The absorption performance of nano-loess coated carbonized board for harmful chemicals
(나노황토 코팅 탄화보드의 유해화학물질 흡착성능)

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1. Introduction

Increase of ‘well-being’ culture in the present time, public interest have been paid attention on health and beauty of life. Because of these reasons, living, architectural, industrial areas have been changed to using more environmentally friendly products which did not emit harmful chemicals for human. However, human are still suffering from harmful chemicals in spite of their efforts that try using environmentally friendly products. An escape to expose from harmful substances, such as formaldehyde, radon, and VOCs, cannot be achieved because we are surrounded by synthetic chemical products and originally existing harmful substances.

Authors are developing new construction materials having adsorption ability of harmful chemicals from wood-based composite products. New construction material is manufactured by pyrolysis of wood-based composites panel and called carbonized board that maintains panel shape. In our previous studies, carbonized board has significant characteristics of VOCs and formaldehyde adsorption, far-infrared radiation emission, and electromagnetic shield. Also, radon can be adsorbed around 70% by carbonized board.

In order to improve the radon adsorption ability of carbonized board, homogenized loess into nano size was applied on wood-based composite panel, then carbonized at 600°C. Effect of nano-sized loess coated carbonized board on radon adsorption was evaluated in this study.

2. Materials and Methods

1) Materials

Medium density fiberboard (12 mm-thick, Sunchang Corp., South Korea) was used for carbonized board manufacture. Loess powder (10 µm) was purchased from Gochanghwangto. Co. LTD. (South Korea).

2) Homogenization of loess

Loess powder (1g) was added in 200 mL of water, and then homogenized with a high pressure microfluidizer (M-110EH, Microfluidizer® Processors, USA). Loess emulsion passed 100 mL/min through two nozzle sizes (200 and 87 µm) with 1000 bar. Different repetition of homogenization was conducted for the loess emulsion preparations.

3) Manufacturing of carbonized board

The 2, 4, 6, 8, and 10 times homogenized and original loess(0.1 g/5 mL in water) were spreaded on cut MDF(260 mm x 130 mm). The nano-sized loess spreaded MDF was wrapped with aluminum foil. Carbonization of boards was conducted by a electronic furnace with nitrogen gas flow (200 mL/min). The temperature in a electronic furnace was raised by 50°C per hour for 600°C then maintained that temperature continuously for 2hrs. After carbonization, carbonized products were cool down under ambient condition.
4) Determination of radon ($^{222}$Rn and $^{220}$Rn)

Total 1800 cm$^2$ of cement board (6mm thick, PRIMAflex™, Hume Cemboard Industries, Malaysia) and nano-loess spreaded carbonized board (200 cm$^2$) were put in a desiccator (11L). At the sampling time, the air in a desiccator was collected 30 minutes with 800mL/min and analyzed the radon concentration by using RAD7 (Durridge Company Inc., MA USA). Three times repeated measurement on each desiccator were occurred weekly for 10 weeks with 3 replicates.

3. Results and Discussion

1) The chemical compositions of loess

In order to investigate the change of chemical compositions of loess by carbonization, X–Ray flourescence spectrometry (XRF) was conducted. Predominant components of original loess was Si, Al, and Fe. After carbonization, composition of loess was similar as that of original, but lower amount of components, such as Ni, Co, Rb, Zr, Zn, and Cu, were not detected. These components may be converted other components during carbonization.

2) SEM images of nano–loess spreaded carbonized board

![SEM images of carbonized board and nano–loess spreaded carbonized board.](image1)

Figure 1. SEM images of carbonized board and nano–loess spreaded carbonized board.

Figure 1 showed difference between carbonized board and nano–loess spreaded carbonized board. On the carbonized board, only wood fibers were observed, while wood fibers were covered by nano–loess on the nano–loess spreaded carbonized board.

3) Effect of radon reduction rate by nano–loess

Our previous study, carbonized board manufactured at 600°C had higher adsorption ability of radon. Therefore, we carbonized wood–based composite material at 600°C. The different size of nano–loess were tested in order to investigate the effect of size. Based on results, non nano–loess treated carbonized board had 69% radon adsorption rate, while nano–loess treated carbonized board had 86%. However, original loess treated carbonized board had lower radon adsorption rate than nano–loess treated carbonized board, which means nano–sized loess affected to increase reduction rate of radon.

![Radon reduction rate of loess treated carbonized board.](image2)

Figure 2. Radon reduction rate of loess treated carbonized board.