REMOVAL OF Ni AND V FROM AQUEOUS SOLUTIONS BY LIGNINS SUBJECTED TO OXIDATIVE TREATMENT WITH $KMnO_4$

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***Abstract*— Lignins were precipitated from Kraft black liquor to different acidic conditions; subsequently were subjected to oxidative treatment with $KMnO_4$. The oxidized material was characterized using IR spectroscopy for structural elucidation, and potentiometry in aqueous medium for determination of carboxylic groups. Among the trends, it found that the proportion of carboxylic groups in lignins increases with the oxidative treatment of the lignin. In addition with the IR were identified functional groups characteristic of lignin and showed also the changes caused by oxidative modification confirming the increase of oxidized groups when comparing the spectra of the different materials. Known the effects of oxidation on the lignins was evaluated adsorptive capacity of the oxidized lignin, showing that the oxidized lignin was able to adsorb up to 98% of Ni available initially, which corresponds to an increase in this ion sorption capacity of the double with respect to which only was precipitated. For its part, the lignin used to adsorb V decreased its adsorptive capacity, reaching only 19% of V fed. Based on this result was improved the experimental method of adsorption and the pH of process was controlled, thus it was obtained an increase of the adsorptive capacity of the material, reaching an adsorption of 91% of V fed. These results agree with the proposed mechanisms on how the metal ions studied in this work can be adsorbed.**

***Keywords*— Lignin, adsorption heavy metal, oxidative treatment.**

I. INTRODUCTION

At present the study of the potential applications of lignin has experienced a huge breakthrough. Your chances of utilization are based on their ability to perform functions such as chemical dispersant, binder, emulsifier and stabilizer of emulsions (Alonso, 2002). In addition, because many functional groups present in its structure have the ability to retain ionic species of a specific size and load, it has been raised its use as a potential bioadsorbent of heavy metal ions for wastewater treatment (Pérez *et al*., 2006).

Among the functional groups found in lignin can be mentioned: hydroxyl groups aliphatic and phenolic, also carboxylic groups which do not occur naturally in the lignin, but they are introduced as a result of the process of obtaining wood. All these groups in general serve as sites for adsorption of metal ions and other components (Lalvani *et al*., 1997; Palman and Khalafalla, 1988), hence is possible to considerer lignin as bioadsorbent.

On the premise of the use of lignin as a possible bioadsorbent of Ni and V ions (metals found as contaminants in waste streams from the process of demetallization of oil and Venezuelan oil coke) it was found that depending on the treatment in which lignins were subjected during their obtaining, they vary the proportion of functional groups present in its structure, which has an effect on the change of power ion adsorbent Ni and V. So, the ion adsorption process of Ni and V by the lignin is strongly influenced by the presence of such functional groups, it found that with increasing number of hydroxyl groups the greater the adsorption of Ni and with increase the amount of carboxylic acid groups the greater the adsorption of V, by completely different mechanisms depending on the pH of the solution (González, 2008).

Potassium permanganate ($KMnO_4$) is able to oxidize certain types of alcohols to aldehydes, ketones and carboxylic acids. Since lignin contains, among other groups, both aliphatic and phenolic hydroxyl, it is possible to take advantage of the oxidating action of the $KMnO_4$ over the lignin in order to increase the proportion of carboxylic groups, which could promote the adsorption of Ni by ion exchange, and of the V by the mechanism proposed by Tracey *et al*. (1990) where the carboxylic acid groups are capable of forming complexes with vanadate molecule.

Figure 1 shows the possible structures resulting from the oxidation of lignin by taking into account that the carboxylic acids are formed by the oxidation of primary alcohols, and also because the $KMnO_4$ is a strong oxidizing agent that can degrade aliphatic chains of the lignin, obtaining from them aromatic carboxylic acids.

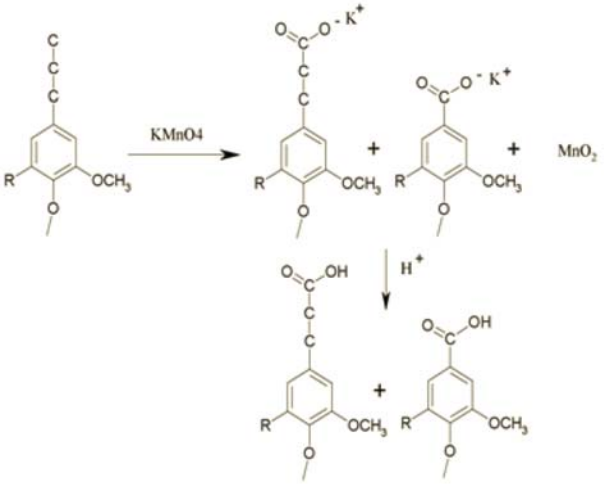

Fig. 1: Structures resulting from the oxidation reaction of lignin