VALORIZATION OF TANGERINE PEELS THROUGH THE SYNTHESIS OF MAGNETIC NANOCATALYSTS

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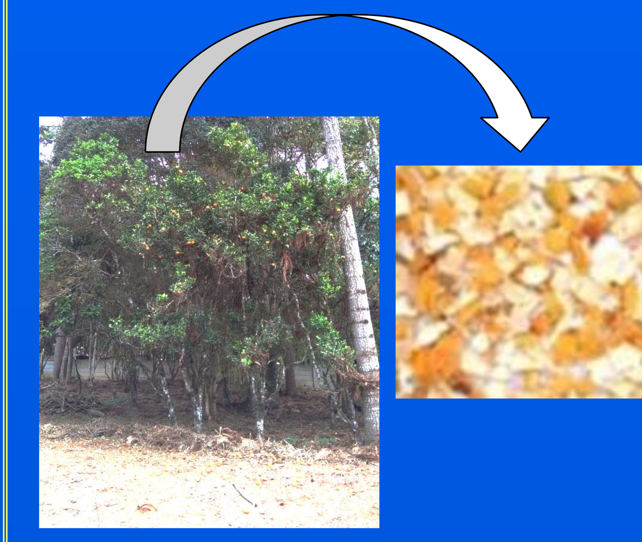
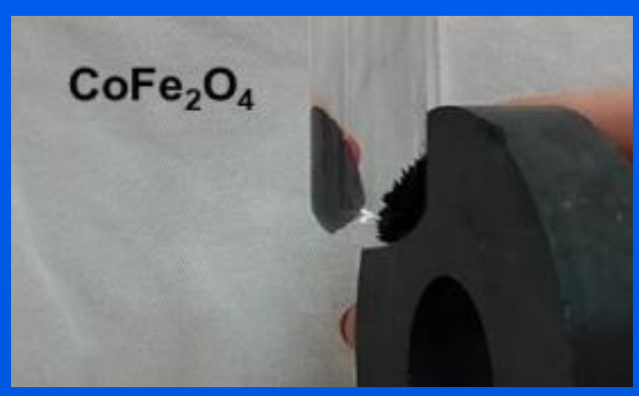
Introduction



Optimization in catalysis can minimize the use of energy and raw materials, reducing waste to the environment. Catalysis can also be applied to the degradation of harmful components into more environmentally friendly components. The possibility of synthesizing nanocatalysts using C. reticulata extract is promising from a citrus fruit containing citric acid.



In addition, the cobalt ferrite (CoFe2O4) is among the most relevant ferrites due to the peculiarities of its properties such as great physical and chemical stability and can be applied to magneto-sensitive systems. Niobium is an abundant transition metal in Brazil, some studies report the efficiency of the photocatalytic activity of niobium oxide in the degradation of dyes in textile industries. The objective of this work was use extracts of tangerine peel (Citrus reticulata) to synthesize magnetic catalysts with cobalt (Co), iron (Fe) and niobium (Nb) for catalytic application to paracetamol (PCT) degradation using photocatalysis.

Results & Discussion

Catalysts Preparation

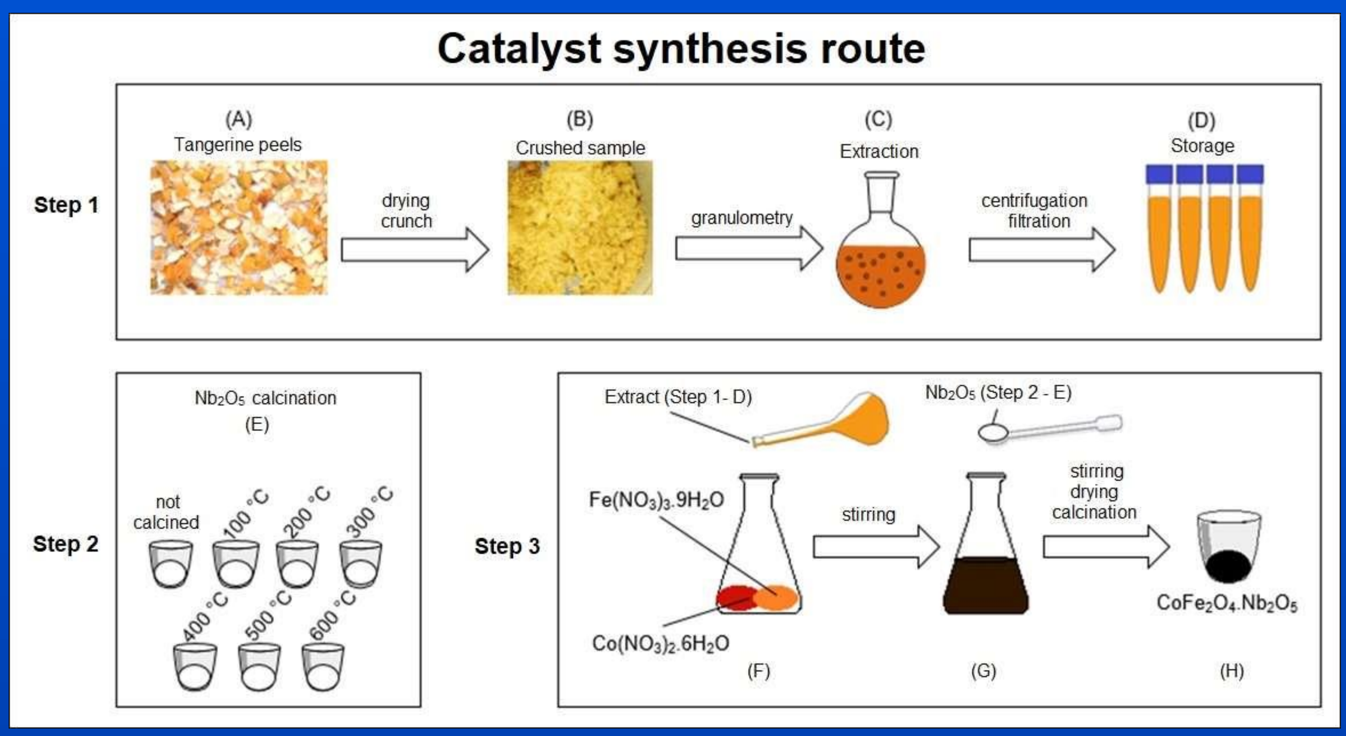
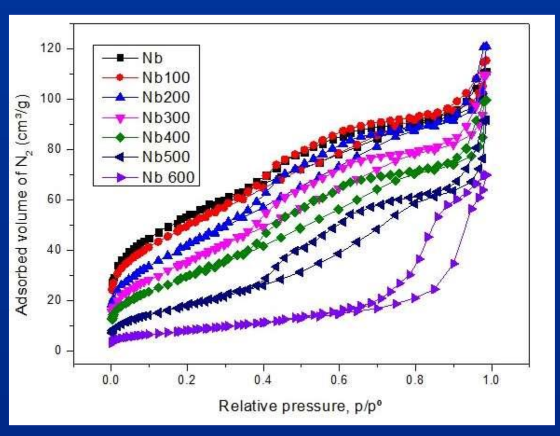


Figure1: Catalysts Synthesis

Figure 1 – Step 1 (A). These peels further subjected to washing under continuous flow of water and previously drying under sun, crushed and sieved. To obtain the tangerine peels extract Step 1 (C), crushed tangerine peels were placed in a 250 mL round-bottom flask with distilled water under magnetic stirring the dispersion further centrifuged. The catalysts synthesis of the, the second step is niobium pentoxide calcination, Step 2 (E). The niobium pentoxide (Nb2O5) was calcined in a calcination furnace, this process resulted in seven samples of niobium oxide: Nb, Nb_{100}, Nb_{200}, Nb_{300}, Nb_{400}, Nb_{500} and Nb_{600}.

Samples	SBET (m²/g)	Sext (m²/g)	Smic (m²/g)	Vmic (mm³/g)	Vtotal (mm³/g)
Nb	185	88	97	50.3	158
Nb100	178	103	75	39	163
Nb200	156	113	43	22.7	160
Nb300	134	106	28	14.5	145.1
Nb400	112	103	9	5.3	131.4
Nb500	69	69	0	0	118
Nb600	31	31	0	0	99.1



- S_{BET}, S_{mic} and V_{mic} decreases as the calcination temperature of Nb2O5 increases;
- The results of pHPZC it is possible to notice that when the cobalt ferrite was produced without the addition of niobium (CFTE) it presented a pHPZC value slightly higher than the other values (Fig.2).

Characterization

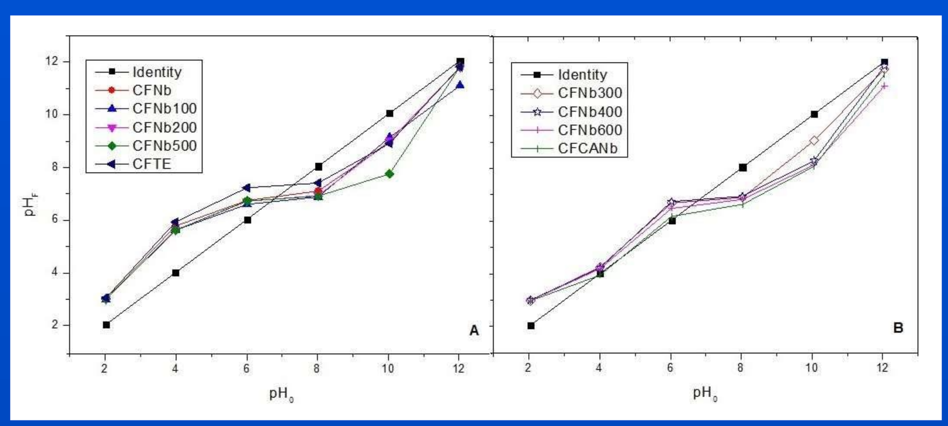


Fig.2- pH_{PZC} curves of the tested materials.

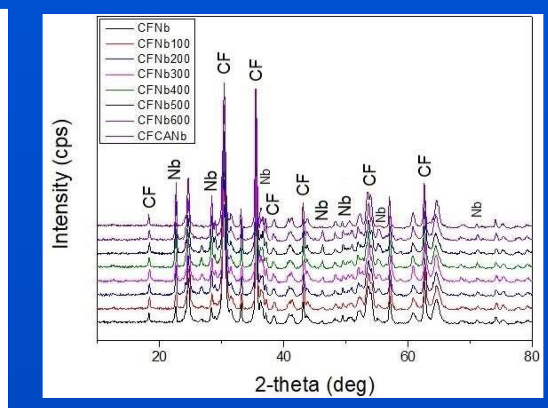


Fig. 3 - Standard X-ray diffractogram of cobalt ferrite.

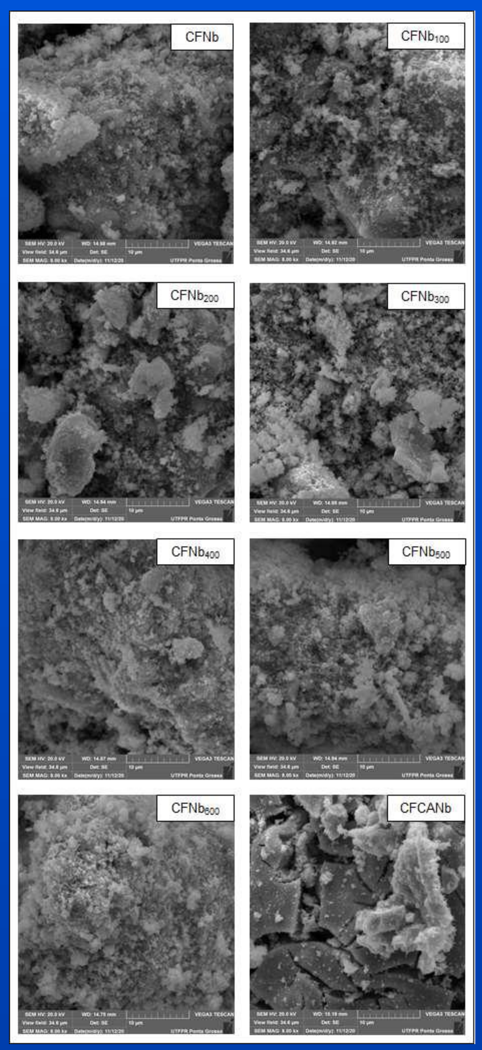


Figure 3: Figure 4 – SEM images of the samples.

- The X-ray diffractograms obtained for the samples CFNb, CFNb100, CFNb200, CFNb300, CFNb400, CFNb500,CFNb600 and CFCANb. In this figure, the peaks related to ferrite were identified as cobalt and niobium pentoxide, represented by the acronyms CF and Nb, respectively (Fig. 3);
- It is possible to observe clusters of nanomaterials, very typical of materials that have magnetic properties;

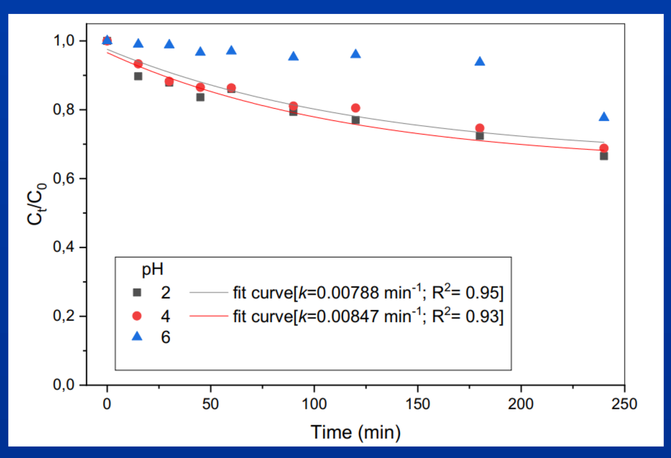


Figura 6. Paracetamol degradation in different pH [300 mg L-1; 20.7 ppm, CFNb].

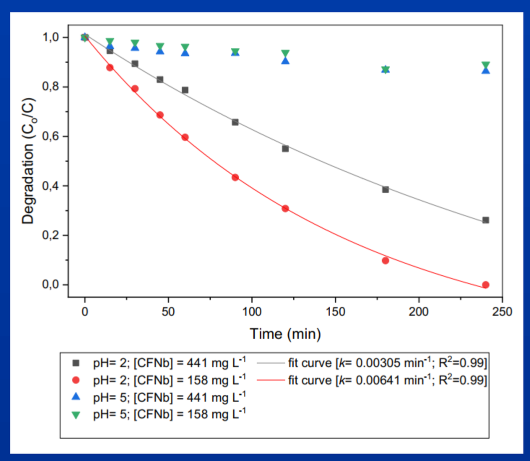


Figure 9. Catalyst concentration influence on photocatalytic paracetamol removal.

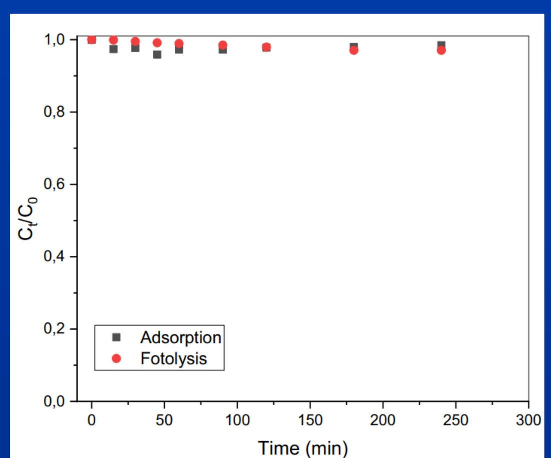


Figure. 10. Adsorption and photolysis results.

- The results obtained were for pH 2,4,6 of degradation of paracetamol 34%, 30%, and 23%, respectively (Figure 8). It was observed that pH was a factor that significantly influenced the Paracetamol degradation.
- The results indicated that at pH 5 the amount of catalyst has no effect on the paracetamol degradation(~11%). However, when the pH studied is pH 2 with a lower amount of catalyst, a better paracetamol degradation performance was obtained (100% - 158 mg L-1; and 74% 441 mg L-1).
- The adsorption and photolysis tests results indicating the need to use the catalyst in the degradation process.

Conclusions

From the results obtained it is concluded that was successfully achieved the objective of creating a methodology via green synthesis, using extract from tangerine peel to obtain nanocatalysts composed of cobalt ferrite and niobium pentoxide. The methodology created, as well as the combination of elements considered, was worthy to patent attempt for the method and product obtained. Among several advantages of the synthesis, it can be highlighted the reuse of biomass residues, the lowcost to obtain the material and the value added to a component richly disposed in the Brazilian territory (niobium). The catalytic materials were active in the studied photocatalytic reaction of paracetamol degradation. Several experiments allowed to find the optimum operating conditions using formic acid to adjust pH 2, catalyst concentration of 158 mg.L-1and mercury vapor lamp power of 250 W. Under these conditions, for the catalyst CFNb, degradation of 100% was obtained, fulfilling the objective of finding a photocatalysis conditions that would degrade the emerging pollutant paracetamol.

Acknowledgment

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