

Facile extraction and characterization of silica nanopowder from Marine National Park beach sand from Malindi, Kilifi County, Kenya via Alkali Fusion route

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Abstract

The silica nanopowder has been in demand every dawn due to its application in various emerging technological advancements [1]. This is due to its desired features such as chemically stable, friendly to the environment, easily biocompatible among others [2,3]. The material has been extracted from various sources mainly from agricultural wastes. The purpose of the study was to utilize locally available beach sand from Marine National Park from Malindi, Kilifi County, Kenya in facile extraction of silica nanopowder via a simple alkali fusion method. The sand was first purified using 6 N HCl solution to eliminate metal oxide impurities. Then, the purified sand was reacted with NaOH to form of sodium silicate (Na_2SiO_3) solution which was then precipitated using HCl acid to form tetraortosilicate acid, $\text{Si}(\text{OH})_4$ (silica gel). The gel was then heated to form amorphous silica (SiO_2). The percentage yield of the extracted silica was 35.0139 ± 0.11 %. The extracted silica was characterized using XRF, XRD and FT-IR. The XRF analysis revealed that the extracted silica content was 94.16 ± 0.47 % which increased from 81.32 ± 0.81 % (Silica sand). The XRD results revealed a highly crystalline quartz as the main component of silica sand. The XRD spectrum of extracted silica showed a broad diffraction peak at $2\theta = 21.76^\circ$ revealing its amorphous nature. The average particle size of the extracted silica was 45.15 nm. The FT-IR analysis showed hydroxyl (-OH) in silanol (Si-OH) and siloxane (Si-O-Si) as important functional groups of the extracted silica. The results showed a low-cost technique for the production of highly pure nanosized silica that can be employed in vast industrial applications.

Keywords: Alkali Fusion, extracted silica, amorphous, beach sand