

Enhancement on Radon Adsorption Property of GAC using Nano-size Carbon Colloids

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Abstract

Granular activated carbon (GAC) is well-known as an efficient adsorbent against a number of gaseous pollutants. Radon is one of those pollutants, and radon has been classified as the second leading cause of lung cancer in USA. This study was to enhance the radon removal efficiency with applying nano-technology. Nano-size carbon colloids (NCC) was produced through electrolysis which is simple and cheap. NCC was used for impregnation with activated carbon. Surface areas of both NCC-treated and non-treated activated carbon did not show a significant difference. However, the results of radon removal efficiency show that impregnated carbon with NCC could capture about 1.3 ~ 2 times of more radon gas compared to non-treated activated carbon. It is assumed that nano-size carbon colloids might have filled up meso-pores, and meso-pores turned into micro-pores eventually. Because meso-pores initially accounted for large portion of whole pores, more radon could be captured to NCC-impregnated activated carbon.

Keywords: Radon, Nano-Size Carbon Colloid, Activated Carbon

1. Introduction

1.1 Radon

Radon is an inert gas, and a naturally occurring radioactive material. Radon is well-known as one of the hazardous indoor air pollutants. Because, radon is colorless, odorless and tasteless, it is not easy to detect or remove indoor radon. Radon can penetrate into lung through respiration, and emits alpha particles during the decays. Alpha particles can cause lung cancer via DNA damage. Due to this fact, radon has been classified as the second leading cause of lung cancer.

1.2 Granular Activated Carbon(GAC)

Granular activated carbon has a relatively larger particle size compared to powdered activated carbon and consequently presents a smaller external surface. These carbons are therefore preferred for all adsorption of gases and vapors as their diffusion are faster. Granular carbons are used for water treatment, deodorization and separation of components of flow system. Generally, GAC is used for pollutant capture in the indoor air. Also, radon is one of the indoor air pollutants which can be captured by GAC. GAC adsorbs pollutants through physical adsorption method. Pores on GAC can be classified into three types; micro-pore, meso-pore and macro-pore. This depends on the size of the pores (micro-pore : 10~100 Å, meso-pore : 100~1,000 Å, macro-pore : 1000~100,000 Å). Pore size is very important because the adsorption efficiency can vary according to the size of target pollutant. In this study, target pollutant is Radon (²²²Rn), and the diameter of radon is approximately 0.44 nm (4.4 Å).

1.3 Nano Technology

Nano Technology is the study of the control of matter on an atomic and molecular scale. Generally, nanotechnology deals with structures of the size 100 nanometers or smaller and involves developing materials or devices within that size. Nanotechnology is very diverse, ranging from novel extension of conventional device physics to completely new approaches based on molecular self-assembly, to developing new materials with dimensions on the nanoscale, and even to speculation on whether we can directly control matter on the atomic scale. Nano Technology is a significant field at the crossroads of engineering and material science. This study focused on producing nano size carbon colloids using an electrochemical method that is a relatively cheap method, and applying this to the removal efficiency assessment of radon through a absorption test.

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Assessment of GAC Adsorption for Radon Removal David A. Cornwell, Nancy E. Kinner, Nancy E. McTigue, 1999

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