

Interactive comment on “Continuous standalone controllable aerosol/cloud droplet dryer for atmospheric sampling” by S. Sjogren et al.

S. Sjogren et al.

staffan.sjogren@nuclear.lu.se

Received and published: 30 October 2012

We thank the referee (R) for the constructive comments, and appreciate to note that the referee found our paper interesting and we understand that the referee liked to review it.

Comments:

R: "...not well structured..."

Answer: We will change the sections to a strict methods section, according to comments from the 2nd referee as well, and improve the structure of methods, results and discussions. See comments to referee 2.

C2693

R: Fig. 3/ Par. 4.1: "...do not specify in text why Ni63 (...for the DMA)..."

A: The Ni63 was used, as usual, before the DMA as the referee points out (panel B). Further, we used a Ni63 (both Panel A and B), before the dryer. In the first case it was used to neutralize the aerosol from the VOAG. This gives a reproducible test of the transmission due to sedimentation and impaction, and reduces electrostatic losses (which we avoided testing at the same occasion, in order not to mix different physical processes). For the second case (panel b) the 2nd Ni63 reduces any multiple charges coming through the DMA. This is of minor importance in order to avoid electrostatic losses and was most probably redundant. We will add explanation in text in section 4.1 and add reference to Wiedensohler (1988).

R: Fig. 3. "A larger cone was used on top of the dryer"

A: The experiments were carried out with one year in between. The larger cone was available for the 2nd experiments, and judged a better technical solution. Especially allowing a port for sampling for CPC1, and more realistic flow expansion in the cone. Text explaining the above will be added in section. 4.1.

R: "DMA works with 5.7 (6.7) lpm sample flow..."

A: We apologize. The DMA in panel B used 2.2 L min⁻¹ sample aerosol flow and 9.8 L min⁻¹ sheath flow. Missing in Fig. 3 panel B is a low pressure-drop filter used after the DMA (downstreams Ni 63) to dilute the DMA sample flow. Referee 2 also pointed out this error. Fig. 3. will be corrected.

R: "...technical details of this counter (CPC 7610)"

A: The minimum particle size, with the used flows, is 14.5 nm (Hermann and Wiedensohler, 2001). The maximum particle size is > 3 µm (TSI manual). This limit depends on the inlet tubing diameter and fill level of Buthanol during measurements (and more generally on the geometry of the aerosol path inside the CPC). The lower size limit is not an issue, as our measurements were done at larger sizes. The larger size limit

C2694

could affect the results we have obtained. In this respect, measuring transmission of the experimental set-up (tubing with bends), or through the CPC reaches approximately the same limit: transmission decreases significantly in the range 4-6 μm diameter, see Fig. 4. It would have been advantageous to use an OPC or APS for the largest sizes investigated, as the referee points out. Important to note is that the inlet to the dryer and the dryer section itself (positioned vertically) has no significant losses in the size range of interest. The explanation will be added in text.

R: "...residence time needed for drying. ... reference Sjogren et al., 2007" Page 5473 line 15

A: Sjogren et al., 2007, investigated the humidification process, of several organic/inorganic mixtures, in the concentrated subsaturated region. This, and other data, resulted in, for example, EUSAAR to recommend the sampled aerosol to persist at high RH during a time period on the order of 10 s in HTDMAs. However, there are only rare reports in the literature of ambient mixtures requiring such "long" times, one reason being that such mixtures often have low water uptake, thus the measurement accuracy must be high to distinguish the effect. The drying, from "the other direction", i.e. from a diluted large droplet, to a size reaching at least the accumulation mode, is not limited by that process. However, surfactants (creating a surface layer – during the drying process) or sparingly soluble organics (that precipitate during the drying process) might reduce the vapour pressure of water from the diluted droplet (e.g. Shulman et al., 1996; Shantz et al., 2003). These effects are reduced as the supermicron size increase, thus the beginning of drying of a 25 μm droplet should be unhindered by such processes. It is important to reach accumulation mode size in the dryer for onwards transport of the aerosol particles/drops, without losses, to the instrumentation. The last drying equilibration to instrumentation RH (say, 20-30 % RH) can generally be done in tubing and additional volumes, if required, after the dryer. We appreciate the call from the referee to cite our own paper, and will try to add text where that finds a place. We will include the information above in the article, as well as the relevant references.

C2695

As to the closing remarks of the referee, we will increase the technical details in text, especially concerning the experimental set-ups and the dryer, for AMT.

References

Hermann, M., and A. Wiedensohler (2001), Counting efficiency of condensation particle counters at low-pressures with illustrative data from the upper troposphere, *J. Aerosol Sci.*, 975-991.

Shantz, Nicole C., W. Richard Leaitch, Peter F. Caffrey, Effect of organics of low solubility on the growth rate of cloud droplets, *JOURNAL OF GEOPHYSICAL RESEARCH*, VOL. 108, 4168, 9 PP., 2003 doi:10.1029/2002JD002540

Shulman, Michelle L., Michael C. Jacobson, Robert J. Carlson, Robert E. Synovec, Toby E. Young, Dissolution behavior and surface tension effects of organic compounds in nucleating cloud droplets, *GEOPHYSICAL RESEARCH LETTERS*, VOL. 23, NO. 3, P. 277, 1996 doi:10.1029/95GL03810

Sjogren S.; Gysel M.; Weingartner E.; et al. Title: Hygroscopic growth and water uptake kinetics of two-phase aerosol particles consisting of ammonium sulfate, adipic and humic acid mixtures. Source: *JOURNAL OF AEROSOL SCIENCE* Volume: 38 Issue: 2 Pages: 157-171, 2007, DOI: 10.1016/j.jaerosci.2006.11.005

Wiedensohler, A.: *J. Aerosol Sci.*, 19, 387-389, 1988.

Interactive comment on *Atmos. Meas. Tech. Discuss.*, 5, 5469, 2012.

C2696