Adsorption of Acid Blue 281 onto Commercial Hydroxyapatite and Fish Scales

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ABSTRACT

Many industries such as paper, plastics, food, cosmetics, textile etc. use dyes in order to colour their products. The presence of dyes in water reduces light penetration and has a derogatory effect on photosynthesis. Many dyes are difficult to degrade due to their complex structure and xenobiotic properties Among these, brightly coloured, water soluble reactive and acidic dyes are the most problematic with their high molecular weight, as they tend to pass through conventional systems uneffected. It is evident therefore that removal of such coloured agents from aqueous effluents is of significant environmental, technical and commercial importance. Adsorption is a process which is widely used in the removal of contaminants from wastewaters.

The use of waste for the production of an adsorbent material may reduce the amount of waste to be disposed and costs from the requirement of using expensive adsorbent. In this regard, fish scale, a low cost adsorbent, is considered worthless, impracticable, and dismissed as a waste. However, it is known that fish scale contains numerous valuable organic and inorganic components, mainly collagen and hydroxyapatite. In this study, firstly, the effects of initial dye concentration, initial pH, adsorbent concentration and temperature on Acid Blue 281 (AB 281) adsorption onto commercial hydroxyapatite (CHAp) and scales of *Dicentrarchus labrax* (FS) were investigated in a batch system and then hydroxyapatite was extracted from scales of *Dicentrarchus labrax* (FHAp) using the alkaline heat treatment method and the functional groups of FHAp were determined by Fourier Transform Infrared (FTIR) Spectroscopy and was compared with CHAp. In the further stages of this study, the adsorption kinetics, equilibrium and thermodynamic studies will be evaluated.

The adsorption results showed that the CHAp powders and FS possessed good adsorption ability for AB 281 dye anions, the adsorption process was fast, and it reached equilibrium in 2 h of contact time. The maximum equilibrium value was determined as 98.9 mg/g for initial pH 2.0, 100 mg/L initial dye concentration, 25 ^{o}C temperature and 1.0 g/L FS concentration. At low pH values, the surface of the FS was surrounded by the hydrogen ions, which enhanced the interactions between acidic dye and FS through attractive force. For optimization studies of adsorbent concentration, the decrease in the adsorbed dye amounts with increasing adsorbent concentration may be attributed to saturation of dye binding sites due to particulate interaction such as aggregation.

According to characterization results in Figure 1 and Table 1; the FT-IR spectra showed chemical information on the both powders in the interval from 4000 cm^{-1} to 450 cm^{-1}. It is clear that, both powders have similar peaks in the interval as shown. This also means that the preparation hydroxyapatite powders from fish scales was successful. As a result, the responsible group from the AB 281 adsorption was hydroxyapatite in FS.

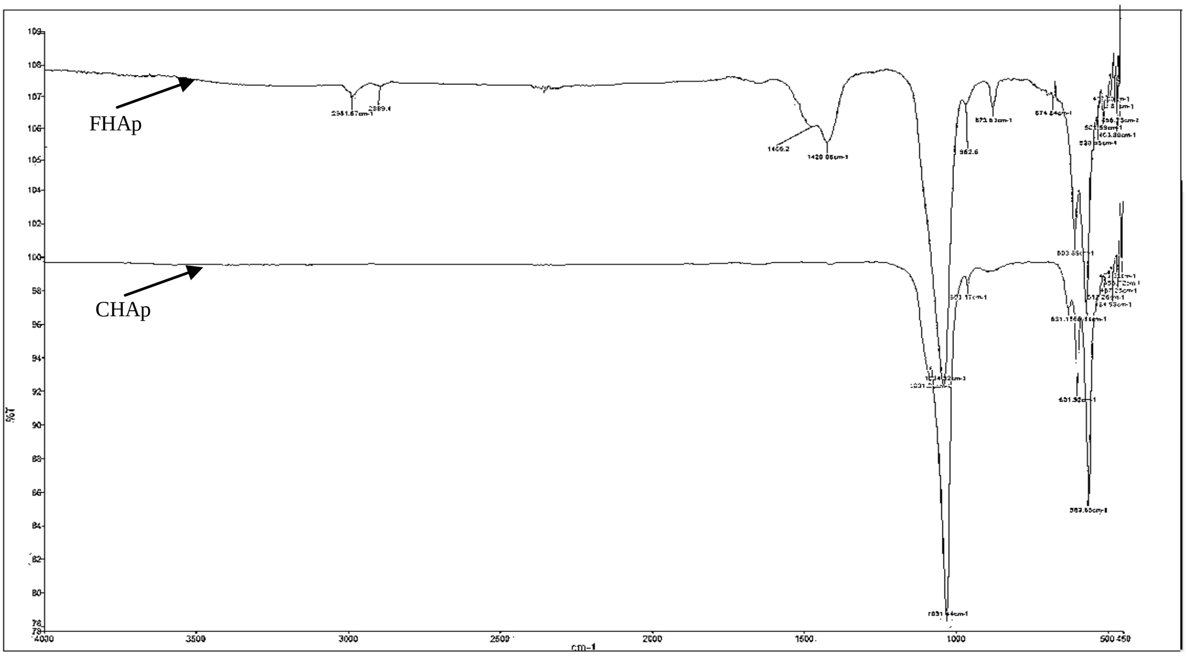

Figure 1: FT-IR spectra of FHAp and CHAp powders

Table 1: Observed infrared band positions for CHAp and FHAp powders

Peak assignments	CHAp	FHAp
Carbonate υ_3	1650-1300	1650-1300
-(m)	-	1460
-(m)	-	1420
Phosphate υ_3	1193-976	1193-976
-(vs)	1091	-
-(vs)	1031	1034
Phosphate υ_1 (m)	963	962
Carbonate υ_2 (ms)	-	873
Phosphate υ_4	660-520	660-520
-(m)	631	647
-(vs)	601	603
-(vs)	563	566

References

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