

Dear Editor and Reviewers, thanks a lot for your efforts and time reviewing our work. We have read your comments carefully, reply to them and improve our MS in accordance. We submitted a clean revised version of our work, but also a version with changes tracked (in red, parts to remove; in yellow, new parts added to the text). We hope this version fulfil your expectations. Find below a reply to all your comments (in yellow, our reply). Best regards.

Reviewers reply in purple

Reviewer 2

Basic reporting

The manuscript is written in clear English, at times the wording is slightly misleading and could be improved (e.g. lines 335-336, the use of “sorption capacity” when this parameter was not measured or calculated, for helpful insights into discussion of sorption data see e.g. <https://doi.org/10.1016/j.watres.2017.04.014>). Figures are relevant to the content and appropriately labeled.

Thanks for your comment. We changed “sorption capacity” to sorption potential to avoid confusion. Anyway, we were not meaning to “sorption maximum capacity”, which is the term that should not be used because we didn't calculate it.

Done as suggested

Unfortunately, during the introduction, as well as during the discussion of the results the authors neglect a portion of previous work on PAH sorption and degradation in the presence of biochar. For example, the fact that desorption from biochar is a rate limiting step for PAH degradation in biochar amended soils has previously been reported but was not discussed in the introduction and not used for the identification of knowledge gaps (e.g. <http://dx.doi.org/10.1016/j.envpol.2013.06.026> and <https://doi.org/10.1016/j.jhazmat.2017.11.010>). Thus, it remains unclear to the reader what is already known, and how this study contributes to the field (see below for some suggestions). Accordingly, the sections at times appear to be less connected to the research aim than they could be and could be more focused on results relevant to the research aim(s).

Thanks for the remark. We include these two relevant papers and tried to link better to the gaps in the introduction.

Done as suggested, although the discussion remains superficial and the aims of the study were not sharpened

Experimental design

The aim of the study is clearly stated, however, based on previous literature the authors could expect that phenanthrene sorption will depend on biochar type and soil properties. The data which were obtained fulfill high technical standards and surely have the potential to go beyond these expectable findings.

Thus, more attention should be given to the identification of existing knowledge gaps in the field, which could be useful to reshape the discussion and conclusion section of the manuscript. The results sections should be organized accordingly to better lead towards the answering of the previously identified knowledge gaps (currently for the first two sections this is not the case). The general aim of the first two sections could be to provide a more detailed mechanistic discussion on biochar-soil interactions with a special focus on the differences between soils and biochars to subsequently help to explain the effect of soil type and biochar type on the sorption and degradation of phenanthrene.

As stated before, we have tried to link better our study with previous gaps, and also provide more mechanistic results that may help to give light. However, we do not agree that the discussion should be reorganised. In the way it is presented now we feel we can get the best outcome of our results. The other two reviewers were in agreement with our opinion. Unfortunately, PBC and OBC, that were the most similar in characteristics, behaved very different, while RBC, different in characteristics, behaved similar to OBC, so some mechanistic hypothesis can be hidden behind this. But we don't feel that our results are less valuable because we cannot reply to all the questions that are unsolved.

The authors avoid making substantial changes regarding this comment, which was also emphasized by the editor

The discussion of Freundlich fits, especially differences in observed sorption nonlinearity (n) could be further elaborated in regards to sorption interactions and the effects of soil fractions on sorption to biochar.

Thanks for your comment. The interpretation of this point has been improved.

As far as I can see, the discussion of nonlinearity remained vague. For instance, one could hypothesize, that nonlinearity is associated to a higher contribution of specific adsorption processes compared to nonspecific partitioning processes and discuss if this holds through for the data presented, based on sorbent properties.

Furthermore, I do not follow what the authors intend to state here: "and finally $1/n$, and RBC increased to some extent DOC in the soil (Fig. 3)" please clarify

At the end of the sorption section the authors indicate that pH may have affected sorption of phenanthrene, but fail to explain why a neutral hydrophobic contaminant would sorb differently in dependence of soil pH.

We are not indicating that pH may have affected sorption of phenanthrene directly- pH change can change some characteristics of soil system in this case characteristics of sorbent (functionality, charge of soil mineral components, changes in humic substances behaviour, ionic strength etc.). In our study, applied soil samples represent heterogeneous matrix with wide range of components. In this way the further and more extensive study is required.

Agree, please include this explanation into the manuscript.

The data presented in the phenanthrene mineralization section are very interesting and may offer more insight than is presented. For instance, the authors could look into the possible facilitation of abiotic phenanthrene transformation by biochar in the sand- biochar system to explain the different trend compared to soil systems.

We see very little (to nothing) biological activity in sand caused low mineralisation of Phe. For this reason we think that chemical facilitation to degrade Phe is not occurring at a significant rate in our sand system, and most degradation is microbe-mediated. A little sentence has been added describing the main role of microbiota in Phe degradation.

Are the authors suggesting that because of low microbial activity there is no abiotic degradation? I cannot follow this reasoning. Surely there are other arguments to exclude abiotic transformation (if this is the case). However, even if we assume that there is no abiotic transformation of PHE, the authors still fail to explain the increase in PHE degradation upon biochar amendment in the sandy soil. Are there indications of increased microbial activity after biochar amendment? If so, this would be a good explanation for their observation.

The section “integrative comments” is very helpful for the discussions of both sorption and mineralization measurements and the authors may consider to merge the two paragraphs with the respective previous sections. The concluding remarks could be sharpened in regards to key findings and how this study may be useful for further research in the field.

We re-write a bit the concluding remarks in accordance to your suggestions and other suggestions from reviewer 1 and 3. However, integrative comments reads fine and interesting, we cannot see that we can sharpen it. Regarding merging parts, as stated before, the authors think that the structure of Result & Dis is appropriate and like to have them separate. The other reviewers also remarked that the results are properly organised in the paper.

The authors avoid making substantial changes regarding this comment, which was also emphasized by the editor

Validity of the findings

The data is robust, statistically sound and the key findings are valid with few remarks that need to be addressed (e.g. see comment on the effect of pH on phenanthrene sorption). The conclusion section should be sharpened towards the key findings and the meaning of these findings for the larger field.

We integrate your comments in our MS, thanks for it. In particular, we tried to highlight mechanistic hypothesis we confirm, and we sharpen our results, but also trying to describe the limitations (field conditions).