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Comment

Interactive comment on “CCN activation experiments with adipic acid: effect of particle phase and adipic acid coatings on soluble and insoluble particles” by S. S. Hings et al.

Anonymous Referee #1

Received and published: 24 March 2008

Review

General comments

The authors present results of laboratory experiments that investigate the CCN activity of pure and mixed adipic acid particles. There has been a series of 11 prior studies in the literature that led to ambiguous results concerning the CCN activity of adipic acid and, thus, the role of slightly soluble organics as CCN in general. The systematic investigation of adipic acid (as a proxy for other slightly soluble organic aerosol constituents) and a thorough discussion of the discrepancies in the literature are certainly a topic suitable for publication in ACP. The paper could be significantly improved by

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a better organization and more structured presentation of the results. In addition, the authors should discuss which of their laboratory-generated aerosols resembles most atmospheric particles in order to give some recommendation on how to treat such compounds in models.

Specific comments

Abstract

p. 4440; l. 14-19: Do both sentences refer to literature studies? It reads as if the scatter mostly occurs for particles < 150 nm.

Introduction

1st and 2nd paragraph: I suggest to carefully reword these very general statements. As they are, they give a misleading picture of aerosol effects on climate:

p. 4440; l. 25/26: this sentence implies that aerosols may enhance the greenhouse effect and not counteract it. Clarify that the aerosol effect has the opposite sign in terms of radiation effects.

p. 4441; l.4: There are many studies that show that aerosol composition is not the most influential parameter in determining their (direct and indirect) effects on radiation.

p. 4441; l. 9-11: Dynamic processes (meteorology), and not aerosol type and composition, determine type of clouds and extent of cloud cover.

p. 4442: Since you refer so many times to the Standard Koehler theory, you should move Appendix A into the main text. In this way, you will be able to shorten the text and avoid repetition. E.g., in l. 11, it would be easier to follow if you mention in the main text where the surface tension data were published.

Experimental

p. 4442, l. 28: Specify 'wider range of conditions'. Wider range of particles sizes, RH,

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mass fractions,...?

p. 4444, l. 4: I believe that the accuracy is 2% of (e.g.) 3.2% (?). Clarify.

p. 4445, l.1-8: In my opinion, this list of the experiments is redundant since you describe them in the following section in detail anyway.

p. 4445, l. 10: The meaning of this sentence is not clear. Remove.

p. 4446, l. 16: In what sense can these particles be considered as single-component particles? Is their behavior the same as pure adipic acid (Sc, crit. diameter) or do they just show a uniform behavior, i.e. no stepwise dissolution of the less soluble compound?

p. 4447, l. 20: Figure 3 could be removed or at least moved into the Appendix. Just a statement that the calibration of the instrument showed similar results compared to literature would seem sufficient here.

Results and discussion

1st paragraph: The whole paragraph is just a copy of previous text; refer to experiments 1-6 (without repeating the list again). Move the important parts of Appendix A here and discuss them in view of your results within the main text.

p. 4449; l. 16/17: How do you quantify the effect on CCN activity? What do the 10% refer to? Supersaturation or critical size,...?

p. 4450; l. 3: Again, what does wide range refer to?

p. 4450; l. 22/23: Is the surface tension for the particles really calculated? It seems that the upper value is the one for water. Is the lower value the one you obtain for concentrated adipic acid solutions? How likely is it that a particle is composed of such a solution close to its activation?

p. 4452; l. 9: Replace 'the' by 'that' (...possible factors that may affect...)

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p. 4452; l. 16-20: What are likely shape factors for adipic acid? What is the extent to which a 'likely shape factor' could move the lines in Figure 5.

p. 4453; l. 13: What do you mean by 'eliminate impurities'?

p. 4453; l.13-17: Can you combine these sentences?

p. 4453; l. 18: Clarify what you mean by 'the CCN activity is determined within 10% by adipic acid'.

p. 4454; l. 26: Add 'nm' (181 nm).

p. 4455; l. 18 ff. The explanation of why the large soot particles behave so differently as compared to the smaller ones does not seem really satisfying to me. Is there any experimental evidence (from other studies and/or systems) that indeed the coating is different on small vs. large particles? I do not understand the statement: the S_c measurements for the larger soot cores are displaced to the right. It seems to me in Fig. 8 that they are not displaced to the right but rather to a higher supersaturation. Thus, they activate at an even higher supersaturation than a wettable particle.

Conclusions

p. 4456; l. 14: This bullet point should be modified. According to your study, at least some of the scatter can be explained based on the generation of the particles.

p. 4456; l. 24/25: Clarify what is meant by an effective diameter that is smaller than particle diameter.

Appendix A

You can shorten major parts of this text and should incorporate it in the main text in order to have a better flow of the whole discussion.

p. 4459; l. 15: Why is this approximation only valid for particles > 30 nm?

p. 4459; l. 20: On p. 4457, you define Kelvin and Raoult term as expressions that

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include dp.

p. 4460; l. 11-24: How relevant is this discussion for the experiments performed here? What case does the adipic acid/ammonium sulfate mixture represent?

p. 4461; l. 17: This equation is just a simplified form of equation A1, i.e. it includes the assumption that the mole ratio of water is 1.

Figures

Figure 5: Is this figure necessary? It does not include any additional result or information as compared to Figures 1 and 4.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 4439, 2008.

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