The Development of Nano-Sericite Process

謝文展、彭元興

E-mail: 9608196@mail.dyu.edu.tw

ABSTRACT

In the Shiangyang region of Taitung County, Taiwan, there is a rich lode of sericite which is one of the most economically valuable minerals in Taiwan. Because in between the plate layers of the mineral, there are potassium ionic bonds exfoliation of the mineral is often difficult. If the potassium content could be reduced or substituted with other ions to decrease strength of the ionic bonds, then the mineral might be more easily intercalated or exfoliated. The purpose of this study was to use the molten salt intercalation method to achieve intercalation or exfoliation of sericite and thus allow diminution of the mineral particles as nano-scale raw material. The experiments entailed using an oil bath to heat varying amounts of sodium hydroxide (at 0, 10, 20, 30, and 45 g to 5 g sericite) or oxalic acid (at 0, 2, 5, 8, 10 g to 5 g sericite) to temperatures between 100 and 200°C and observe the ensuing displacement or intercalation efficacy on the sericite layers. The treated sericite was then swelled using nitric acid neutralization. The before and after treatment sericite specimens were examined using an X-ray diffractogaphy (XRD), scanning electron microscopy (SEM), and its energy dispersive spectroscopy (EDS) attachment to observe whether the lattice spacing occurred. The specific surface area of the modified sericite was assessed by the Brunauer-Emmett-Teller (BET) and methylene blue adsorption methods. The post-treatment solution was also analyzed with an inductively coupled plasma (ICP) analyzer to see whether potassium ion was substituted. The XRD results indicate that simply heating sericite raw material to 100, 150 and 200°C caused no modification of the crystal lattice spacing. There was no discernible structural modification by SEM examination as well. With the addition of sodium hydroxide, the XRD results suggest that diffraction peaks corresponding to impurity pyrophyllite diminished with increasing sodium hydroxide dosage and temperature increases. At the 20 g NaOH dosage and 200°C, sericite crystal lattice spacing started to change. The 45 g NaOH and 200°C treated and acidified specimen showed diffraction peaks shifting from the original 4.36 and 6.43 A to 4.36 and 7.90 A, with marked increase in the interlayer spacing. At the condition of 200°C, the specific surface area of the sericite increased with the NaOH dosage from the original 23.7 m2/g to 78.0 m2/g at the 45 g NaOH dosage. The results of sericite lattice spacing and specific surface area, heating by oil bath with NaOH lowered crystallinity of the mineral and expanded interlayer spacing. The cationic exchange capacity (CEC) increased from the original 4.98 meq/ 100 g to 46.8 meq/100 g at the 45 g NaOH dosage. With the addition of oxalic acid, on the other hand, the XRD results showed nearly identical diffraction patterns with similar intensities, indicating a lack of exfoliation or modification of interlayer spacing. The specific surface area even decreased with the addition of oxalic acid. Thus, oxalic acid was deemed ineffectual in modification of sericite.

Keywords : sericite ; molten salt intercalation method ; nano-scale ; nano-scale exfoliation nano-scale exfoliation exfoliation ; methylene blue

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