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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Chemical aging of single and multicomponent biomass burning aerosol surrogate-particles by OH: implications for cloud condensation nucleus activity" *by* J. H. Slade et al.

Anonymous Referee #2

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In the study the CCN activity of model compounds for biomass burning aerosol is studied for single components and their mixtures, and how aging is affecting the CCN activity. The main conclusions are that aging of mixed particles is not affecting their CCN activity in case of studied compounds and that mixed particles have higher CCN-activity than would be anticipated from single component measurements when simple volume mixing rules are used. The second result is well explained and follows earlier studies on slightly soluble organic aerosol. The first conclusion is not so well based as very limited amount of composition data is used and part of oxidation experiments is poorly analyzed. Anyhow, as the topic of organic aerosol hygroscopicity and CCN

activity is important and largely discussed in the scientific community, I recommend manuscript to be published after experiments are more deeply analyzed to support the main findings. Also the conclusion should acknowledge the limited dataset used.

Main comments:

Page 6784: "When including MNC solubility limitations, i.e. applying the experimentally derived κ of pure MNC in the volume mixing rule, the predicted κ of the mixture is significantly less at 0.204 (open blue circles in Fig. 4). However, when excluding the effects of solubility, predicted κ =0.300 (closed blue circles in Fig. 4), is in excellent agreement with the measured κ " I found this sentence misleading. It sounds like the solubility limitation should be excluded to get correct result and when solubility limitation is included, the result is wrong. Maybe this should be reworded to make it clear, that the problem is the volume mixing rule used, and the best result is always achieved when solubility limitations and dissolved fraction of different compounds are correctly calculated.

Page 6784: How close match for LEV:MNC mixtures do you get if you correctly calculate the solubility effect through Köhler-theory instead of assuming complete solubility?

page 6782 and Table 2: It would be interesting to see if there is size dependence in the measured kappa values for KS similar to ammonium sulphate. The reported uncertainty is quite high. Is this due to increasing kappa (increasing Van't Hoff factor) with increasing particle size? If it is, then this information should be used when hygroscopicity of particles is calculated.

Section 3.4: It is already shown in 3.3 that with binary mixtures there is no change in the measured hygroscopicity after oxidation, so what is the motivation to present results with ternary mixtures?

Section 3.5: I agree with Referee #1 here. Particles of different sizes have different mass fractions of coating material. Better analysis of different particle sizes and corre-

sponding hygroscopicities could be conducted. It should be quite straightforward task to estimate coating thickness for different sized particles and use Köhler theory to estimate the solubility limitations. At the moment this is only speculated. Also there could be more discussion why observed 10 nm coating is not slowing down water uptake and decrease CCN activity.

Page 6796: "Chemical aging has no major impact on the CCN activity of mixed water-soluble and insoluble compounds beyond the point that the insoluble component becomes infinitely soluble. Below this point, chemical aging can influence the CCN activity of the insoluble component." This is quite strong statement and valid only for compounds studied here. Also, how insoluble compounds become infinitely soluble? Maybe weakly soluble compounds, or compounds with low solubility would describe these compounds better. Also state more clearly that these weakly soluble compounds become fully dissolved in dilute liquid aerosol before activation into cloud droplets.

Figure 3: Please mention also the dry particle size used in the calculation.

Figure 4: Is the legend correct? Now the particles with the highest mass fraction of KS are not the most hygroscopic.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 6771, 2015.