

Study on The Evaluation of Influence on Indoor Residential Environment by Painting of Bio-ceramic Paint

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ABSTRACT: Recently densification of buildings is made and development. Distribution of new construction materials are in progress. This study is purposed to review the possibility of applying new building materials for improving indoor air environment and reducing cement-related pollution materials. For evaluating effect of reducing cement-related pollution materials and effect of improving indoor air environment, we measured indoor pollution materials such as Cr_6^{+} , Pb, Radon, VOC(Volatile Organic Composites) of which elapsed time is 28 days. As the result of 3 times measurements on first day, 15th day, 30th day, it rose by about 5 times when 15 days passed and for bio-ceramic test room, about 1/2 was reduced

Keywords: VOC(Volatile Organic Composites), bio-ceramic, eco-friendly building materials

1. INTRODUCTION

Recently densification of buildings is made and development and distribution of new construction materials are in progress. But in the process of manufacturing construction resources and materials, issue of indoor air pollution by harmful chemical materials is found to be serious. Indoor air pollution is caused by various indoor pollution sources such as adhesive materials, paint, building interior finish, insulating materials, furniture and volatile organic composites. Degree of diffusion of harmful pollution materials from each source shows big difference according to its components, manufacturing process, working method and indoor, outdoor environmental condition.

According to social demand for eco-friendly building materials diffusing less pollution materials and materials

manufacture companies' efforts to reduce it, domestic development of eco-friendly building materials reached a certain level. Sustained development and research of building materials, beyond first level of low diffusion of pollution materials, is entering into positive concept such as performance of removal and control by adsorption, dissolution of pollution materials in indoor air. But due to no objective evaluation and study on these functional materials conducted well, it's difficult to evaluate objectively at present.

This study is intended to verify the possibility to improve indoor environment through evaluation on the object of bio-ceramic paint.

2. STUDY CONTENTS AND METHODS

2.1 Study contents

This study is purposed to review the possibility of applying new building materials for improving indoor air environment and reducing cement-related pollution materials. Object material is bio-ceramic paint, which is a building material generally painted on finished cement surface and used as furnishing material or final finishing material. Test condition was set as 2 test rooms of one coated with bio-ceramic paint as finish material and another one finished with general cement. For evaluating effect of reducing cement-related pollution materials and effect of improving indoor air environment, we measured indoor pollution materials such as Cr_6^+ , Pb, radon, volatile organic composites of which elapsed time is 28 days. Performance related to properties of bio-ceramic paint was reviewed through dewing test, thermal conductivity.

2.2 Test methods

Test object was constructed in single storied structure of 2 test rooms to enable comparison test. Additionally in order to maintain same indoor temperature and humidity, peripheral condition such as sunlight was considered.

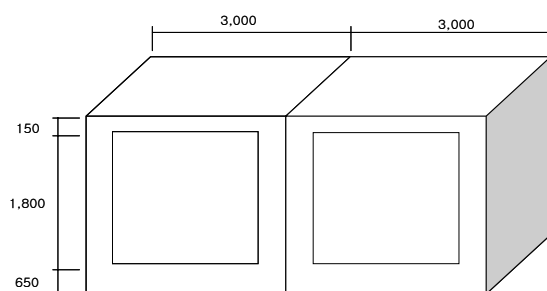


Figure 1: Plane and sectional view of test object

For evaluation items, certified test methods on the basis of specified standards were adopted. But as there is standard or test method concerning every concerned item, for this item, method to induce the result of

item selected through indirect measurement was used.

Table.1: Selection of evaluation method according to evaluation item

Evaluation item	Evaluation object	Evaluation method
Cr_6^+	product	Method of test process for soil pollution
thermal conductivity	product	Method to test thermal conductivity of KS L 9016:2005 insulation materials
dewing	product	Method to test dewing-prevention performance for KS F 2295:2005 window
radon	space	Method of test process for indoor air quality:2004
VOCs	space	Real-object evaluation law

3. Test Result

Selected evaluation item can be divided into that for evaluation of product itself and that for evaluation of the space where object product is worked. Cr_6^+ and Pb, thermal conductivity, dewing were measured by painting product on the plane surface of test object and radon, volatile organic composites, formaldehyde were measured by painting object product inside of test object.

1) Cr_6^+ and Pb

Cr_6^+ is originated from worn-out concrete and included in the air to work as pollution materials in indoor air, and in case of general apartment house, interior space is finished with wall paper and others and so, it is rare to be exposed to concrete directly.

As the result of test, anti-corrosion matter was not so serious Cr_6^+ and Pb were found to be not included as the result of test by process test method for soil pollution.

Table 2: Result of test for Cr_6^+ and Pb

name	Item	Result	Test method
Ceramic paint	Cr_6^+	0.00	Process test method for soil pollution
	Pb	0.00	

2) Thermal conductivity

Thermal conductivity was tested by producing ceramic test object painted on concrete plate and same concrete plate on which product is not painted. As the result of test, thermal conductivity of general concrete was found to be 0.332W/m·k and that for concrete painted with bio-ceramic paint to be 0.265W/m·k.

Table 3: Result of testing thermal conductivity

name	Item	Result	Test method
General concrete	Thermal conductivity	0.332	Ks L 9016:2005
Bio-ceramic concrete	(W/m·k)	0.265	

3) Dewing

Test was conducted by painting bio-ceramic paint inside of test object 1,000*1,000*120mm. Indoor side was made maintain permanency temperature and humidity of temperature 20°C and humidity 50% and variation of temperature of 5°C, 0°C, -5°C, -10°C was given to outdoor side and dewing state on the surface was watched after maintaining normal state of 50% humidity on indoor side.

Table 4 : Result of dewing test

Item	Condition		Result
	Indoor	Outdoor	
Test of dewing-protection performance	20°C 50%	5°C	-
		0°C	-
		-5°C	-
		-10°C	Dewing



Figure 2: Installation of test object and phenomenon of dewing occurrence

As the result of testing dewing on test object, under the condition of -10°C, small water drop appeared at right corner apart as well as steaming-up to 2/3 point of test object and in right bottom, some large water drops were found, but phenomenon of flow did not appear.

4) Radon

Characteristics of diffusion including high initial concentration of volatile organic composites and formaldehyde, major pollution materials of Sick house syndrome, and reduction over elapsed time are shown. But, different from it, radon is known as sustained to be diffused of certain amount. In this study, change in concentration was watched by 3 times measurements for 15 days. After testing for 8 hours using continuous measurement unit by process test method for indoor air quality, alpha count value was converted into pCi/L, unit for measuring radon concentration.



Figure 3: Radon measurement of mock-up test building

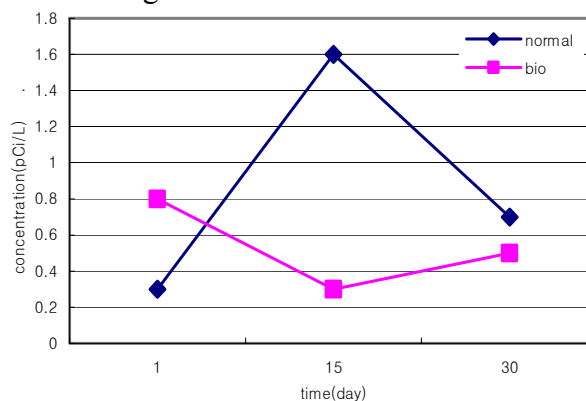


Figure 4: Change in radon concentration according to elapse of time

5) VOC and HCHO

VOC(Volatile organic composites) and formaldehyde(HCHO), major causes for Sick house syndrome, were tested on the basis of process test method for indoor air quality.

When measuring, in order to exclude influence by entrance and exit of measurer, measurement was conducted outside by installing measurement hole and using Teflon-made tube not influencing test result.



Figure 5: View of installation of measurement units

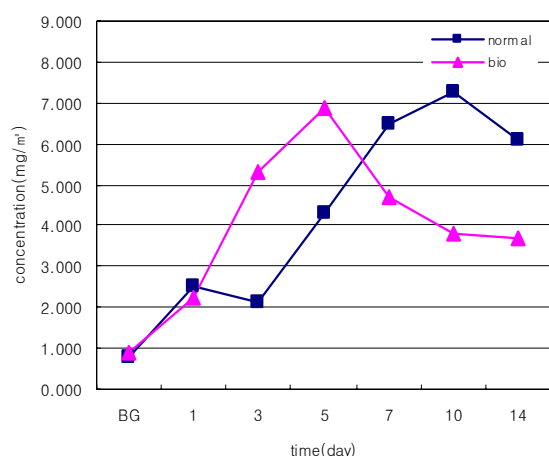


Fig. Concentration distribution of volatile organic composites

In case of test room painted with ceramic, TVOC showed maximum concentration of 6.89 mg/m^3 after 5 days passed, and in case of general test room, TVOC showed maximum concentration of 7.30 mg/m^3 after 10 days passed. In case test room painted with ceramic paint, after having shown high concentration on 5th day, it entered into reducing tendency. In case of general test room, after having shown high concentration when 10 days passed, it entered into reducing tendency. Initially test room painted with ceramic paint shows high

indoor concentration, and after 7 days passes, it shows rapid reduction.

4. DISCUSSION

This study was intended to find out characteristics of bio-ceramic paint and basic performance of product, and evaluate environment-adjusting performance for actual space through mock-up test in consideration of characteristic of work.

$\text{Cr}_6^{+}/\text{Pb}$ was founded to be not included as the result of process test method for soil pollution in soil for the object of powder among bio-ceramic paints.

Regarding thermal conductivity of concrete was confirmed as 0.332 W/mk and that of concrete painted with bio-ceramic concrete as 0.265 W/mk demonstrating insulation performance of bio ceramic.

As for dewing-prevention performance, under the conditions of permanency temperature and humidity of indoor temperature 20°C , humidity 50% and outdoor temperature -10°C , small water drop appeared at right corner apart as well as steaming-up to 2/3 point of test object.

As the result of 3-times measurements on first day, 15th day, 30th day, it rose by about 5 times when 15 days passed and for bio-ceramic test room, about 1/2 was reduced.

In case of total volatile organic composites (TVOC), general test room showed increase of concentration and 7.30 mg/m^3 was indicated when 10 days passed and then, entered into reducing tendency. Bio-ceramic paint increased concentration initially and entered into reducing tendency after indicating concentration of 6.89 mg/m^3 when 5 days passed.

5. CONCLUSION

This study is purposed to review the possibility of applying new building materials for improving indoor air environment and reducing cement-related pollution materials. Object material is bio-ceramic paint, which is a building material

generally painted on finished cement surface and used as furnishing material or final finishing material.

Accordingly we suggest that major performance of bio-ceramic paint is effective for indoor environment, it is estimated that additional study is required for concrete toxic and energy saving.

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