MANUFACTURE OF CARBOXYMETHYLCELLULOSE USING WHITE WASTE PAPER

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CarboxyMethylCellulose (CMC) is one of the derivatives of cellulose and linear, long chain, water soluble, anionic polysaccharide. CMC is prepared by substitution of MonoChloroacetic Acid (MCA) or its sodium salt (NaMCA) to hydroxyl groups in cellulose Anhydroglucose (AGU) units. The average number of carboxymethyl groups per one AGU group of cellulose is defined as the degree of substitution (Ds). Ds value is a good indicator to identify solubility characteristics. CMC is one of the major ingredients widely used for different applications in food industries. Non-food application of CMC includes its usage in formulations for cleaning products such as detergents and co-binders for paper making, formulation of oil drilling solvents and in some textile and cosmetic industries. The process of preparation of CMC consists mainly of two steps. First step is Mercerization with aqueous sodium hydroxide (NaOH) at room temperature and the second step is etherification with MCA/NaMCA for 3½ hours at 60 ^{o}C to form CMC/NaCMC; sodium glycolate is produced as a by-product. In the industry, CMC is prepared by various methods which include the fluidized bed technique, sheet carboxymethylation, rotating drum technique, solvent-less method using a double screw press and paddle reactor, etc. The present study was focused on the preparation of NaCMC for non-food applications using white waste paper as raw material to extract cellulose. In addition, the main manufacturing unit was designed using a steel rotation drum by adding ceramic balls into the inside of the drum. This technique allows generation of heat from the impact of ceramic balls on the walls of the rotating drum for the Etherification process without further use of an external heat source. Cellulose from white waste paper was extracted by soaking it in 1% w/v NaOH and Hydrogen peroxide (alkaline peroxide pre-treatment) for 8 hours and allowing a few hours to drain the water. It was dried at 60 ^{o}C until the moisture content became 40%. The cellulose percentage was determined using the chlorination method. Sufficient amount of water, 50 kg of cellulose, 10 kg of NaOH and 200 ceramic balls (diameter 5 cm) were added to the rotating drum. The drum was allowed to rotate for 1 hour for Mercerization. 22 kg of NaMCA was added to the drum and it was once again rotated for 3½ hours for the process of etherification. Temperatures were measured at the end of these two processes using a digital thermos-sensor. Fourier Transform Infrared (FTIR) spectroscopy was used to confirm that the developed product is NaCMC. IS3520 methods were used to determine the Ds and active matter content of the developed product. Furthermore, water solubility in tap water and colour of developed product were observed. The result of the chlorination method indicated that the cellulose sample extracted from white waste paper contained 77% cellulose. The results of FTIR analysis confirmed that carboxyl groups were substituted onto the cellulose

backbone when carboxymethylation reaction occurred and NaCMC was produced. The average Ds value was 0.49 and it was in the recommended range of 0.4 to 1.5 which is used in the export market. The average temperatures at the end of Mercerization and Etherification process were 41 ^{o}C and 74 ^{o}C respectively inside the rotating drum. The active matter content and water solubility were 58.5% and 68.2% respectively and it was of whitish to ash in colour. The results of the present study concluded that white waste paper could be used as a raw material for processing of NaCMC. The addition of ceramic balls into the rotating steel drum eliminates the use of an external heat source required for etherification to produce NaCMC. The characteristics of the developed NaCMC are suitable for use in industries with non-food applications.

Keywords**:** CarboxyMethylCellulose, White waste paper, Impact of ceramic ball

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