Review of "Developing A Custom-Built Metal Cloud Chamber: Analysis of Aerosol Coagulation at Low Humidities."

General Comment:

Experimental facility presented in this manuscript is primarily aimed to understand wall-loss and coagulation processes of aerosols under controlled temperature and humidity conditions. Such facility holds potential to improve understanding of aerosol-processes in the atmosphere as well as improving cloud-chamber. However, this facility in current stage lacks temperature and humidity control. Since current set-up and any results presented here do not involve cloud-microphysical processes like CCN activation or cloud-droplet formation, it is not appropriate to consider this facility as a cloud-chamber.

This paper describes the experimental facility, data processing, parameter fitting in details and discuss wall-loss and coagulation factor for different aerosols, by fitting observations into loss-equation. Although it has significant uncertainty, studies highlight that soot particles adhere to each other, more than others in dry conditions. I have few concerns regarding set-up and data processing. Hence, I would recommend reject and resubmit when more results are available, along with addressing major and minor comments listed below.

Major Comments

Comment 1: Authors emphasize that this facility is specifically designed to investigate coagulation processes of aerosols under different conditions (line 61-63). Further, authors have not shown any results which deal with cloud-microphysical processes like CCN activation or presence of cloud droplets. Under such limitations, it is inappropriate to call the facility as "cloud chamber", which appears in title, abstract and few paragraphs. Since, it mostly deals with aerosol-processes, it should be referred to as an aerosol-processing chamber.

Comment 2: Line 17-19: Uncertainty in the fitted coagulation factor, especially for sodium chloride and sucrose is too large to conclude that soot particles adhere to each other more than others. Conclusion does not seem robust considering this uncertainty level. It needs additional observation and analysis to reduce uncertainty.

Comment 3: Line 67-69: This study is also aimed to refine further experimental design. However, it has not been discussed the way it will help?

Comment 4: Line 133-138: Authors have used multiple minimization methods for fitting the size distribution each time step. Are methods same at each time-step? Do they change with aerosol species? Which methods have performed better?

Comment 5: Line 140-142: Fitted size-distribution has been extrapolated on both tails of distribution. What is the observed range of the distribution? What is the extrapolation range? Have authors compared the extrapolated values with any observations? Further, 21-samples (3 minute per scan, line 118) running average is about 1-hour running average which can smoothen data significantly when observation is limited by 6 hours. Can you discuss in details?

Comment 6: In Fig. 4(a), there is significant drop in wall eddy diffusivity between 4 and 5 hours for soot particles, before it increases again. Can authors explain the reason?

Comment 7: Coagulation and wall-loss factor can be very different for cloud-chambers, because of wet walls and supersaturated conditions. What is the insights from current results that can be helpful for moist cloud-chamber?

Comment 8: There is a large literature on aerosol chambers, including wall loss models and coagulation. This should be reviewed and the originality of this chamber should be discussed.

Minor comments:

Comment 1: Line-183: Indicate the plot number in the supplement.

Comment 2: Line-201: Why does gravitational settling diminish over time as mixing subsides? Please include the reference here.

Comment 3: Lines 91-93: Does dilution line affect the residence time in the chamber? How?