Activated carbons derived from wasted coffee grounds and olive stones as highly porous materials for air pollutants adsorption

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Typical everyday waste materials such as agricultural by-products, food waste, and industrial by-products, are potential precursors of activated carbon. Furthermore, these materials need an environmentally friendly way of reducing the problems related to their disposal. There have been studied different biomass waste as a potential precursor of porous carbon. For example, potato peels[1] , argan nutshells[2] , orange peels[3] , banana peels[4] and others were successfully carbonized and used for various pollutant removal purposes.

In this work, as bio-precursors of porous carbons, we have chosen coffee grounds and olive stones and we studied physical and chemicals properties within the adsorption capacity of CO_2 and Volatile Organic Compounds (VOC) as typical air pollutants. Coffee is one of the most widely consumed beverages and more than five million tons of it is produced annually[5] . Typically, coffee grounds and other organic wastes are composted, burned, or in the worst scenario – end up in the landfill. Alternative ways of using waste coffee grounds on an industrial scale are for example transforming them into biofuel, biodiesel, bioethanol, or biomaterials. Also in recent years, olive oil production has increased. Four leader producers of olive oil in Europe are Spain, Italy, Greece, and Portugal. Thanks to the range of different valuable properties, it is used in gastronomy, cosmetics, and pharmaceuticals. However, the manufacturing process of olive oil is also related to the generation of large amounts of waste and by-products like leaves, olive mill wastewater (OMW), and olive mill solid wastes (OMSW) which are stones, olive mill husk, olive cake, and pomace. OMSW are rich in cellulose, hemicellulose, and lignin, which makes them another potential precursor for activated carbon.

To prepare carbons firstly, the biomasses were pyrolyzed at 500°C and biochars were obtained, and then microporous activated carbons were produced by means of chemical (K_2CO_3) and physical (CO_2) activation. The influence of the activation process, type, and time of activation have been also investigated. The physio-chemical properties were characterized by N_2 and CO_2 isotherms, SEM, TGA and FTIR. Measurements of VOC adsorption were performed in a 17L chamber, at room temperature for 90min and Methyl Ethyl Ketone (MEK) was chosen as a model of VOC. The concentration was monitored using a photoionization detector (PID). As expected, carbon without activation (biochars) showed the lowest surface area equal 330 m^2g^{-1} and hence the lowest adsorption capacity. The surface for chemically activated carbons area was respectively 1487 m^2g^{-1}, and 870 m^2g^{-1}, from coffee grounds and olive stones, whereas physically activated carbons yielded values of 716 m^2g^{-1}, and 778 m^2g^{-1}, respectively. The highest adsorption capacity value (61% after 90min of exposure) for MEK was detected for the coffee grounds chemically activated carbons, the one with the highest surface area.

The literature has many articles dealing with activated carbons produced from various biomass. However, have not yet been reported study focused on biocarbons from coffee grounds and olive stones for VOC adsorption. The major novelty of this research is producing activated carbon from coffee grounds by physical activation in temperature 800ºC and short time activation – 1hour

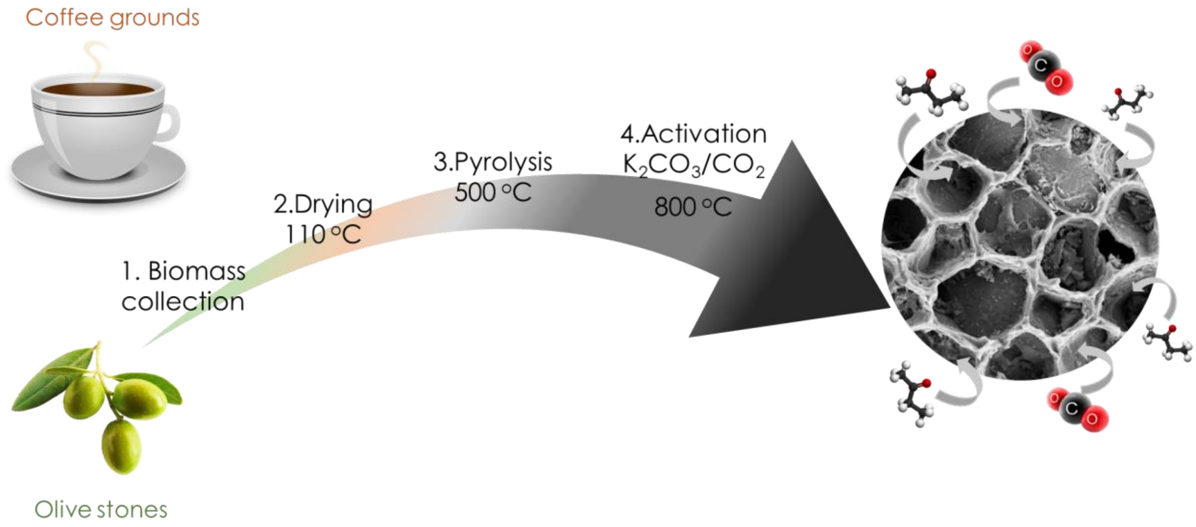

Fig. Graphical abstract.

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