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Preparation of activated carbon from fish scale

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ABSTRACT

In the present case, preparation of fish scale based porous carbon from two different types of fish's scales (talipia and rohu) purchased from the local market has been studied. Phosphoric acid of 20 M concentration has been used for porous carbon preparation. Brunauer–Emmett–Teller (BET) and Scanning Electron Microscope (SEM) analysis have been done to study the porosity, surface area distribution, pore size distribution and surface morphology of the activated carbon formed in each case. A comparison has been done with the commercially available activated carbon and the fish scale based porous carbon based on the physical parameters.

Keywords— *Fish scale, Phosphoric acid, Porous carbon, Norit CGP*

1. INTRODUCTION

The wastewater from the dyeing industry has been one of the major sources of many environmental problems. It contains dyes that are harmful to the environment. The presence of even very low concentrations of dyes in the effluent is highly undesirable. And toxic chemicals. Therefore, wastewater with dye contaminations needs to be properly treated before its release into the environment.[1] In the complicated procedures of water treatment, activated carbon materials are important due to their significant adsorption ability[2] for reactive dyes, in addition to being used as an adsorbent, activated carbon is also treated as catalysts support, energy store[3],[4] in the chemical industry due to their high specific surface, high degree of surface reactivity, and variable surface chemistries. However, as these active carbon materials have high production costs, researchers focus more and more on the development of the alternative and environmental-friendly raw materials for producing cost-effective activated carbon with high adsorption capacity. [2] Most recent studies have concentrated on the agricultural by-products, such as bamboo, [5] coconut shell, [6] saw dust, [7] cotton stalks, [8] fruit stones, [9] buffing dust [10]. Fish scales can be a good option. It is a by-product of Fisheries. The main components of fish scales are protein and hydroxyapatite. During the carbonization, the protein will provide the carbon source while hydroxyapatite serves as a template to form a specific porous structure. For these reasons, we developed a fish-scale-based porous carbon, which has a high surface area and lamellar hierarchical structure [11]. In this article, we will be developing fish-scale-based porous carbon (FSC) as an adsorbent. The influence of the acid on the fish scale of two different species has been studied and compared with the commercial activated carbon Norit CGP.

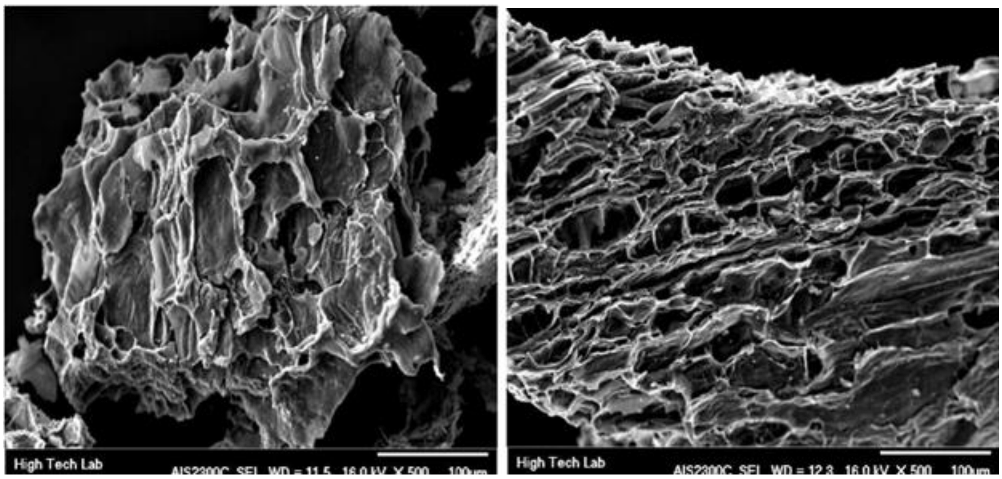
2. MATERIAL AND METHODS

Raw materials (fish scale) from tilapia and rohu were collected from the food market. The clean and dry fish scale was precarbonized at 330 C° for 3 h in air. The precarbonized powder was mixed with KOH at a weight ratio of 1: 1, followed by the activation in an N2 atmosphere at 950°C for 1 h. [12]. The products were kept in 20 M of phosphoric acid and finally washed with deionized water to remove the excess acid present on the surface. The fish-scale-based porous carbon (FSC) formed from talipia fish scale was named FSC1 and from rohu, fish scale was named FSC2 the commercial activated carbon, CGP Super (Norit), was used as comparison through the whole study. Textural characterization of the fish was carried out by adsorption/desorption measurement of nitrogen at 77 K (ASAP 2020, Micromeritics, USA) and the surface morphologies of FCS were examined by scanning electron microscopy (SEM, Model: HITACHI S-4700).

3. RESULT AND DISCUSSION

Figure. 1 shows the surface morphologies of the FSC1 and FSC2. It could be seen that the FSC (figure 1. (a)) had the lamellar structure and pores on the surface. The large-size pores were analogous to channels. This morphology is seen as common for both the type of fish scales (Talipia Fish Scale FSC1 and Rohu fish Scale FSC2).

The BET surface and pore volume of the FSC1 was 2243 m^2/g and 2.42cm^3 /g respectively and for FSC2 was 2203 m^2/g and 2.01 cm^3 /g, with an average pore diameter of 4.47 nm for FSC1 and 4.12 nm for FSC2. These parameters were much higher than those of the CGP (Table 1). Owing to the high specific surface area, large pore volume and ideal porous structure, the FSC1 and FSC2 was promising as the adsorbent for wastewater treatment.



(a) **(b)**

Fig. 1: SEM of (a) Talipia Fish Scale and (b) Rohu Fish Scale

Table 1: Comparison between FSC1, FSC2 and CGP

Sample	FSC1	FSC2	CGP
Specific surface area (m^2 g^{-1})	2243	2203	1281
Pore volume (cm^3 g^{-1})	2.42	2.01	1.13
Average pore diameter (nm)	4.47	4.12	3.14

4. CONCLUSION

In summary, it is seen that the fish scale carbon (FSC) formed out of talipia and rohu fish shows good surface morphology. From the comparison between FSC1, FSC2 and commercial activated carbon and it has been found that both FSC1 and FSC2 are having BET surface, pore volume and average pore diameter greater than that found in the commercial one. Therefore, we can conclude by saying that both the activated carbon formed is suitable and will probably show better adsorption capacity when used for water treatment.

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