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Food Wastes As Adsorbent Materials for Water Decontamination: The Use of Kiwi Peels To Remove Emerging Pollutants and Textile Dyes

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Extended Abstract

The high rate of resource consumption and large amounts of produced wastes have been reported to drive towards an ecological collapse. Interestingly, a circular economy approach could reduce this environmental concern avoiding the waste management, and all outputs (products, by-products, wastes) would become inputs (material and energy) to other processes. When the model is based on the production of renewable biological resources, and these resources are converted into value-added products, the concept of bio-circular economy take place. [1,2] It means to develop an economy plan based on the production from biological resources with a sustainable transformation of wastes, offering alternatives to their dumping, burning, composting etc. About this purpose, the use of fruit Peels as food/agricultural wastes have attained interest, as adsorbent materials for water purification, avoiding their disposal according to the principles of Green Chemistry and Sustainable Development.[3] For this purpose, this work proposes, among wastes, the use of Kiwi Peels to remove emerging pollutants (not regulated substances that could affect both human health, and the whole environment, causing severe problems [1,2]) and textile dyes from water. Indeed, among the explored wastes, Kiwi Peels removed the largest number of contaminants. Kiwi Peels were characterized by adopting in synergy FTIR-ATR, TG and SEM analyses, before and after their use, and as result they are proposed as recyclable adsorbent. To infer information about the behaviour of Kiwi Peels during water treatments, model contaminants were selected and investigated (Ciprofloxacin, CIP, and Direct Blue 78, DB); so, the role of several parameters affecting the process was assessed. The thermodynamic, the adsorption isotherms and kinetics were also studied. Finally, to extend the lifetime of Kiwi Peels, desorption experiments were carried out by using hot water or salt solutions. 10 cycles of adsorption/desorption were studied, evidencing the recycling of both pollutants and Kiwi Peels (**Figure 1**). Moreover, another aspect investigated in this work regards the possibility of using Advance Oxidation Processes (AOPs) to induce the pollutants solid-state photodegradation as an alternative approach for adsorbent regeneration. Also, in this case, FTIR-ATR, SEM, and TG analyses were used in synergy for investigating the adsorbent features after the AOPs' application. If, on the one hand, the SEM and FTIR-ATR results revealed the absence of important post-treatment changes, on the other hand, the TGA suggested some modifications. Finally, mixtures of pollutants were also studied and in the case of dyes, dyeing experiments were also performed, evidencing the dye ability to colour cotton fibers after the colour recycling (**Figure 2**). Particularly, the experiments of dyeing were executed during the Kiwi Peels desorption in hot water at 323 K, without further additives.

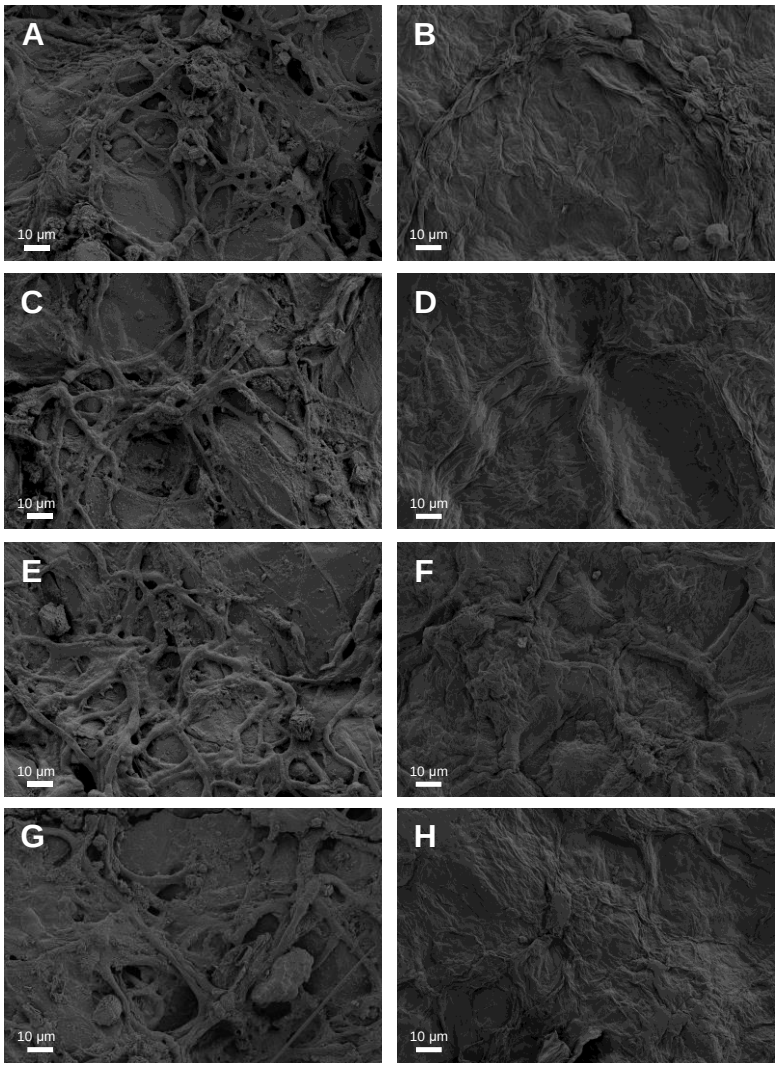

Figure 1: Representative SEM images of Kiwi Peels before the adsorption (**A**, **B**), after the adsorption (**C**, **D**), after the pollutants desorption (**E**, **F**), after 10 cycles of adsorption/desorption (**G**, **H**). Images of both the outer (**A**, **C**, **E**, **G**) and inner (**B**, **D**, **F**, **H**) side of the peel samples are reported.

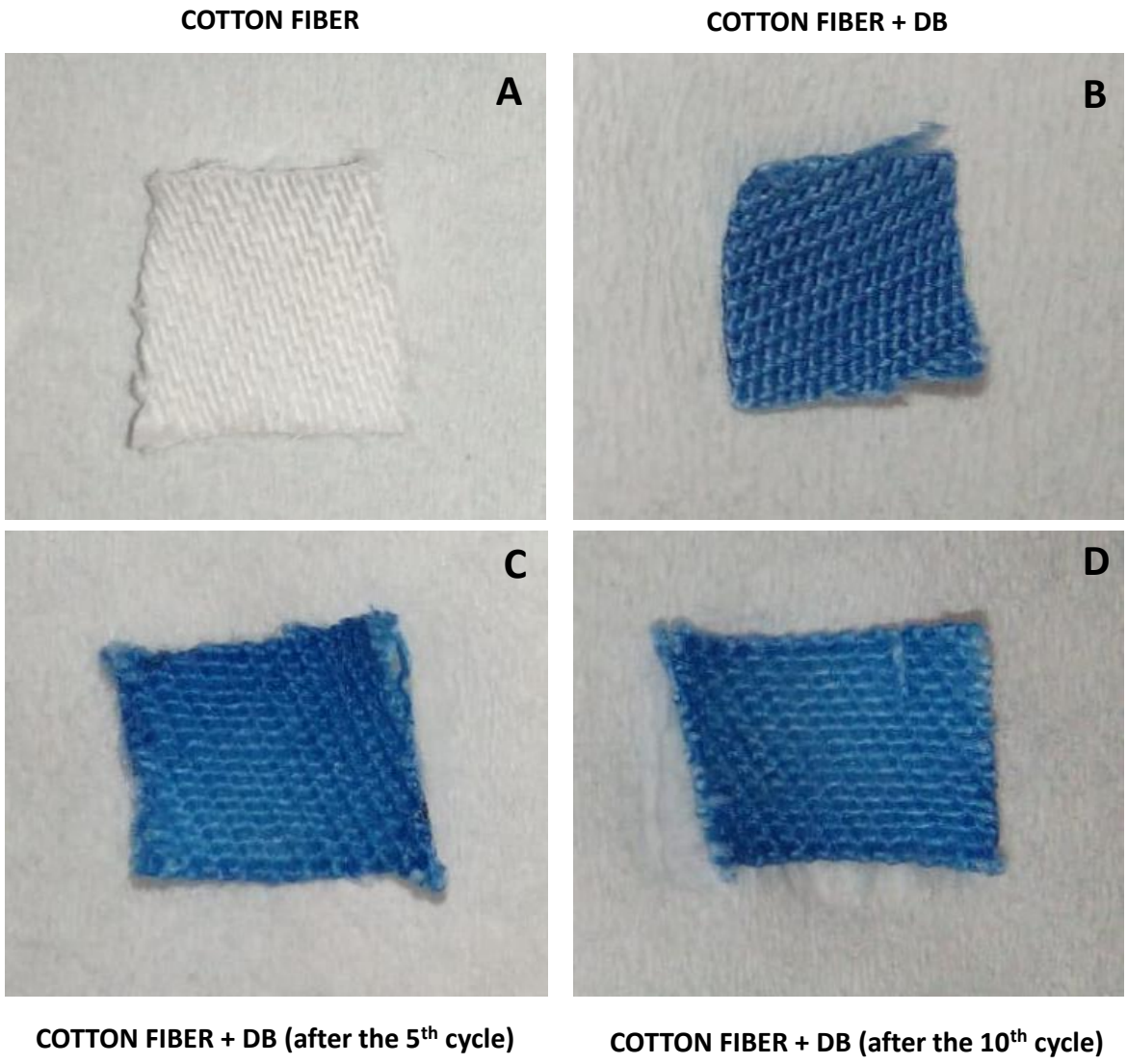

Figure 2: Dyeing experiments of white cotton fiber **(A)** with DB previous the adsorption onto Kiwi Peels (**B**), after the desorption from Kiwi Peels used 5 (**C**), and 10 times (**D**).

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