

***Interactive comment on “Emission factors and light absorption properties of brown carbon from household coal combustion in China” by Jianzhong Sun et al.***

J. Sun et al.

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**Reply to Referee 1<sup>#</sup>**

**General comment:**

The manuscript "Emission factors and light absorption properties of brown carbon from household coal combustion in China" by Sun et al., presents valuable measurements of the emission factors and optical properties of brown carbon and black carbon fractions resulting from household coal burned for heating/cooking purposes in China. An optical method using an integrating sphere was applied to analyze several coals burned in typical stoves at both chunk and briquette styles. The method is not new but it is applied to an interesting study. The protocols are sufficiently well described, the study has been done carefully and the interpretation makes sense. The results are potentially interesting for other researchers engaged in aerosol studies. The paper is adequate to the journal scope, it is well formatted and presents a valuable experiment, so it deserves publication in the ACP. Except for some small technical corrections, I have only one major concern about reference Sun et al., 2016. Please see below.

**Response:**

Thanks a lot for the positive comments and recommendation for publication in ACP. We noticed that the reviewer has only one major concern, which is on the reference “Sun et al., 2016”. We will specifically address such concern in our response to “**Comment 5**” below.

**Comment 1:**

Page 5 line 17: L/min should be l/min;

**Response:**

We have changed "L/min" to "l/min" in revised version (page 5 line 17).

**Comment 2:**

Page 5 line 18: "... into the PFS-4000..." should be "...into a FPS-4000...";

**Response:**

Thanks for reminder. We have changed “into the PFS-4000” to “into a FPS-4000” in revised version (page 5 line 18).

**Comment 3:**

Page 9 line 18: something is missing in the sentence starting with "It's interesting that...";

**Response:**

The sentence is a complex sentence with “it” as the formal subject and the “that-clause” as the logic subject (page 10 line 12, revised version). With this sentence, we intend to show that the absorption Ångström exponent (AAE) comes lowest in the coals of medium  $V_{daf}$ , which happens to be opposite to that  $EF_{BC}$  and  $EF_{BnC}$  comes highest in the coals of medium  $V_{daf}$ . This can be seen by

comparison of our two figures in the manuscript (Figure 3, Figure 5). In fact, some of our previous studies (e.g., Chen et al., 2006; Zhi et al., 2008, 2009) have repeatedly concluded that the maximal  $EF_{BC}$  occurs in medium maturity coals around  $V_{daf}=30\%$ .

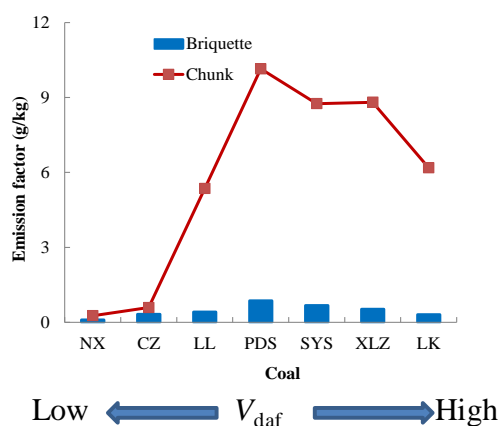


Fig. 3. “bell-shape” for  $EF_{BC}$  against  $V_{daf}$

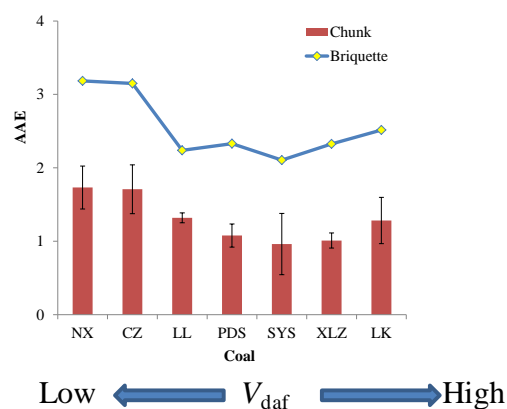


Fig. 5. “U-shape” for AAE against  $V_{daf}$

**Comment 4:**

Please complete captions of figures and tables to make them more informative, for example, describing the meaning of the abbreviations used;

**Response:**

Thank you. We have examined all figures and tables and tried to make their captions more informative by explaining the meaning of the abbreviations, as follows:

- (1) Page 21 revised version, Table 1: We added the full names of the coal mine locations of the 7 coals (at the end of the table).
- (2) Page 22 revised version, Table 2: We added the full names of the 4 coal stoves (at the end of the table).
- (3) Page 23 revised version, Figure 1: add “PTFE means Polytetrafluoroethylene” to the caption.
- (4) Page 24 revised version, Figure 2: change “CarB (diamonds, squares) and HASS (forks, triangles)” to “CarB (carbon black, diamonds, squares) and HASS (humic acid sodium salt, forks, triangles)”.
- (5) Page 25 revised version, Figure 3: “BC and BrC” have changed to “black carbon (BC) and brown carbon (BrC)”.
- (6) Page 26 revised version, Figure 4: add “The 4 stoves are respectively Wanjia brand briquette stove (WJ), Simple Chunk stove (SC), Huanding brand chunk stove (HD), and Laowan brand chunk stove (LW)” to the caption.
- (7) Page 27 revised version, Figure 5: change “of AAEs” to “of AAEs (absorption Ångström exponents)” in the caption.

**Comment 5:**

Reference Sun et al., 2016 is an unpublished work and, based only on the title; it appears to have a significant overlap with the present manuscript, so authors should explain what part of the work is done in each manuscript.

**Response:**

The reference “Sun et al., 2016” is indeed our unpublished work. Different from the present work

that focuses on household coal in terms of BrC emissions, “Sun et al., 2016” had intended to focus on household biomass in terms of BrC emissions. The same method (i.e., the integrating sphere, IS) had been planned for these twin papers. However the “Sun et al., 2016” paper (on biomass) has so far not been finished and submitted, which makes our reference senseless. In this case we have to cancel the reference to “Sun et al., 2016” throughout our revised version.

By the way, the planned paper “Sun et al., 2016” is close to being finished and will in return refer to the current paper (on coal) regarding IS method.

Thanks again for the careful and constructive reviewing.

## References

- Chen, Y., Zhi, G., Feng, Y., Fu, J., Feng, J., Sheng, G., and Simoneit, B. R. T.: Measurements of emission factors for primary carbonaceous particles from residential raw-coal combustion in China, *Geophys. Res. Lett.*, 33 (20), 1-4, 10.1029/2006gl026966, 2006.
- Zhi, G., Chen, Y., Feng, Y., Xiong, S., Li, J., Zhang, G., Sheng, G., and Fu, J.: Emission characteristics of carbonaceous particles from various residential coal-stoves in china, *Environ. Sci. Technol.*, 42 (9), 3310-3315, 10.1021/es702247q, 2008.
- Zhi, G., Peng, C., Chen, Y., Liu, D., Sheng, G., and Fu, J.: Deployment of coal briquettes and improved stoves: possibly an option for both environment and climate, *Environ. Sci. Technol.*, 43 (15), 5586-5591, 10.1021/es802955d, 2009.