NANOMATERIALS FROM IMPURE MARBLES: SYNTHESIS, CHARACTERIZATION AND SPECIFIC PROPERTIES

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Synthesis of value-added products using readily available naturally occurring minerals is one of the significant efforts on industrial and economical development of a country. Marbles are widely distributed carbonate rocks in Sri Lanka which cover over 10% of land area of Highland Complex. However, current uses of Sri Lankan marbles are limited to lime, construction and fertilizer industries due to their high variability of chemical and mineralogical compositions, intense fractures, coarse grains and impurities. Therefore, identification of suitable value-added products is a timely needed requirement on value-addition to impure marbles. This research work attempts to synthesize value-added products such as Precipitated Calcium Carbonate (PCC), magnesium hydroxide [$Mg(OH)_2$], magnesium oxide (MgO), their nanoparticles, their polymer-nanocomposites, Amorphous Calcium Carbonate (ACC) and poly(acrylate)(PA^-)-encapsulated $Mg(OH)_2$; hollow calcium carbonate (HCC), hydrophobic PCC and hydrophobic $Mg(OH)_2$ from impure marbles with novel, economical and industrially viable techniques. All these products have broad-range of industrial and medical applications.

Calcium and magnesium components have to be extracted separately from marbles in order to synthesize pure chemical products. Out of devised methods, the best method is preparation of calcium sucrate solution from dolomite. Herein, calcined dolomite (CaO.MgO), prepared by heating dolomite is added to a sucrose solution in order to prepare calcium sucrate. The MgO of calcined dolomite together with impurities is separated out from calcium sucrate as precipitate which is digested in 1 M HCl to prepare magnesium chloride ($MgCl_2$) solution. PCC products are synthesized by adding sodium carbonate or by bubbling carbon dioxide (CO_2) through calcium sucrate. PCC nanomaterials are synthesized using additives of poly(acrylic acid) (PAA), poly(methyl methacrylate) (PMMA) and Triton X-100 with several methods described in this thesis. The size of PCC nanoparticles is in the range 20-53 nm. The PCC/PMMA nanocomposite shows specific properties of acid resistant and greater dispersibility in organic phases. Hollow PCC with novel bone-like morphology is fabricated on novel PAA/cetyltrimethylammonium chloride template. Novel PA^--encapsulated $Mg(OH)_2$ stable colloidal composite and $Mg(OH)_2$ nanoparticles are prepared using above $MgCl_2$ solution. Both these nanomaterials are heated at 500 °C to produce MgO nanoparticles which can adsorb over 93% of methylene blue dye from effluents. The synthesized PCC and $Mg(OH)_2$ nanoparticles are modified with fatty acids to synthesize hydrophobic materials. Calcite deposits at Balangoda are used to synthesize anticorrosive polyaniline (PANI)/PCC nanocomposites for first time. In this composite, unstable vaterite form of PCC has been stabilized by PANI. With the devised techniques, there is a great possibility to initiate new industry in Sri Lanka in order to minimize the importing cost of PCC and to export magnesium-based nanomaterials.