

Interactive comment on “Inorganic salts interact with organic di-acids in sub-micron particles to form material with low hygroscopicity and volatility” by G. Drozd et al.

Anonymous Referee #2

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This study by Drozd et al investigated the volatility and hygroscopicity of sub-micro oxalate salt particles. The authors measured the CCN activity and calculated the kappa values for different particle systems. Furthermore, they investigated the volatility of oxalate salts using aerosol-CIMS. The authors concluded that the reactions between oxalic acid and certain inorganic salts (e.g. NaCl, MgCl₂) can form low volatile and less hygroscopic oxalate salts. Overall, this is a well written paper, easy to follow and read. This study provides a useful data set showing the effects on particle volatility and hygroscopicity from the interactions between oxalic acid and inorganic salt. The subject discussed is very important and is within the scope of ACP. The following comments or

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issues need to be addressed before it can be considered for publication.

Specific comments:

1. The authors only investigated the oxalic acid and its salts and the general conclusion that author stated may not apply to other dicarboxylic acid, as indicated by the other reviewer. I suggest the authors revise the conclusion carefully, unless additional information is provided.
2. Line 20 on P30654 and corresponding discussion on the surface enhancement of oxalate salts in the manuscript, I agree that Mg Oxalate could be enhanced on the particle surfaces, but it is not clear to me this also applies to Ca and Zn salts. Please provide additional references.
3. P30656, L22, wrong citation. Laskin et al.(2005) did not investigate the surface reactions between oxalic acid and metal-chlorides.
4. P30658, L24, Please add the purities for these chemicals.
5. P30659, L10-L12, is that 10% RH higher than deliquescence RH? If yes, shouldn't all particles be aqueous?
6. P30659, L20, I didn't find any data on the amount of adsorbed the oxalic acid on the particles. Please provide estimated coating or mass ratio of oxalic acid to inorganic or size distribution after coating. As it is described and showed in Fig.1, poly-dispersed particles were passing through the coating devise. Inorganic seeds with difference size would be expected to have different coating thickness which means that the reaction may produce different amount of oxalate salt. So, the composition of particles with different size can be different thus when you measure the CCN activity, you are looking at different particles at different sizes.
7. P30662, L15. Please provide references.
8. P30663, L17. Please provide references.

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9. P30664, L13, Please include the densities in the tables.
10. P30665, L6-7, this sentence is not clear.
11. P30665, L13-15, the statement is not clear and should be explained in more details.
12. P30666, are these calculations referred to the data in Table 4? Why there is only one value for some systems, not a range?
13. P30667, L4-6, I think the authors somehow misinterpreted the study by Laskin et al 2012. Cl:Na could be zero for some systems, for example, citric acid/NaCl after reaction.
14. P30667, L11-27, the statements and conclusions are lack of supports. First, as mentioned above, you may look at particles with different compositions at different sizes, depending on the extent of the reactions and how much oxalate was formed. So the presented direct comparison of kappa values maybe not so straightforward. For example, the curves in Fig.3 for mixed particles. Second, the study by Sullivan et al. 2009 cited here didn't provide kappa values for M-Ox. Did you measure the CCN activity and calculate kappa values for the pure oxalate salt, e.g. Mg-Ox, Ca-Ox, and Zn-Ox? The values in Table 4 for mixed MCl₂+OxA could be the values for fully reacted particle, i.e. only M-Ox left. This could be also the reason that the discrepancies between measured values and calculations based on Eqn. 8 and 9. Please also provide the uncertainties for all the k_{mean} in the tables.
15. P30668, L25-28, this sentence is not clear. What do you mean "seem to behave as if made from pure CaOx"?
16. P30669, L1, what do you mean "clear increase in signal"? I suggest the authors use quantitative value to define the onset temperature, for example a ratio of signals of 1.1 to that at 25 degree.
17. Table 1, for the enthalpy calculations, why the last 4 or 3 data points are used? It is clear that it is not linear as shown in Fig. 5 from 75 degree.

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18. Table 2, what is Na₂Ox as compared to NaOx in Table 1? Please provide the reference for kappa for NaCl.
19. Fig.1 Caption, this is only for CCN measurements.
20. Fig.2 I suggest to separate the data and plot them in two panels for readability.
21. Fig.5, why the normalized signals are different for two independent experiments? Did you have duplicated experiments for CaOx? Any experiments for the mixed particles shown in Table 4?

Technical comments:

1. P30655, L22, missing "." for the end of sentence.
2. P30664, L5. Delete ",".
3. P30664, L23. Should be "Fig.2"
4. P30668, L3, correct the reference, should be 2003?

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 30653, 2013.

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