The Incorporation of Layered Type Clay in Graphite-Clay Based Electrodes as a Property Enhancement for High-temperature Applications

L.W.N. Tharangani[1], D.T. Rathnayake[2], K.S.P. Karunadasa[3] and C.H. Manoratne[3]

[1]*Department of Physical Sciences, Rajarata University, Mihinthale, Sri Lanka*
[2] *Department of Science and Technology, Uva Wellassa University, Badulla, Sri Lanka*
[3]*Materials Technology Section, Industrial Technology Institute, Colombo 7, Sri Lanka*

Although the recent developments in the field of graphite-clay based electrodes are mainly confined to kaolin type clays, the present study has been investigated the possibility of incorporating layered clay in the fabrication process. The fabrication of graphite-bentonite (layered clay) electrodes (cylindrical) was achieved by mixing raw materials in distilled water (graphite to bentonite ratio of 20:80, 40:60, 50:50, 60:40 and 80:20), stirring the content for 1h at 800 rpm and finally pressing the dry composite material (1.00×10^{-2} kg) under 1.03×10^{4} N ram force to obtain the electrodes with 4.00×10^{-2} m longer and 1.00×10^{-2} m in diameter, respectively. The compressed electrodes were fired at around 823 K for 1 h. The resistivity of fired electrodes was calculated subsequent to the resistance measurements. Results indicate that the electrode with 80% graphite is accounted for lowest resistivity (1.00×10^{-3} Ω m) whereas the highest resistivity for electrode containing 20% of graphite (1.10×10^{-2} Ω m). The resistivity range between the electrode with the lowest and highest amount of graphite is narrower for graphite-bentonite electrodes, unlike other graphite-clay based electrodes. It is also evident that the resistivity is abruptly decreased with the increased amount of graphite. The fired electrodes are very stable in both molten salts and aqueous solutions. A very high affinity of bentonite towards graphite is observed that further ensures stronger and homogeneous electrode matrix. The uniform composite matrix with minimum defects is accounted for a substantial electrical continuity and low resistivity across the entire electrode. The working temperature range up to 1473 K, low resistivity, electrical and mechanical stability, lightweight and durability are the key attributes of the fabricated electrode. The application of modified bentonite (conductive nanocomposites of clay) in electrode fabrication is also possible and will be achieved in the future.

Keywords: Graphite, Bentonite, Layered clay, Composite electrode, High-temperature application