

**PhD offer**  
Montpellier, South of France

**Evaluation of the use of biochar to improve the quality of waste water used in agriculture**



LISAH | LCA  
Montpellier | Toulouse



**PhD Description**

The topic of this thesis is to determine the best means of purifying pesticide-contaminated runoff water in fields and attenuating their spread to non-targeted areas. In answer to this growing problem is a technique which is both simple and eco-friendly: the use of biochar. A partial and targeted amendment with biochar will be applied to field drainage water to absorb the pesticides which are particularly attracted to biochar (e.g. Liu et al., 2018; Yavari et al., 2015). Moreover, as biochar is made from agricultural waste this decontamination strategy is also part of the circular economy approach.

Although most studies show that the majority of pesticides have a high affinity for biochar, these results have been obtained after short-term experiments we do not yet have information on their long-term behavior, or the physicochemical properties of ageing biochar (e.g. Sorrenti et al., 2016; Zhelezova et al., 2017; Wang et al., 2020)- in a climate that alternates harsh droughts and high- intensity rainfall as well as significant temperature variations. Thus to establish the long-term use, many questions need to be answered, in particular on the processes of sorption and degradation of pesticides in connection with the evolution of the intrinsic properties of biochar linked to ageing in the field. In addition, we also need to determine the optimal position of this biochar with agricultural infrastructures (e.g. Reichenberger et al., 2007).

To provide some answers, the objective of this thesis will be (i) to study the biophysical mechanisms conditioning the fate of contaminants after biochar amendment on the ditch network, and (ii) to model the effect of a targeted biochar amendment on an extended network which limits the dispersion of contaminants towards water resources (e.g. aquifers) supplied by these networks. Ultimately, this work should lead to the proposition of conceptual scenarios for targeted and reasoned use of biochar in agricultural ditch networks, under a Mediterranean climate, to reduce the dispersion of contaminants.

**Approach considered**

To meet these challenges, the planned work is based on an experimental and modelling approach, on a laboratory and field scale. Experiments under controlled conditions will aim to characterize the mechanisms of sorption and degradation of pesticides concerning biochar matrices. Field experiments are planned on the one hand to obtain biochar at different stages of ageing, and on the other hand to provide the data necessary for the calibration of the mechanistic modelling. The work carried out by understanding the processes of the fate of pesticides in the context of biochar amendment will be used in a numerical simulation experiment plan for the environmental assessment of biochar application strategies at the scale of each network.

## Organization and plan of the thesis project

This thesis subject is part of a research project ([EauCharb'Oc](#) – 2022-2025) partly funded by the Occitanie region through the regional challenge on waters [Woc](#). It brings together 5 scientific laboratories and aims to participate in the initiation of a living lab anchored in the regional wine-growing territory (Hérault basin) concerning the problem of improving the quality of runoff water in agriculture and its reuse as a drinking water supply. Half of the funding for the thesis is provided by the AgroEcoSystem department of INRAE and the other half by the Occitanie region.

The student will be welcomed at the UMR LISAH Montpellier, with visits to be planned on the UMR LCA site, in Toulouse. He or she must enrol in the GAIA (Biodiversity, Agriculture, Food, Environment, Land, Water) doctoral school at Montpellier university.

The thesis is planned to begin between October and December 2022 depending on the availability of the candidate and last for 3 years.

## Thesis advisory board:

- o Dr. Claude Hammecker (co-director, UMR LISAH – Tunis, [claud.hammecker@ird.fr](mailto:claud.hammecker@ird.fr))
- o Dr. Philippe Behra (co-director de thèse, UMR LCA – Toulouse, [philippe.behra@ensiacet.fr](mailto:philippe.behra@ensiacet.fr))
- o Dr. Jeanne Dollinger (supervisor, UMR LISAH – Montpellier, [jeanne.dollinger@inrae.fr](mailto:jeanne.dollinger@inrae.fr))
- o Dr. Anatja Samouelian (supervisor, UMR LISAH – Montpellier, [anatja.samouelian@inrae.fr](mailto:anatja.samouelian@inrae.fr))

## Required profile

We are looking for a motivated student, with strong skills in contaminant biogeochemistry. The candidate should be skilled in laboratory work and data processing. Being competent in modelling the hydrological transfers of polluting compounds would be an advantage for this position. The candidate must be dynamic, enthusiastic and show good autonomy. He or she must have good writing and excellent communication skills.

## How to apply:

Please send your application to: [jeanne.dollinger@inrae.fr](mailto:jeanne.dollinger@inrae.fr)

Include A detailed CV, a motivation letter, a transcript of the final years of the degree prepared (Master or engineer), and a copy of the Master's Thesis (if available) as soon as possible. Applications are expected before the end of august and will be requested as they are received. An audition may be scheduled for the candidates selected following the file review phase.

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## Bibliography :

- Liu Y., Lonappan L., Brar S. K. Yang S. 2018. Impact of biochar amendement in agricultural soils on the sorption desorption, and dégradation of pesticides : a review. *Science of the Total Environment*. 645 : 60-70
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- Sorrenti, G., Masiello, C.A., Dugan, B., Toselli, M., 2016. Biochar physico-chemical properties as affected by environmental exposure. *Sci. Total Environ*. 563–564, 237–246. <https://doi.org/10.1016/j.scitotenv.2016.03.24>
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- Wang, L., O'Connor, D., Rinklebe, J., Ok, Y.S., Tsang, D.C.W., Shen, Z., Hou, D., 2020. Biochar Aging: Mechanisms, Physicochemical Changes, Assessment, And Implications for Field Applications. *Environ. Sci. Technol.* 54, 14797–14814. <https://doi.org/10.1021/acs.est.0c04033>
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