Measurement of radon concentration in soil and Verification of radiation hormesis effect in radon radioactivity environment

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- Experiment of Radon exposure by time and concentration
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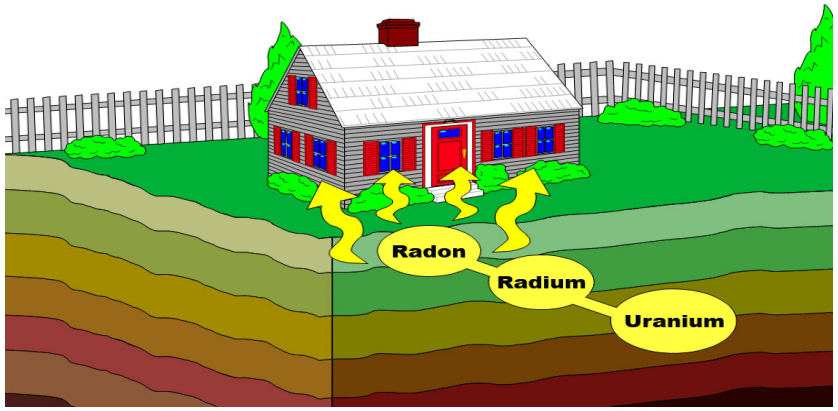
Introduction

Introduction
- Occurrence and influence of radon

Occurrence of radon

- Radon is generally emitted in building materials such as concrete and gypsum board, but most of the radon is released in the earth's crust by about 85%.



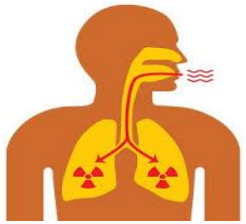
86
Rn
Radon
222.0176

Characterization of radon

- When uranium in natural materials such as soil or rocks continuously collapses, it becomes radium.
- Finally radon is the radioactive gas that is generated when radium collapses.

92 **U** Uranium 238.0289 → 88 **Ra** Radium 226.02854 → 86 **Rn** Radon 222.0176

Influence of radon



- When the radon enters the lungs by breathing, it can mutate the chromosomes in the cells that cause lung cancer.

Introduction
- Radiation Hormesis effect

Radiation hormesis effect

- It is the hypothesis that **low doses of ionizing radiation are beneficial**.
- It stimulate the activation of repair mechanisms that protect against disease.

Introduction
- Purpose

Purpose of study

- Confirming the radiation hormesis effect of soil microorganisms.
- Proving the radon concentration and exposure time at which the hormesis effect appears.

Sampling

Sampling
- Materials and Methods

Locatio
Radon contamin
Top so
Radon contamin
Depth 15
Radon contamin
Depth 30
Contro
Top so
Contro
Depth 15
Contro
Depth 30

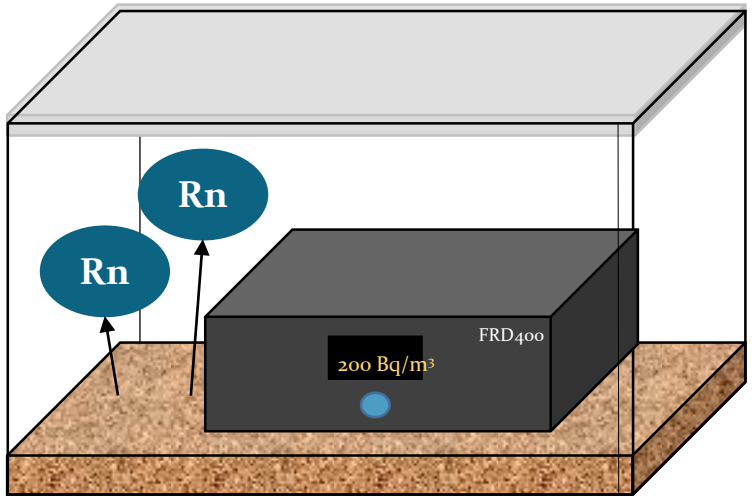
Sample name
C2-T
C2-1
C2-3
C3-T
C3-1
C3-3

- Soil samples were collected from radon contaminated sites and three control groups in one mountain in Goesan-gun, Chungcheongbuk-do, South Korea.
- All four points spaced each other 2m apart.
- Soils were collected at 0cm, 15cm, 30cm depth at each site using a sterile shovel.

Analysis the characteristics of Goesan soil - Materials and Methods

Analysis the characteristics of Goesan soil Materials and Methods - Materials and Methods

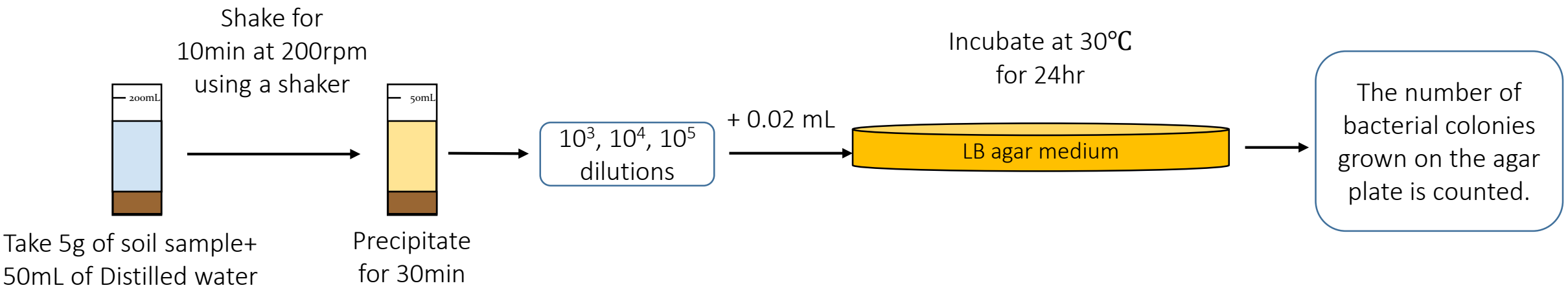
1. Radon concentration in Goesan soil



Soil samples from Goesan were placed in a plastic container, sealed well and measured for 1 hour using FRD 400.

Analysis the characteristics of Goesan soil
- Materials and Methods

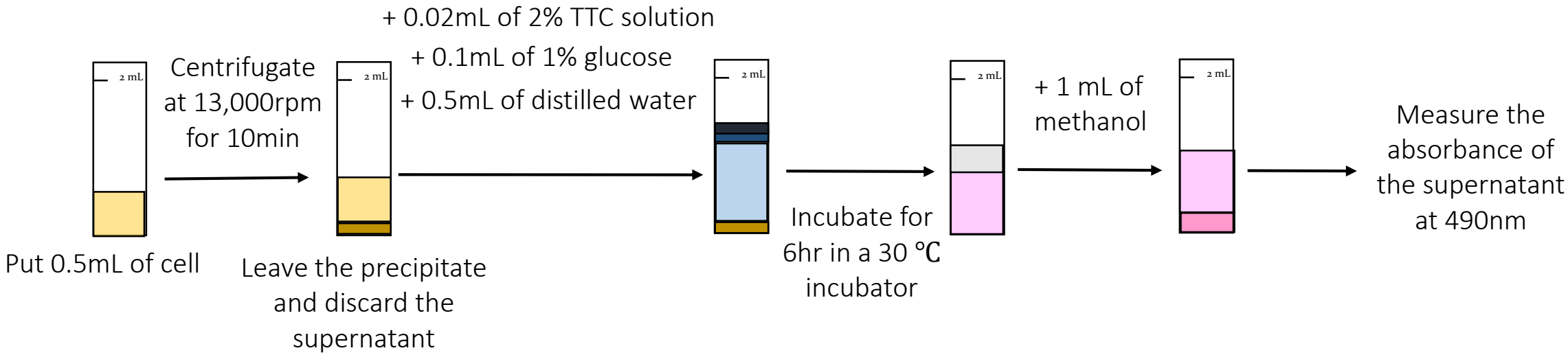
2. The number of plate culture count (Dilution plate method)



- Analysis for counting the number of microorganisms cultured on a solid medium of a flat plate

Analysis the characteristics of Goesan soil
- Materials and Methods

3. The value of Dehydrogenase measurement

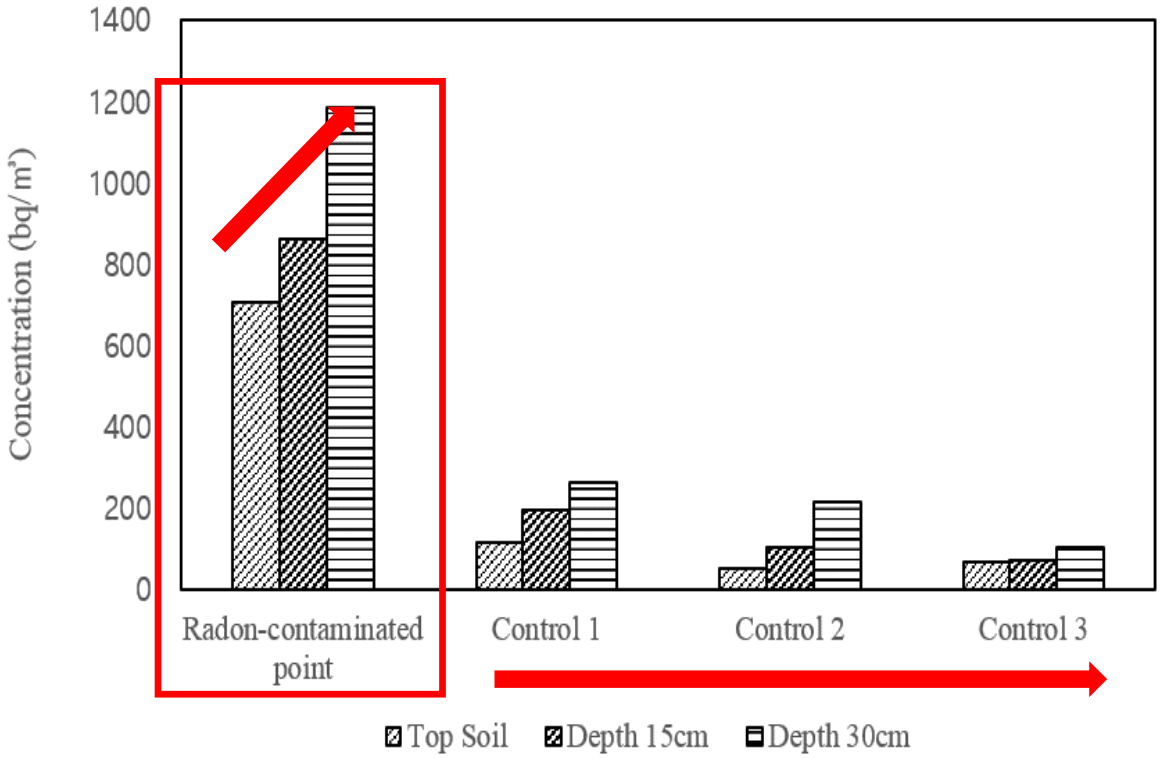


- Indicator of the overall activity of soil microorganism

Analysis the characteristics of Goesan soil - Results

Results and discussion
- Radon Concentration Measurement and characteristics of Goesan soil

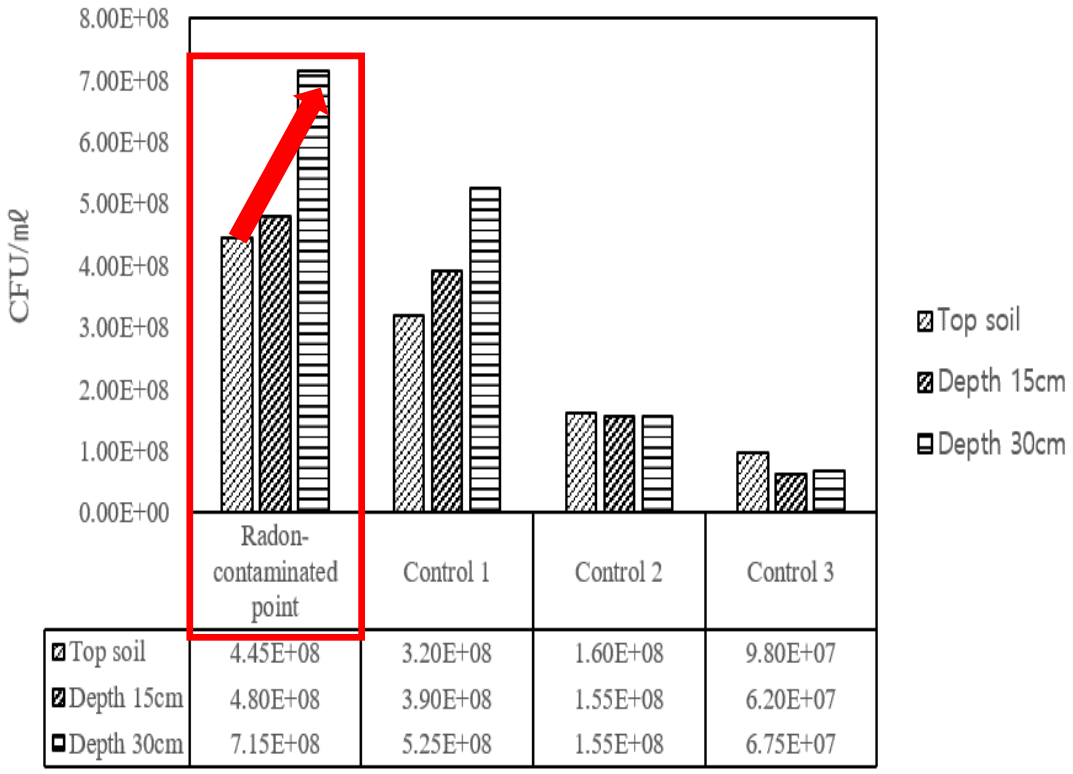
1. Radon concentration



- Radon contamination sites have the highest radon concentrations in the soil.
- The higher the depth of the soil, the higher the radon concentration.
- Radon concentration in the soil decreases as it moves away from the radon contamination point.

Results and discussion
- Radon Concentration Measurement and characteristics of Goesan soil

2. The number of plate culture count



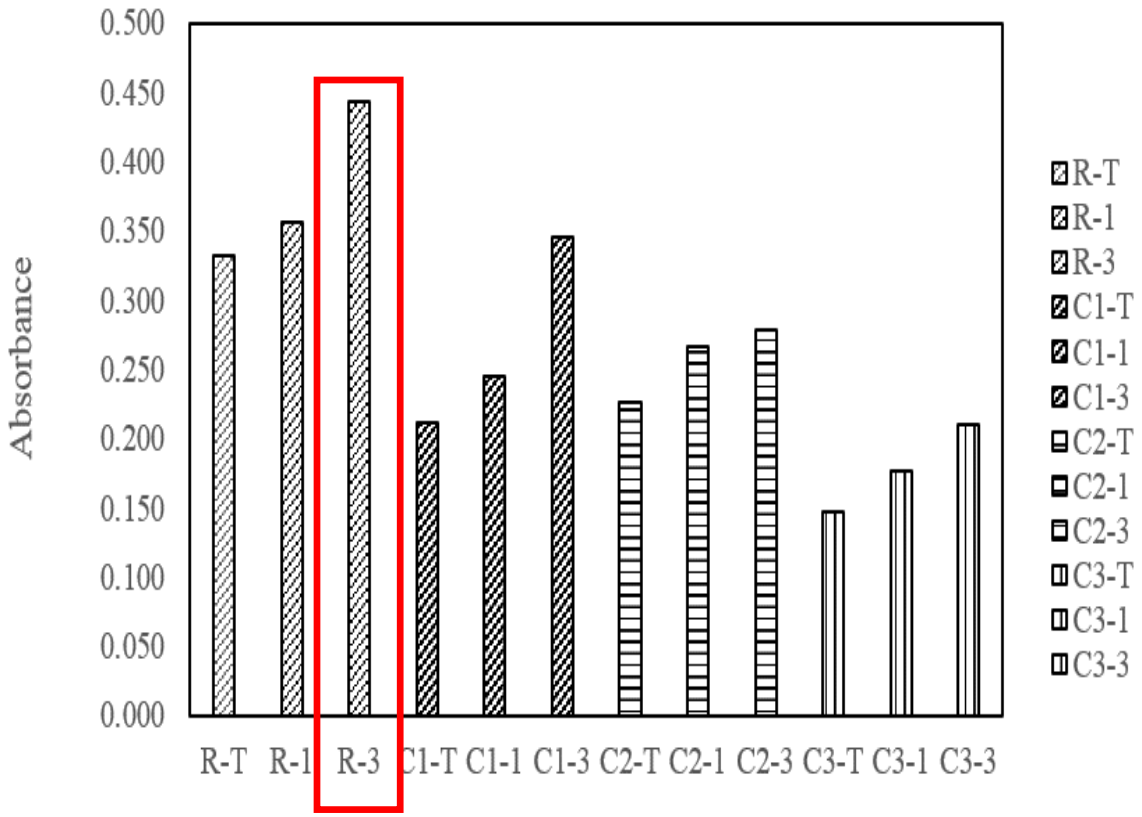
	Radon-contaminated point	Control 1	Control 2	Control 3
Top soil	4.45E+08	3.20E+08	1.60E+08	9.80E+07
Depth 15cm	4.80E+08	3.90E+08	1.55E+08	6.20E+07
Depth 30cm	7.15E+08	5.25E+08	1.55E+08	6.75E+07

- The number of plate culture count was the highest in the radon contaminated soil. Also, the number of growing colonies was higher in deep soils.

- These results confirmed the survival of microorganisms can be improved even if the radon concentration is high.

Results and discussion
- Radon Concentration Measurement and characteristics of Goesan soil

3. The value of Dehydrogenase measurement



- The value of dehydrogenase measurement was the highest at the point where the radon concentration was high.
- From these results, it was confirmed that the activity of microorganisms was increased when exposed to radon.

Experiment of radon exposure to Goesan soil by time and concentration
-Materials and Methods

Experimental of Radon exposure by time and concentration - Materials and Methods

1. Experiment condition

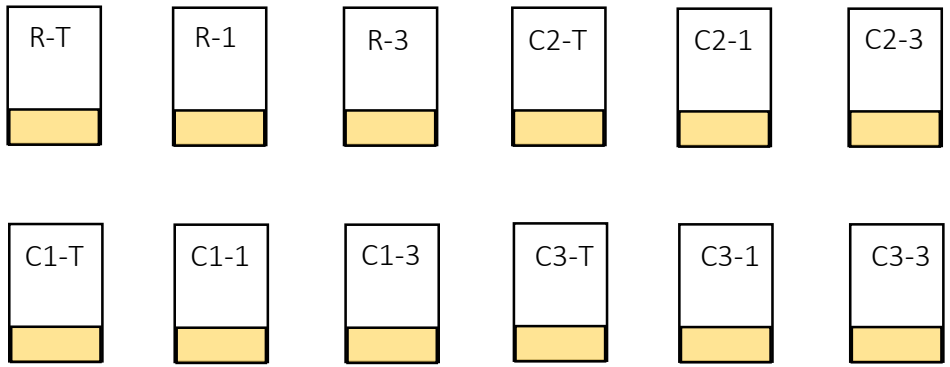
<Experiment Condition>

- Concentration: 14,000bq/m^3, 1,400 bq/m^3, 185bq/m^3
- Exposure time: 1, 3, 5 hours

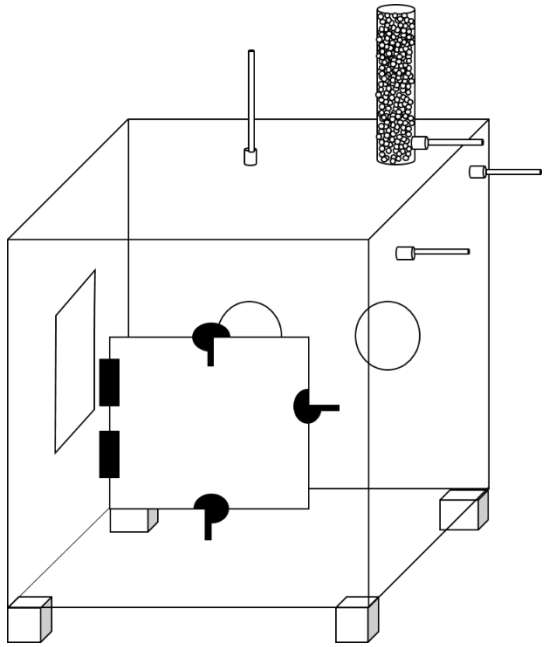
Radon gas source

Experimental of Radon exposure by time and concentration - Materials and Methods

2. Experiment setting



The liquid medium containing the soil microorganisms extracted from each sample



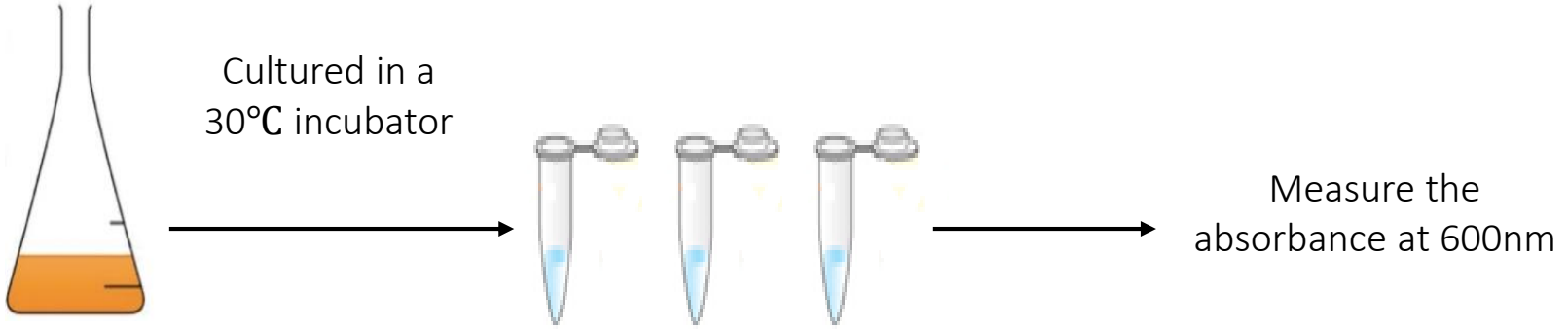
Chamber

Adjust the radon concentration in the chamber

- 14,000 bq/m^3
- 1,400 bq/m^3
- 185 bq/m^3

Experimental of Radon exposure by time and concentration
- Materials and Methods

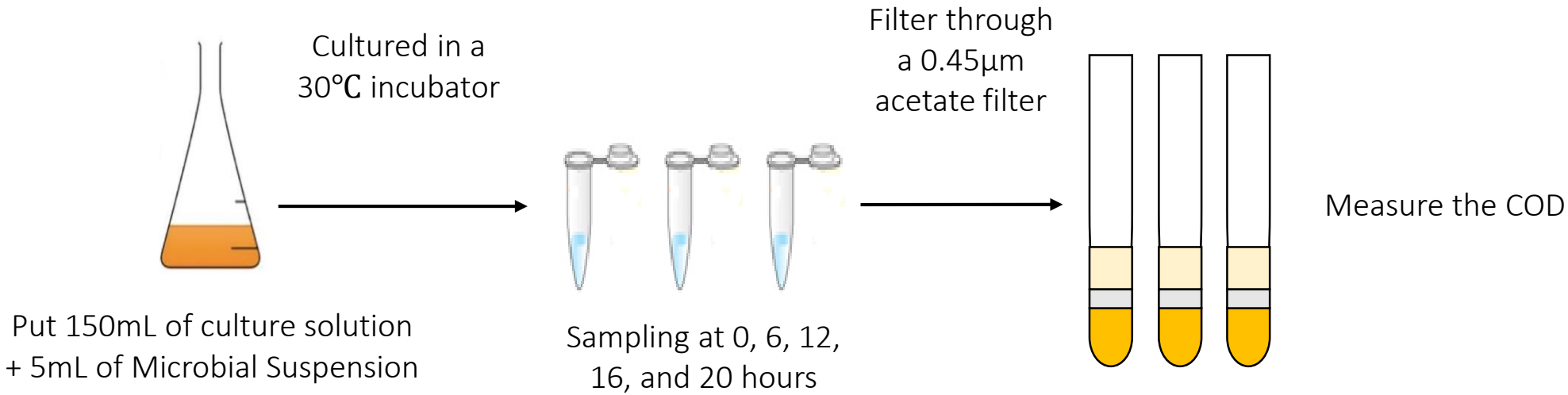
3. OD 600



- Analysis for measuring the concentration of bacteria or other cells in a liquid

Experimental of Radon exposure by time and concentration - Materials and Methods

4. COD



- Used to measure the degradation ability of the microorganisms exposed to radon

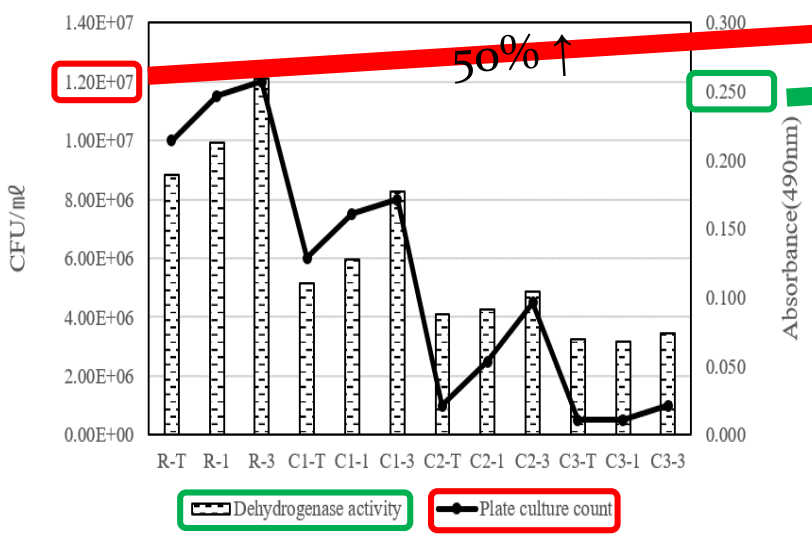
Experiment of radon exposure to Goesan soil by time and concentration

-Results

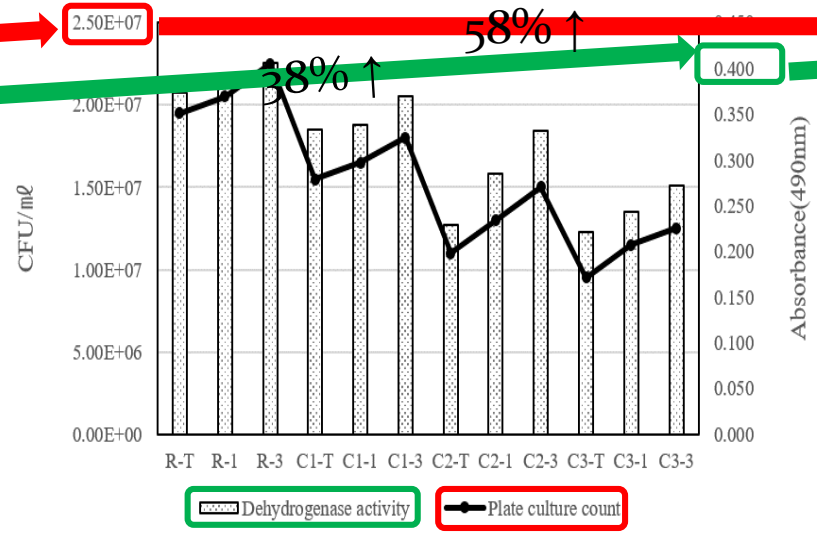
Results and discussion
- Radon exposure experiment results by concentration and time

1. The number of plate culture count & The value of Dehydrogenase measurement – 185bq/ m^3

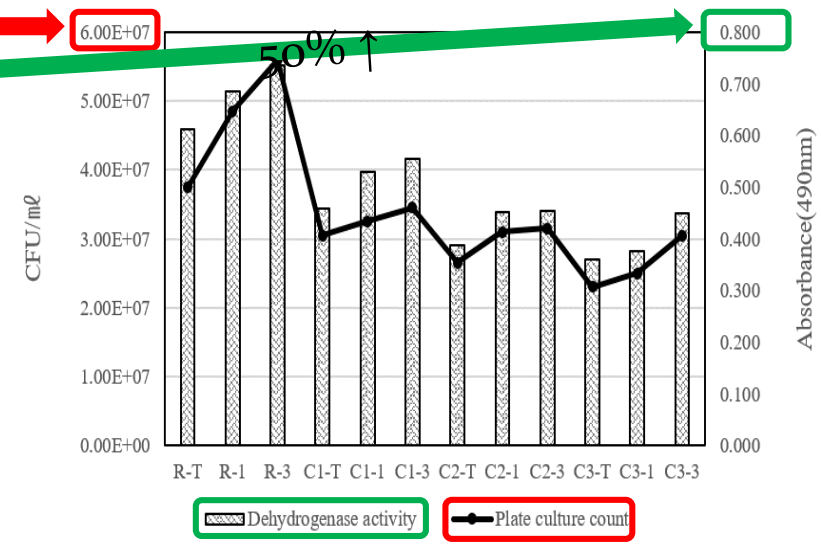
(a) 185bq/m^3, 1hr exposure



(b) 185bq/m^3, 3hr exposure



(c) 185bq/m^3, 5hr exposure

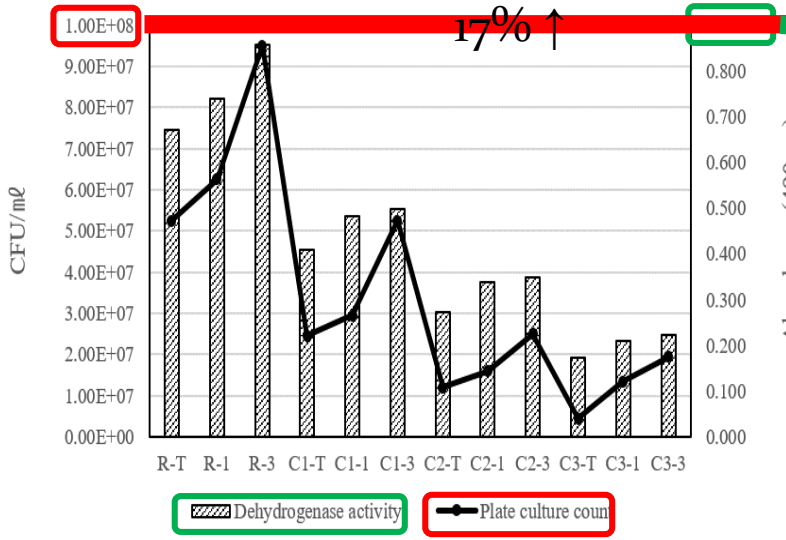


- When exposure concentration is 185bq/m^3, the number of plate culture count and the value of dehydrogenase measurement increase by increasing exposure time.
- These results show that as radon exposure increase, the number and activity of microorganism increase.

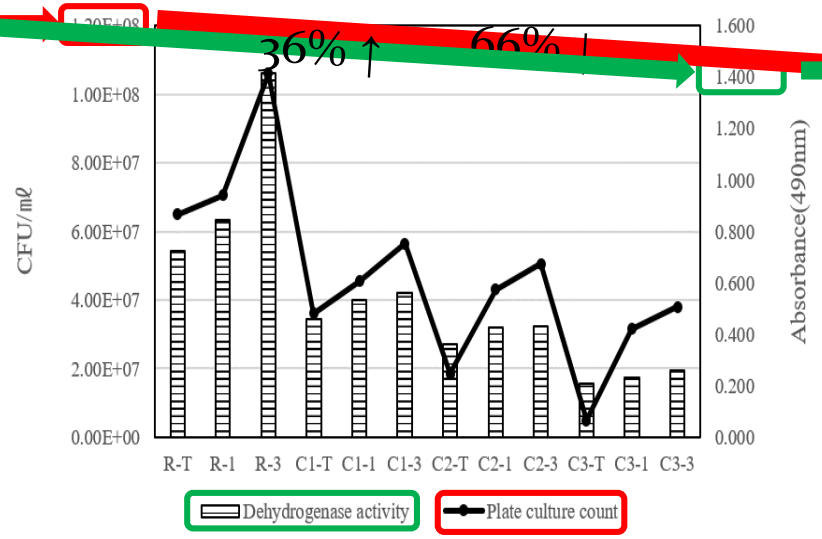
Results and discussion
- Radon exposure experiment results by concentration and time

1. The number of plate culture count & The value of Dehydrogenase measurement – 1,400bq/ m^3

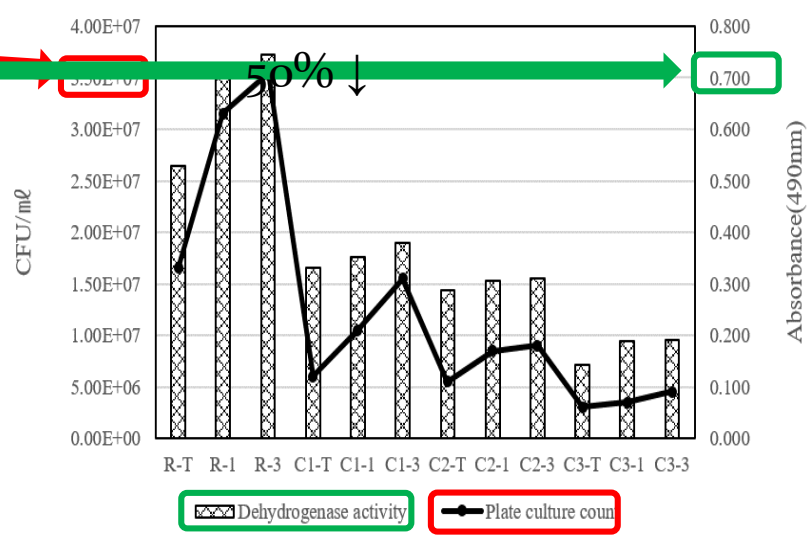
(a) 1,400bq/m^3, 1hr exposure



(b) 1,400bq/m^3, 3hr exposure



(c) 1,400bq/m^3, 5hr exposure

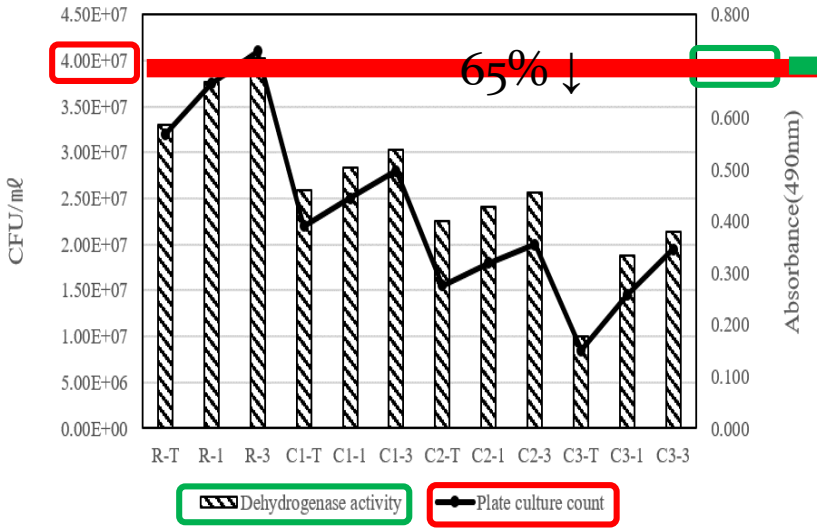


- When exposure concentration is 1,400bq/m^3, the number of plate culture count and the value of dehydrogenase measurement increase by increasing exposure time from 1hr to 3hr.
- But increasing exposure time from 3hr to 5hr, the number of plate culture count and the value of dehydrogenase measurement decrease.

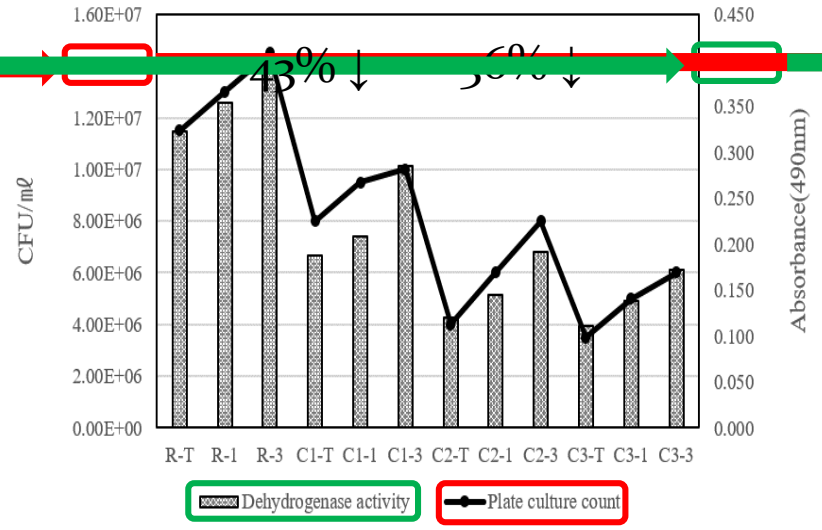
Results and discussion
- Radon exposure experiment results by concentration and time

1. The number of plate culture count & The value of Dehydrogenase measurement – 14,000bq/ m^3

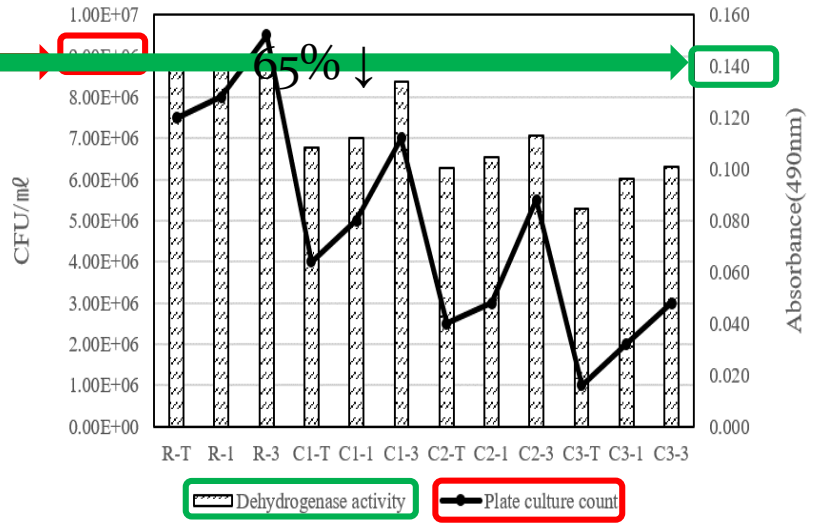
(a) 14,000bq/m^3, 1hr exposure



(b) 14,000bq/m^3, 3hr exposure



(c) 14,000bq/m^3, 5hr exposure

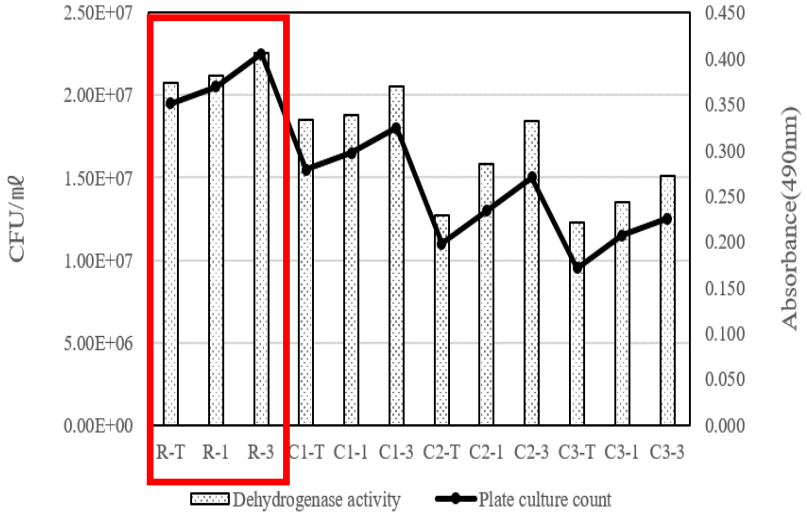


- When exposure concentration is 14,000bq/m^3, the number of plate culture count and the value of dehydrogenase measurement decrease by increasing exposure time.
- The maximum value was shown at 1 hour exposure, and the longer the exposure time, it did not grow well due to adverse effects on microorganism growth.

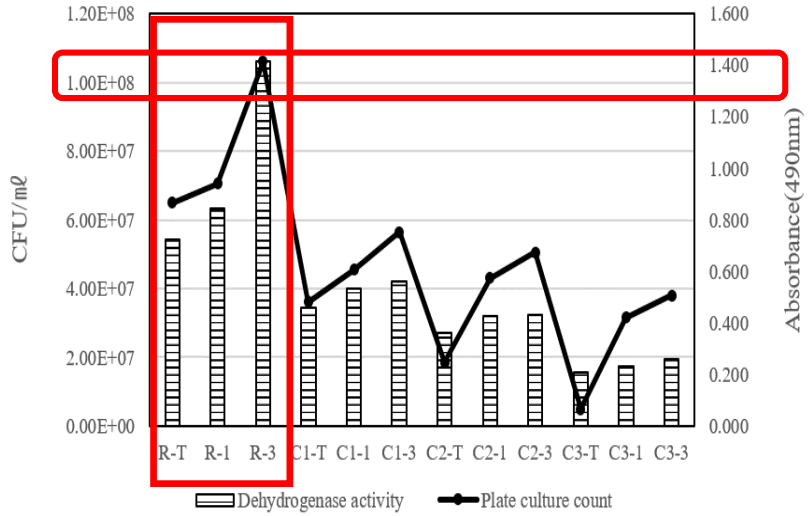
Results and discussion
- Radon exposure experiment results by concentration and time

1. The number of plate culture count & The value of Dehydrogenase measurement – **3hr exposure**

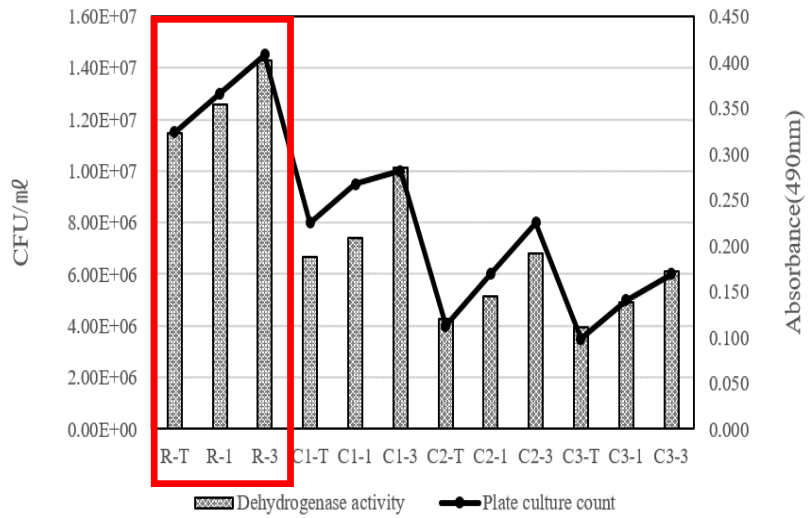
(b) 185bq/m^3, 3hr exposure



(b) 1,400bq/m^3, 3hr exposure



(b) 14,000bq/m^3, 3hr exposure

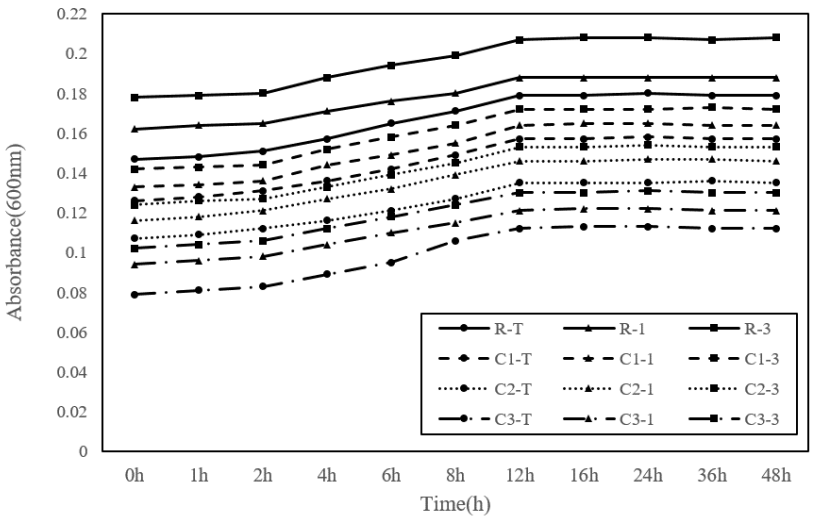


- As compare all results of experiment, the value of the all radon contamination point is the maximum when exposure time is 3hr.
- As a result, when radon concentration is 1,400bq/$m^3$and exposure time is 3hr, results show the highest growth of microorganism.

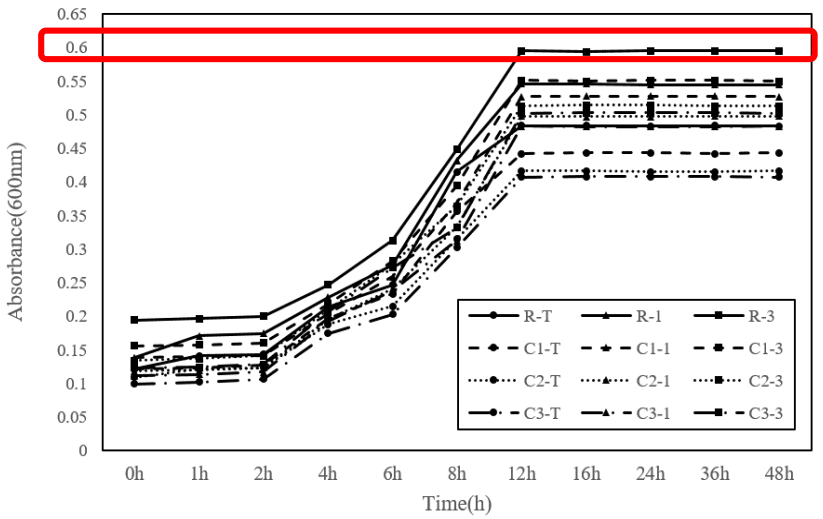
Results and discussion
- Radon exposure experiment results by concentration and time

2. The value of OD 600 – **3hr exposure**

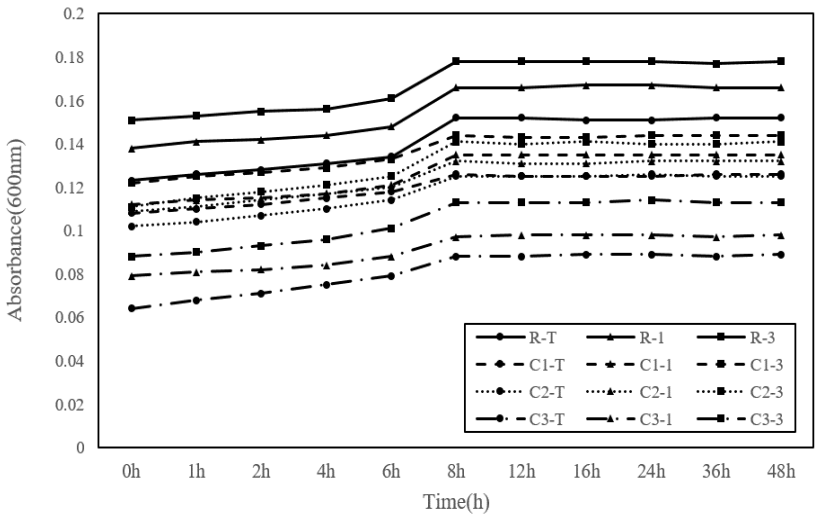
(b) 185bq/m^3, 3hr exposure



(b) 1,400bq/m^3, 3hr exposure



(b) 14,000bq/m^3, 3hr exposure

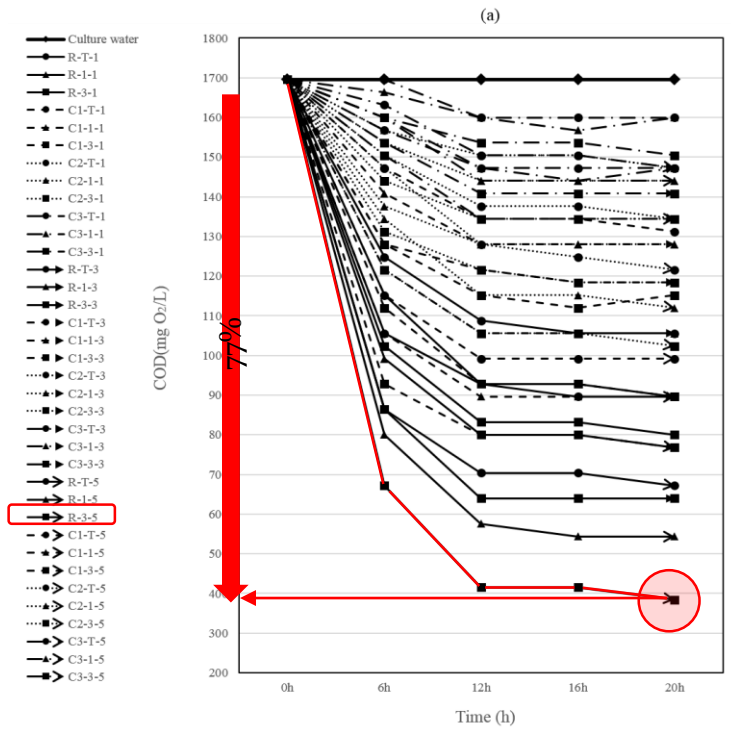


- The value of OD 600 at all experiment conditions shows almost same increase/decrease trends as the number of plate culture count and the value of dehydrogenase measurement.
- Compared all the value of OD 600 of 3hr exposure time experiment.
- As a result, when radon concentration is 1,400bq/m^3, the value of OD 600 also shows the highest growth of microorganism.

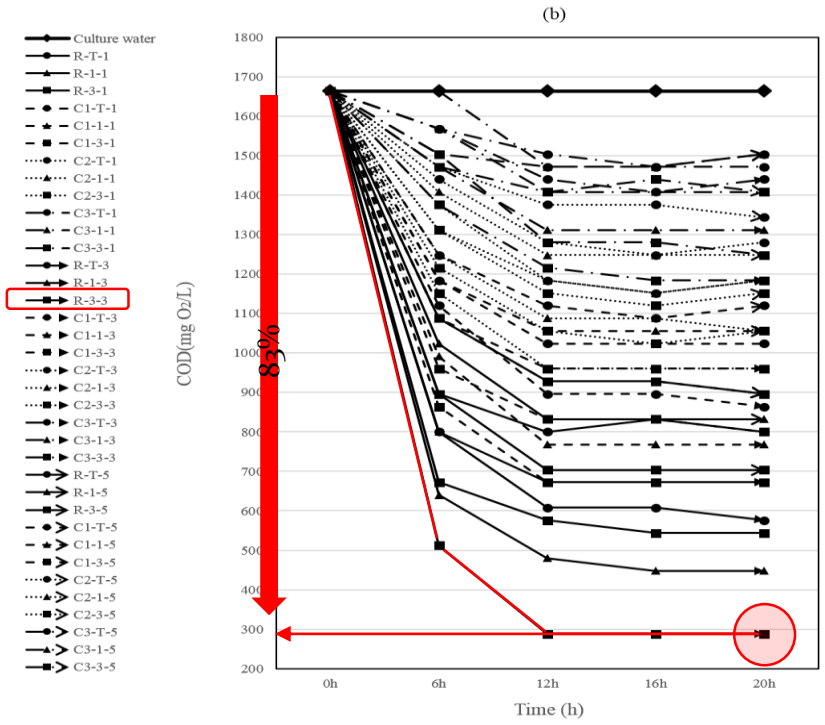
Results and discussion
- Radon exposure experiment results by concentration and time

3. The value of COD

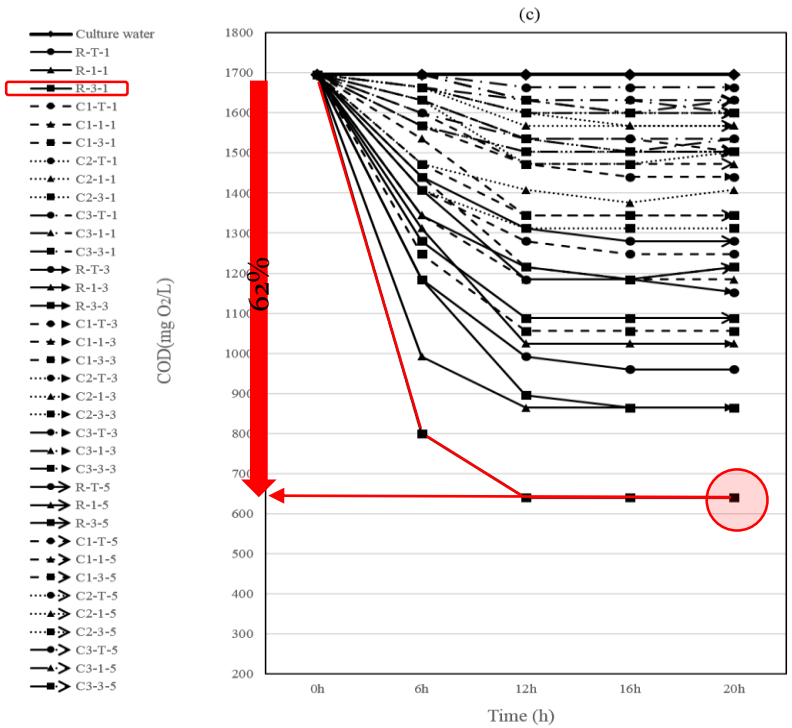
(a) 185bq/㎥ exposure



(b) 1,400bq/㎥ exposure



(c) 14,000bq/㎥ exposure



- When radon concentration is 1,400bq/m^3 and exposure time is 3hr, the rate of carbon decomposition was highest for 83%.
- As a result, it confirm that the carbon decomposition ability was improved due to the promotion of microbial activity when exposed to a slightly high concentration of radon.

Results and discussion
- Discussion

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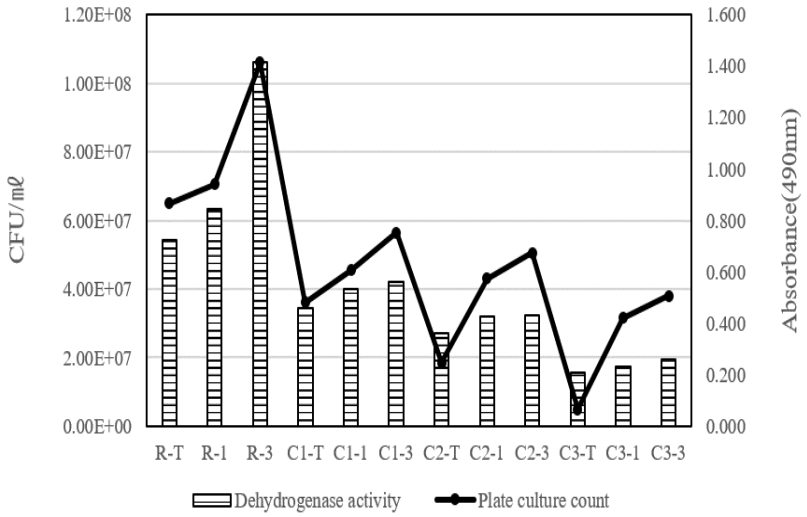
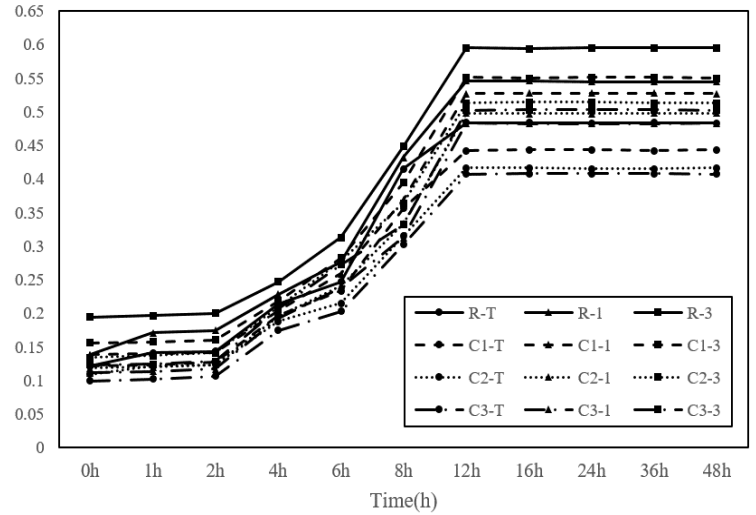
Total results – 1,400bq/ m^3, 3hr

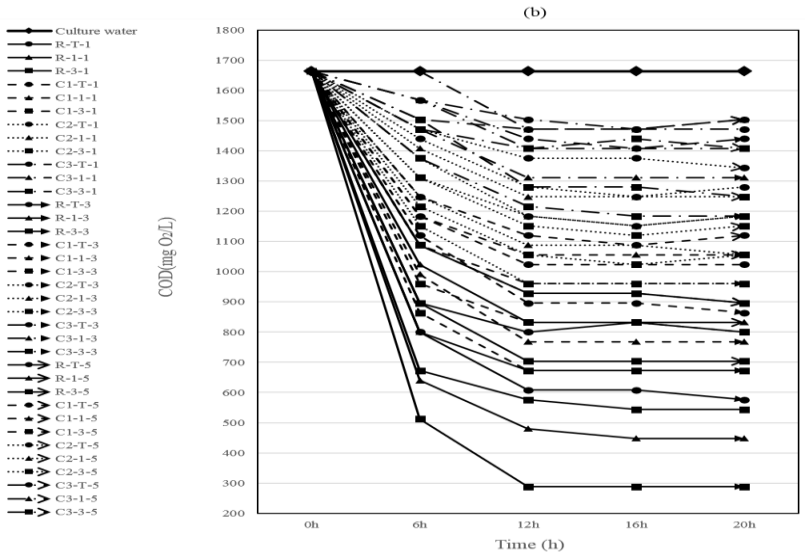
(a) Dilution plate method & Dehydrogenase analysis



(b) OD 600 measurement



(c) COD



- Three results prove that the conditions of radon concentration 1,400bq/m^3 and exposure time 3hr appears highest growth of microorganism and highest carbon decomposition.

Conclusions

Conclusions

- In this study, all of the experimental results were confirmed that when exposed to 1,400bq/m^3 of radon concentration makes the better physiological activities of microorganisms compared to exposure to low concentration of 185bq/m^3 and high concentration of 14,000bq/m^3.
- Based on these results, it was verified that when exposed to a proper concentration of radiation, a beneficial effect can be obtained such as promoted growth reaction or physiological activity of the microorganism.
- In conclusion, this study demonstrated the radiation hormesis effect of radon on soil microorganisms.

Thank you