

## ***Interactive comment on “Insights into secondary organic aerosol formed via aqueous-phase reactions of phenolic compounds based on high resolution mass spectrometry” by Y. Sun et al.***

**Anonymous Referee #2**

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This manuscript is a valuable contribution to our understanding of multiphase reaction pathways of abundant precursors in the atmosphere. It is mainly based on laboratory work which provides a good insight into what might happen in the atmosphere. However, in spite of some efforts by the authors, the atmospheric implications of the results remain rather vague.

1) The authors do not elaborate on the gas-to-particle distribution of their precursors. All the compounds studied are rather volatile and has small Henry-constants (see e.g. Feigenbrugel et al., Atmos. Environ. 2004). Therefore they mostly remain in the gas phase even inside clouds, and their supply from the gas phase would remain rather

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limited (see eg. Gelencser and Varga, ACP 2005). Bulk laboratory experiments differ from multiphase reactions in that precursors are readily available for reactions and need not be replenished from the gas phase. With this in mind, the question arises how relevant is the initial concentrations of phenolic compounds in the solutions from atmospheric standpoint?

2) Aside from the above constraint, there is a significant element in the experimental protocol that could severely distort the characteristics of the resulting SOA: bringing the reaction mixture into dryness could result in substantial losses and semi- and even less volatile SOA products that can still be relevant under atmospheric conditions.

3) This point is manifested in the SOA carbon yield that can be deduced from the published data (from data reported in Table 1), though the authors themselves do not provide a carbon balance. For phenol, a carbon yield of about 25 % can be estimated, with the notion that the initial compound cannot be detected. This raises the question that what happened to 75 % of the carbon atoms initially present in the solution: most of them had been lost as carbon-dioxide or highly volatile species already from the reaction solution; or they had been blown off upon evaporation from the Al cup? A TOC analysis of the liquid phase prior to the drying step could have helped.

Minor comments:

1) The good match between the OM/OC data provided by the AMS and the gravimetry/TOC measurements is more than surprising given that AMS measures compounds in individual particles (with a varying degree of ionization efficiency) whereas gravimetry is carried out from blown-off bulk samples (with significant losses of semi-volatile species).

2) It is not surprising at all (despite statement in Page 2924 line 2) that SOA from phenol is more oxidized (have higher O/C ratios) yet it produces less high MW and high O/C species: the lower is the carbon number of the compounds containing oxygen, the higher will be the O/C ratio.

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