurements of the particle size distribution and kappa value of atomized liquid smoke are measured to determine if liquid smoke is a good proxy for aerosols from biomass burning

Compound	Kappa
Sodium Chloride (NaCl)	1.28
Ammonium Sulfate ($(NH_4)_2SO_4$)	0.61
Sulfuric Acid (H_2SO_4)	0.90
3:7 Organic: Inorganic material	0.62
Pure Organic Material	< 0.2

Known Kappa values for various compounds.

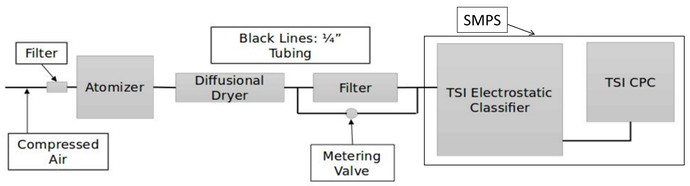
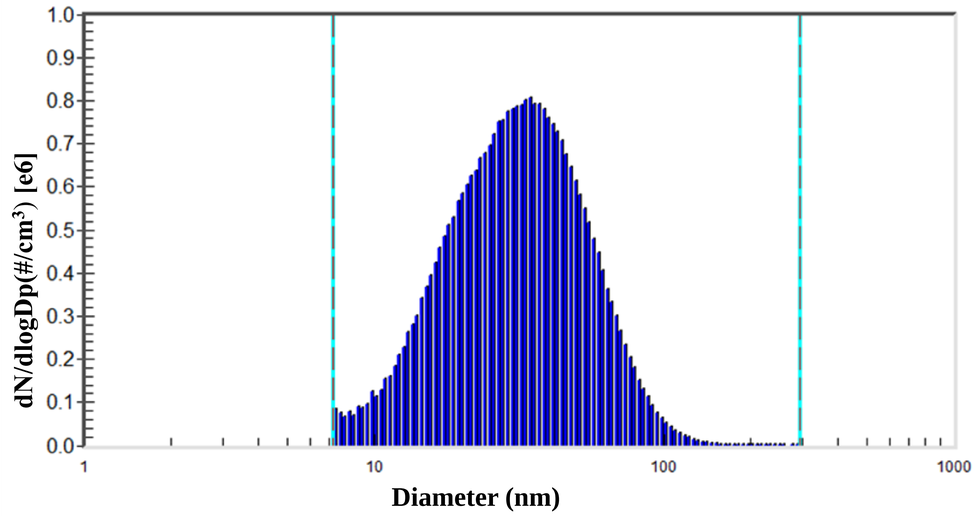


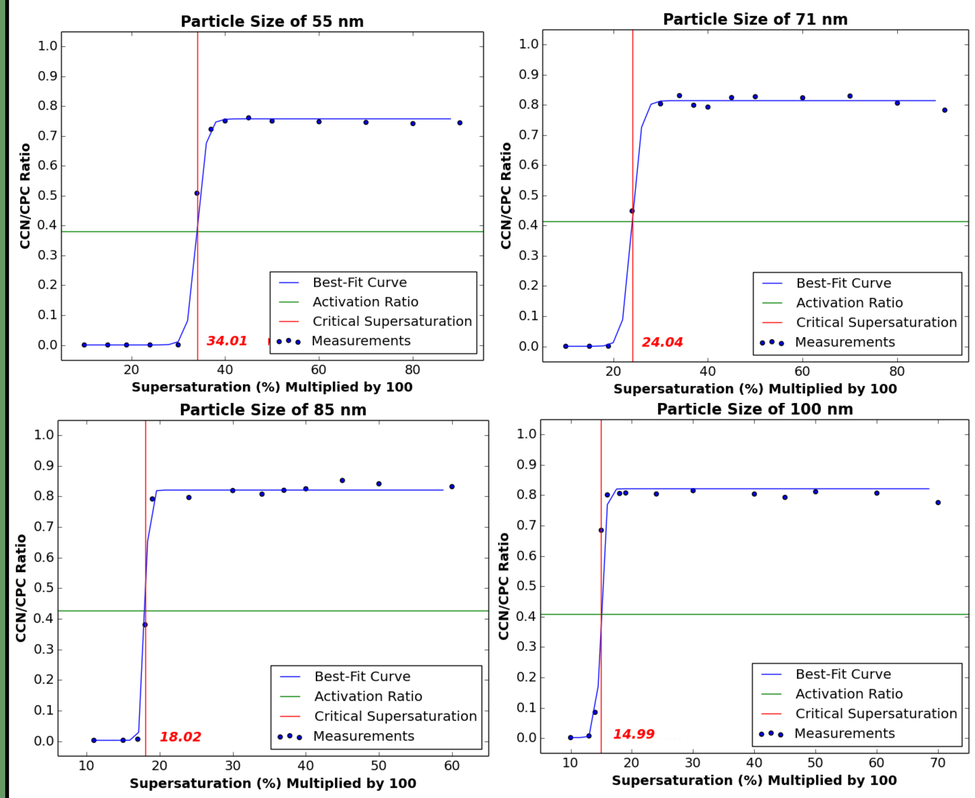
Image showing the instrument setup for obtaining the size distribution of the liquid smoke using the TSI Scanning Mobility Particle Sizer (SMPS) which is the combination of the TSI Electrostatic Classifier and the TSI Cloud Condensation Particle Counter (CPC).

Acknowledgments

The National Institute of General Medical Sciences of the National Institutes of Health under Award Number T34GM122835 and the National Science Foundation, award AGS-1754244 supported Alexa Otto's work on this research. The solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.



Scanning Mobility Particle Sizer (SMPS) measurements of a solution of 0.03 % liquid smoke and ultra-purified water.



Activation Curves to find the Critical Supersaturations of 55, 71, 85, and 100 nm size particles of Liquid Smoke. Data taken using lab set up in upper right panel. Critical supersaturations are indicated in red and used to calculate Kappa.

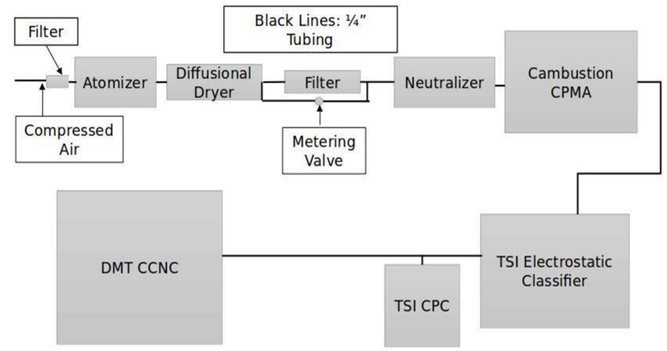


Image showing the instrument setup for finding the Kappa values of liquid smoke using the Centrifugal Particle Mass Analyzer (CPMA), TSI Electrostatic Classifier, CPC, and the DMT Cloud Condensation Nuclei Counter (CCNC).

Diameter	Kappa
40.0 nm	0.87
55.2 nm	0.84
71.0 nm	0.78
85.0 nm	0.81
98.2 nm	0.76

Calculated Kappa Values for Liquid Smoke at Different Diameters

Conclusion

- Kappa for liquid smoke ranges from 0.76 to 0.87.
- Average of the Kappa values for Liquid smoke is 0.81 +/- 0.042.
- The liquid smoke Kappa values are similar for particle in the range of 40 - 100 nm.

Future Work

- More comparison and chemical testing of store bought liquid smoke.
- Testing in the PI Cloud Chamber at Michigan Technological University to see how it interacts with simulated atmosphere.