REGULAR ARTICLES

CARBONIZATION OF "ALGARROBO NEGRO" (*Prosopis Nigra*): A STUDY OF ITS MICROSTRUCTURE AND MAIN VOLATILE COMPONENTS

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***Abstract*—Modifications in the micro-structure of wood from Algarrobo negro (*Prosopis nigra*) in function of the tem-perature were studied by scanning electronic microscopy (SEM). Some non condensable gases obtained by isothermal pyrolysis were investigated employing gas chromatography (GC). The results showed that the basic ana-tomic structure of wood remains almost un-changed in the working temperature range. It was also found that in the gas phase and with increasing tempe-rature, the concentrations relative to carbon monoxide and water decrease whereas there is a pro-nounced increase in the concentration of me-thane from 300ºC.**

***Keyword*— wood, carbonization, micro-structure, gas analysis**

I. INTRODUCTION

We have previously studied the thermal degradation process of wood sawdust of six hardwood species from the Chaco-Santiagueño region in Argentina under isothermal conditions. "Algarrobo Negro" (*Prosopis nigra)* was one of the wood species analyzed there (Herrera *et al.,* 1986), and is the species studied in this work. We have also reported on the pyrolisis of its lignins (López Pasquali and Herrera, 1997). The thermal behavior of each of the main components of wood (lignin, α-cellulose and hemicelluloses A and B) gives information about the different processes that take place in each of them and that affect the overall thermal degradation of wood (Herrera *et al.,* (1989) and Wottitz *et al.* (2001)). In 1988, Bourgois and Guyonnet demonstrated that the hemicelluloses in pine wood are the most sensitive thermal components. Therefore, they are the first components to degrade and go into the gas phase. They also, start the decomposition of lignin that has a more stable structure.

As the size and distribution of the particles influence the reactions occurring during the wood degradation processes (Lahiri, 1980), we employed here wood cubes having a side of 2 mm and analyzed the degradation process under these new working conditions. The experi-mental information gathered was compared with the behavior predicted by the Avrami Erofeev and Arrhenius equations. Agreement was observed between the experimental results and the Avrami Erofeev equation. In contrast, no agreement was found with the Arrhenius equation in the whole temperature range studied but the model was found suitable when separate and definite temperature ranges were taken into account (López Pasquali and Suarez, 2000).

Scanning electron microscopy (SEM) has been employed by several authors to explain the changes that occur in wood as a result of temperature effects. Thus, Kollmann and Sach (1967) employed SEM to get an insight into the high temperature effects on certain wood cells from *Fagus sylvatica.* Zicherman and William-son (1981, 1982) used SEM to observe the changes in wood microstructure as a result of fire effects and in 1982 and 1992 several authors have reported on the effect of different chemical substances applied to wood as fire retardants.

Connor and Daria (1993) found in wood from *Eucaliptus delegatensis* that visual ob-servation studies give quantitative information on the changes that occur in wood when it is carbonized. Rivera *et al.* (1994) used SEM to identify vegetal charcoal whereas the use of this technique allowed Donaldson (1995), to deter-mine the fractures of the cells on the tangential surface of air dried woods.

Gas chromatography analysis of the gases generated during thermal degradation of woods has been used by Bourgois and Guyonnet (1988) in pine wood and Faix *et al.* (1991) in *Picea abies* and *Fagus sylvatica.* This technique allows identification of the gases as well as understanding the pyrolysis evolution during carbonization.

It is possibly that during this process the reactions are strongly influenced by the resis-tances to mass and heat transfer in wood particles. This resistance is dependent upon the inner structure of the wood and the physical and chemical changes that are produced during carbonization. As no information is available in the literature on wood from "Algarrobo negro", we investigated the modifications of the microstructure in function of the temperature and of the analysis of some non condensable gases obtained from isothermal pyrolysis. Our aim was to obtain further information on the physical and chemical changes that take place during the isothermal pyrolysis of wood.

II. MATERIALS AND EQUIPMENT

A hardwood from the "chaqueña" region in the Argentine Republic, "Algarrobo Negro" (*Prosopis nigra*) was selected. The samples preparation for their later analysis required close attention due to the hardness and other particular features of this wood. On this account,