

## ***Interactive comment on “Removal of Dyes from Simulated Wastewater using Low Cost Activated Carbon Derived from Date Pits” by Salam A. Mohammed et al.***

### **Anonymous Referee #1**

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#### DWES reviewer comments

Removal of Dyes from Simulated Wastewater using Low Cost Activated Carbon Derived from Date Pits.

The authors investigated the adsorption of four different dyes on activated carbon prepared from date pits. Waste materials are indeed a cheap precursor for activated carbon as compared to coal/wood/peat based on material costs. The main costs for operating an activated carbon treatment process are regeneration costs. If it would turn out that activated carbons based on waste products can't be effectively regenerated (e.g. high carbon losses, high capacity losses), it may actually turn out to be a

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more expensive treatment alternative. So “low cost” can be debated.

In the results and discussion section, it would be helpful to compare the results with other literature. Methylene Blue, for example, is widely used to test activated carbon performance, including activated carbons based on waste materials.

The manuscript is generic at the moment. It could be improved by elaborate more on the experimental choices that were made. For example, both furnace heating and microwave heating were used. Based on literature, the authors could mention what differences are to be expected on the final properties of the activated carbon, and check for these differences, e.g. with a pore size distribution / BET surface analysis. SEM microscopy alone is not sufficient. Then there were 4 different dyes used by the authors, which probably have different size, charge, hydrophobicity. It would be stronger to relate these properties to the differences in adsorption efficacy, rather than just mentioning which one adsorbs well and which one adsorbs poorly.

Specific comments on the manuscript are mentioned below.

Line 18-20: The authors mention aqueous pollution in general as a problem that can be solved with activated carbon, but are specific in their title (i.e. Dyes). It would be better to focus on dyes specifically in the abstract as well.

Line 21: Date pits are introduced as precursor for activated carbon. Could the authors motivate this selection over conventional precursors?

Line 25-26: “These variations. . .discussed”. According to the reviewer, this statement can be omitted. Every researcher tries to display and explain his/her data as good as possible, that doesn't have to be mentioned explicitly.

Line 40-41: Are the authors referring to the direct use of rice husk, orange/lemon peel as adsorbents, or their use as (cheap) precursor for activated carbon?

Line 47-49: Particle size is expected to be important for removal kinetics. Equilibrium adsorption capacity should be closely related to adsorption surface.

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Line 56-57: The authors should elaborate on the expected effect of the different heating methods on their activated carbon properties, in order to justify both methods.

Line 58-60: The authors mention four different dyes that are used in their experiments. It would be helpful to explain why these four dyes were selected, again to justify their inclusion.

Line 73: Demineralized water with added Dye may not be a good representative for simulated wastewater, as effects of e.g. competition with / pore blockage by NOM, pH value and buffering, and particle fouling in a packed carbon bed are not included. Also, simulated wastewater should contain dye concentrations similar to actual wastewater of e.g. a textile industry case study. It would be more prudent to not refer to your solution as simulated wastewater.

Line 78-80: Acid is also used to activate precursors, and creates an adsorption surface with different functional groups that which are produced when e.g. steam is used for activation. Was the acid used for activation in this work as well? And is this choice expected to be beneficial for dye adsorption? i.e. are functional groups created with acid activation that interact with the dyes?

Line 87: The section on adsorption experiments should describe the amount (mass) of activated carbon that was used, and the filtration velocity or bed volumes treated during continuous down flow treatment.

Line 92: What was the actual pH of the solution? Are the pH probes used sensitive enough in demineralized water? Typical pH probes need some conductivity to measure the pH, and demineralized water has low conductivity.

Line 92: It is mentioned in the section "preparation of activated carbon" that it was dried at 70 degrees Celsius. Is this a second drying step, or are the authors referring to the same drying step? It might be more clear to include the one, or both drying steps in the "preparation of activated carbon" section.

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Line 97-101: When measuring dye concentrations with a spectrophotometer, usually each dye has a characteristic peak at a unique wavelength. The adsorption at that wavelength is correlated to the dye concentration via a calibration curve. Did the authors use the complete wavelength range to measure dye concentrations, or did they use specific wavelengths? If so, please report these for each dye.

Line 104-107: The authors are not clear in describing their method. The activated carbon preparation is described as an acid wash, followed by either heating by furnace or microwave. After this, the carbon is sieved and two size fractions are obtained. Here, in the results and discussion section, an additional modification is mentioned, but it is unclear what exactly this modification is. This should be more explicit, and it should be mentioned in the materials and methods section.

Line 116-120: Do the authors have supplemental analyses to support this, besides only a SEM image? BET surface and/or pore volume distribution analyses would be helpful. A SEM image alone is insufficient to state beforehand that the porosity is enough to have efficient AC.

Line 136: % removal is with respect to the initial concentration, and should be calculated as  $( ([dye]_{initial} (influent) - [dye]_{final} (effluent)) / [dye]_{initial} (influent) ) * 100$ . It is unclear why [dye] predicted is used. It is not clear to the reviewer that the authors are using predictive models. If so, equation (1) would probably be Error (%) or Deviation (%), rather than Removal (%), with  $( [dye]_{removal, measured} - [dye]_{removal, predicted} ) * 100$

Line 148: a smaller AC particle size should enhance adsorption kinetics, but eventually result in the same equilibrium adsorption as larger AC particles (all else being equal). Apparently, in the experimental setup of the authors, kinetics are important. In drinking water treatment, typically the equilibrium adsorption capacity is leading, and kinetics are less important.

Line 149-150: For regular activated carbon, the internal adsorption surface is much

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larger than the external surface. So, while grinding to smaller diameters does create a larger external surface, this is not by definition significant.

It is unclear how table 1 is connected to Figure 2 & 3. If it is conveying the similar information, the authors should choose using only the figure or only the table. However, in the figures, all dyes seem to be almost completely removed eventually, while table 1 shows much lower removal percentages for EY.

Line 32: spelling; Catastrophes Line 33: spelling; get rid of Line 36: spelling; Colorants (American spelling) or Colourants (British spelling) Line 123: NIR = Near InfraRed. "Near" is already included in the abbreviation. Line 130: "an" should be "and". Other spelling error: consequently. Line 138, line 144, line 148: "pore size" should be "particle size"

Figure 1: contrast of A) / B) / C) and D) within figures is a bit poor.

Table 1 is not referred to, or discussed in the main manuscript. Table 1: the 4th column should have superscript "b" at "AC used". Table 1: FCP/MCP/FCP/MCP abbreviations should be written in full somewhere in the manuscript.

Figure 2 & 3: Y axis title "predicted" is confusing. Are these not experimental results? Figure 2 & 3: The time scale should be the same for all figures and expression in minutes would be more convenient.

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Interactive comment on Drink. Water Eng. Sci. Discuss., <https://doi.org/10.5194/dwes-2018-1>, 2018.