Study of the Influence of *Nejayote* and Other Additives on the Cohesive Strength and Electric Properties of Carbon Black Agglomerates

Regino González,[1] Edilso Reguera,[2] Juan M. Figueroa,[3] José de la Luz Martínez[3]

[1]*Facultad de Química–Institute of Materials and Reagents, Universidad de la Habana, Havana 10400, Cuba*
[2]*Facultad de Física–Institute of Materials and Reagents, Universidad de la Habana, Havana 10400, Cuba*
[3]*Centro de Investigación en Ciencia Aplicada y Tecnología Avanzada del Instituto Politécnico Nacional, Calzada Legaria, No. 694, Colonia Irrigación, Delegación Miguel Hidalgo, C.P. 11500, D.F., Mexico*

Received 29 November 2001; accepted 15 April 2003

ABSTRACT: An investigation was carried out on the influence of *nejayote* and other additives (water, potassium lignosulfonate, and furfuryl alcohol), on the cohesive strength and electrical properties of carbon black agglomerates. The thermal stability of carbon black agglomerates with potassium lignosulfonate and *nejayote* was similar. The influence of *nejayote* and potassium lignosulfonate on the cohesive strength of carbon black agglomerates was also similar but the electrical properties were different. The carbon black agglomerates with *nejayote* have a lower electrical conductivity. The influence of water on the cohesive strength of carbon black agglomerates was not significant but it was important in their electrical conductivity. *Nejayote*, a waste by-product from the corn-processing industry, appears as a potential agglutinant in the carbon black pelletization process. © 2003 Wiley Periodicals, Inc. J Appl Polym Sci 90: 3965–3972, 2003

Key words: additives; cohesion; carbon black agglomerates; electrical conductivity; agglutination

INTRODUCTION

Carbon black (CB) is a complex material. It is widely used in the plastic, paint, and rubber industries.[1] Nonrubber applications of CB are generally based on its absorption of visible and ultraviolet light; its electrical conductivity; and to a minor extent, on its high surface area and adsorptive capacity. Many aspects of the behavior of CB are based on its electrical properties. Electrical conductivity is important in many rubber and plastic materials, including antistatic applications, wire and cable sheathing, shielding against electromagnetic interference, and positive coefficient materials.[2] It can be added to some insulators to give them a controlled electrical conductivity.

The application of CB in pellet form in different technological sectors depends on, among other factors, the grain size distribution and hardness of the pellets. All these parameters are associated with the agglutination process, which depends on the quantity of water and additive used in the pelletization process. Potassium lignosulfonate (LSP) is one of the most important additives, which is obtained from spent wood-pulp liquors after chemical treatment.[3] Other natural sources can also be used as agglutinants in the CB pelletization process. For instance, certain technologies in the corn-processing industry generate waste by-products, which could be combined with LSP in the agglutination of CB. However, this possibility needs to be evaluated.

Alkaline cooking of corn in a saturated solution of lime [$Ca(OH)_2$] followed by its steeping and washing is a well-known procedure for production of corn-based food in Latin American countries such as Mexico and Guatemala.[4] This process is know as *nixtamalization*. The cooking liquor and the washing water, the so-called *nejayote*, are important sources of pollution.[5,6] *Nejayote* is characterized by a high organic matter content and it is especially rich in polysaccharides, that is, about 75% of nonstarch polysaccharides from alkaline-soluble hemicelluloses, known as "corn hull gums,"[7–10] which have potential functional properties, such as thickening, emulsifying, stabilizing, and extending.[7]

The highly alkaline cooking/steeping liquor (ph 11–12, *nejayote*) is rich in corn solids and excess of lime. It is a waste by-product of both traditional nixtamalization and industrial instant flour production processes. Manufacturing plants dedicated to the corn nixtamalization process usually integrate large waste and wastewater treatment facilities to meet environmental regulatory requirements. *Nejayote* has a chemical oxygen demand (COD) of about 25,000 mg/L, a biological oxygen demand (BOD) of 8100 mg/L, and a suspended solids content of 20,000 mg/L.[8] In addition to

Correspondence to: R. González (reginog@yahoo.es).
Contract grant sponsor: Centro de Investigación en Ciencia Aplicada y Tecnología Avanzada del Instituto Politécnico Nacional (CICATA-IPN, Mexico).

Journal of Applied Polymer Science, Vol. 90, 3965–3972 (2003)