Sorption Properties of Greenwaste Biochar for Two Triazine Pesticides

This work by ISTC's Wei Zheng and Kishore Rajagopalan and collaborators from Delaware State University provides innovative solutions for producing energy and food in a sustainable environment. Renewable energy can be produced by converting greenwaste such as using highway grass clippings for gasoline or biodiesel through a process called pyrolysis (heating to 450°C with limited oxygen) and then implementing some refining techniques. However, the pyrolysis process produces a byproduct called biochar, which is a carbon-rich substance similar to activated carbon. The biochar byproduct could be landfilled, but the researchers have a better and more useful idea.

The other aspect of this research is determining how to produce food without contaminating the environment. The researchers considered two common pesticides. Atrazine and simazine are used as broad-spectrum pesticides/herbicides for agricultural, recreational, and residential uses, but the most common use is for field crop applications. These pesticides can inadvertently contaminate water ways and water bodies from rain events and soil erosion. To prevent this contamination, the researchers proposed mixing biochar into the soil to prevent pesticide/herbicide loss from the field.

In the lab, various solutions of atrazine and simazine were mixed with biochar to test the concentration of atrazine/simazine to sorption properties based on particle size, solid/solution ratio, and pH, as well as how atrazine and simazine compete for sorption to biochar when in the same solution. The researchers found that within the first minute, atrazine concentrations in the solution were reduced by 34 to 51% in combination with decreasing particle size (0.250–0.053 mm). Then atrazine slowly decreased in solution until a maximum sorption level on the biochar was reached. The smaller the particle size for biochar, the quicker the equilibrium level was reached. Similar sorption results occurred with simazine.

When biochar was added in increasing increments to each of the pesticide solutions, more atrazine or simazine was taken up by the biochar. However, even though more chemicals were absorbed, the sorption capacity decreased, meaning that each particle of biochar took up less pesticide when more biochar was present in the solutions. The researchers also found that both pesticides had a greater sorption capacity under increasing acidic conditions, but the capacity was the same under basic (neutral) conditions. Finally, the researchers discovered that atrazine and simazine will compete to sorb to biochar when they are in solution together. This means that if equal amounts of atrazine and simazine are in solution, then equal amounts will be on the biochar. However, if one has a greater concentration than the other, the greater concentration will be the most sorbed to the biochar.

These results indicate that biochar can be an effective agent for removing pesticides and herbicides from the environment. Biochar could be applied to the edges or buffer zones of fields to filter out pesticides and herbicides from water leaving the field system.

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- **Metals**
- **Metalworking Fluids**
- **Per- and Polyfluoroalkyl Substances (PFASs)**
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Publications

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