Journal of Radioanalytical and Nuclear Chemistry
https://doi.org/10.1007/s10967-020-07259-6

Alpha track detection study on CR-39 from granitic wastes employing tetraethyl ammonium bromide as chemical etchant

Sushma S. Chavan[1] · Hemlata K. Bagla[1]

Received: 1 February 2020

Abstract
The concentrations of ^{238}U, ^{232}Th and ^{40}K in the granite materials significantly contribute to the environmental radioactivity during its cutting, molding and processing during daily and regular uses. Solid State Nuclear Track Detection (SSNTD) technique was employed for alpha track detection using CR-39 from filtrate & residue waste samples of granites. Etching was carried out by new chemical etchant comprising of 5% tetraethyl ammonium bromide (TEAB) with 6 M NaOH (w/w) solution. Track appearance profile, track density (T_d) and track diameter for all samples were studied. Radionuclides contents of granitic filtrate samples were measured by using ICP-MS.

Keywords SSNTD · CR-39 · Alpha tracks · Granitic wastes · Tetraethyl ammonium bromide

Introduction

Solid state nuclear track detection and its areas of potential applications are growing rapidly for the study of radiation measurements [1, 2]. Natural radioactivity exists in geological formations like rocks, soils, plants, air, water and in building materials like granites and marbles. There are several non-nuclear industries which release natural alpha emitting radionuclides like ^{238}U,^{232}Th, ^{226}Th, ^{222}Rn & ^{40}K into the environment. During the industrial cutting and processing of granite stone, the amount of waste generated is 65% of the total production and the proper disposal and utilization of this waste is one of the problems being faced by the stone industry. Even though the granite cutting waste is being utilized as landfill, the quantity being utilized is negligible as restrictions are being imposed for landfilling. Naturally Occurring Radioactive Materials (NORM) are present in different building materials which are originated from natural rocks which contain significant amount of radionuclides such as ^{238}U, ^{232}Th and their decay products. Granites as well as marbles are widely used materials in buildings homes and contain an average of 3 ppm (40 Bq/kg) uranium and 17 ppm (70 Bq/kg) thorium. Thus, radiation measurements on granite surface can show levels like those from low grade uranium mine tailings [3, 4]. ^{222}Rn, ^{220}Rn, ^{226}Ra, ^{232}Th, ^{214}Po, ^{218}Po contents have been studied in building construction materials such as ordinary cement, gypsum, limestone, clay soil, sand, bricks, soil gas, uranium ore mines marbles and ceramics employing LR-115 as a solid state nuclear track detector [5–12]. Assessment of radon concentration has been studied from building materials such as cement, granite, marble, ceramic, hollow brick, sand, sand-gravel-stone, marbles, ceramic tiles, ashlars employing CR-39 organic polymeric detector [13–15]. ^{222}Rn, ^{226}Ra ^{238}U & ^{232}Th with their daughter elements from bricks, alpha particle (radon) from houses of various constructions: iron concrete, brick, clay, stone, reeds, air, soil, geological fissures have been studied [16–21]. The building materials significantly contribute the concentrations of ^{238}U,^{232}Th and ^{40}K to the environmental radioactivity which varies according to regions, reliant on the geochemical and ecological characteristics of the area. Therefore, occupational workers in granite processing industries are likely to be exposed to dust particles with much higher alpha radiation level. It is therefore of vital interest to monitor the alpha activity in the solid residues and effluent wastes from streams emanating from these industries. As a result of an expansion in natural mindfulness, radiological impacts of normal rocks utilized as building materials are subject of several studies. In this present study, we have used SSNTD technique to study alpha particle track detection and

✉ Hemlata K. Bagla
hemlata.bagla@kccollege.edu.in

1 Department of Nuclear & Radiochemistry, Kishinchand Chellaram College, Vidyasagar Principal K. M. Kundnani Chowk, Churchgate, Mumbai 400020, India

Published online: 26 June 2020