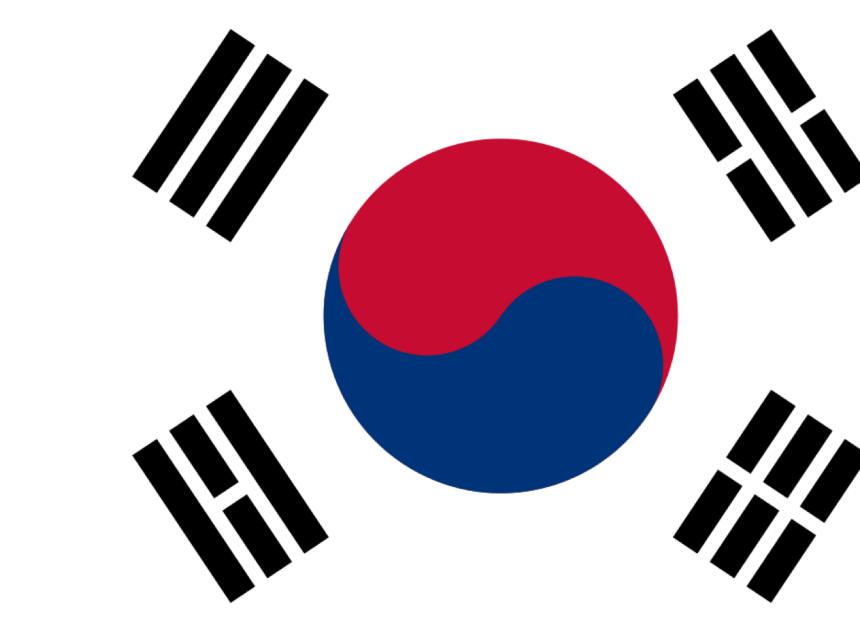


A Study on Particulate Matter (PM) and Volatile Organic Compounds (VOCs) Adsorption by Alginate Gel

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I. Environmental Consequences and Problems

Particulate Matter (fine dust) is now one of the most significant environmental problem



- 880,000 deaths per year caused by fine dust - more than smoking
- Death rate in 2019 - increased by 23.5% compared to 1990.



- Volatile Organic Compounds (VOC) are toxic chemical produced from household necessities like paint, air conditioning, and ventilation
- Causes Sick Building Syndrome

It is necessary to develop an inexpensive, environmentally friendly way to improve indoor air quality.

II. Background & Goals

- Existing air filters (activated carbon)
- Greenhouse gases are produced during manufacturing



- Discovered that alginate gel adsorbed dust well
- **Alginate is an eco-friendly material** made from seaweed extracts and also naturally decomposes
- **The cost of alginate is low** at \$30 per kg
- We thought alginate gel can be utilized to create an eco-friendly air purifier

Our goals are to make a alginate air purifier which can

1. Reduce the amount of indoor particulate matter
2. Eliminate hazardous substances such as VOCs

Reference

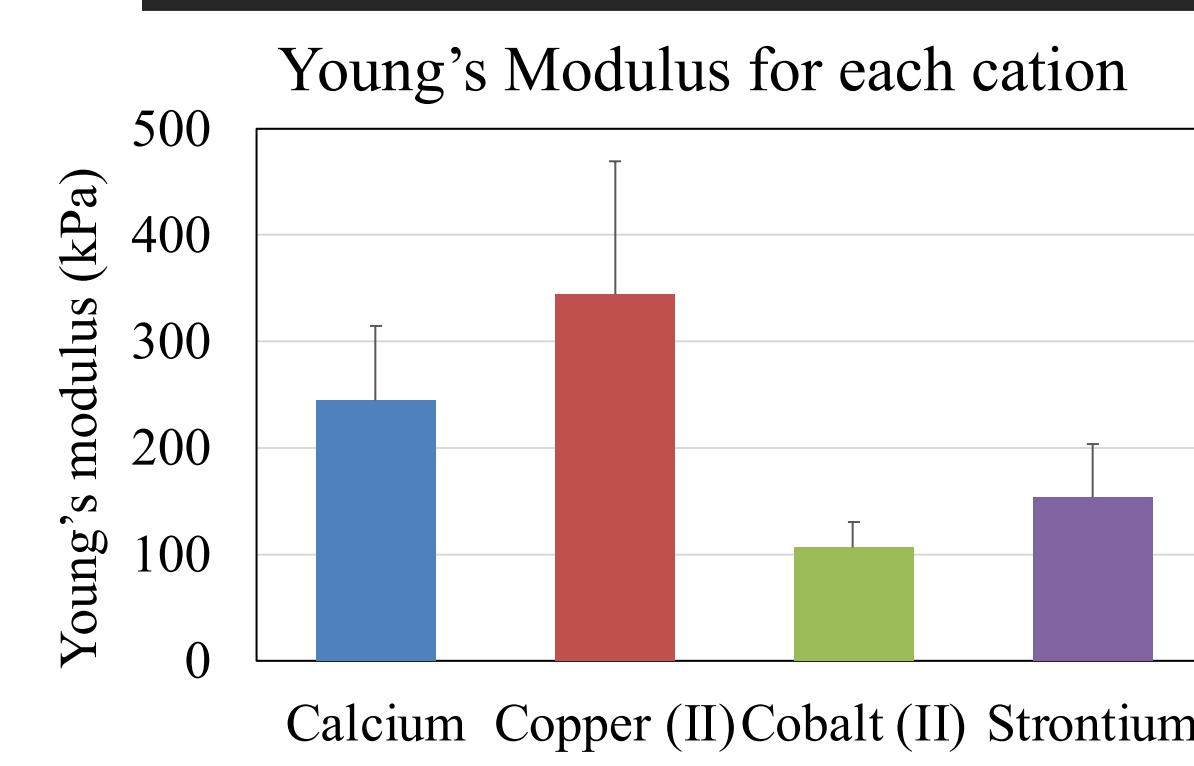
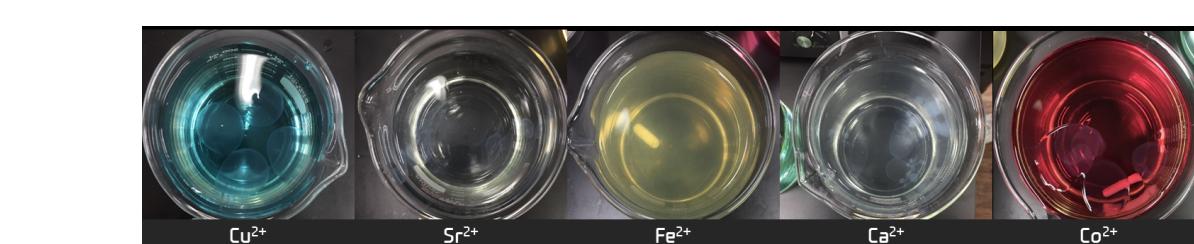
- [1] Lin, Y., et al. (2005). Removal of organic compounds by alginate gel beads with entrapped activated carbon. *Journal of Hazardous Materials*, 120(1-3), 237-241.
- [2] Jeon, C. (2017). Adsorption characteristics of heavy metals using alginic acid. *Journal of Korean Geo-Environmental Society*, 2017(9), 93-94.
- [3] Kaklamani, Georgia; Cheneley, David; Grover, Liam M.; Adams, Michael J. and Bowen, James (2014). Mechanical properties of alginate hydrogels manufactured using external gelation. *Journal of the Mechanical Behavior of Biomedical Materials*, 36 pp. 135-142.

III. Methods & Result

Experiment 1

Finding the optimal condition for the alginate gel formation

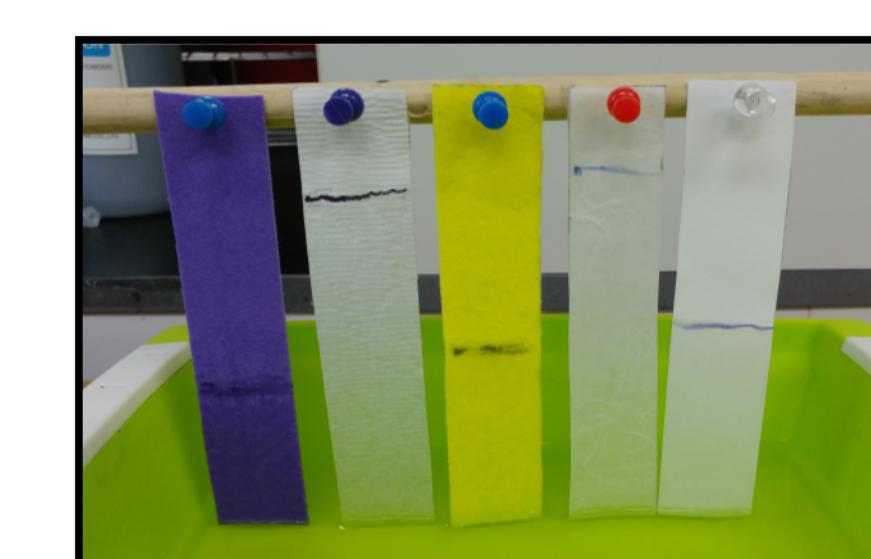
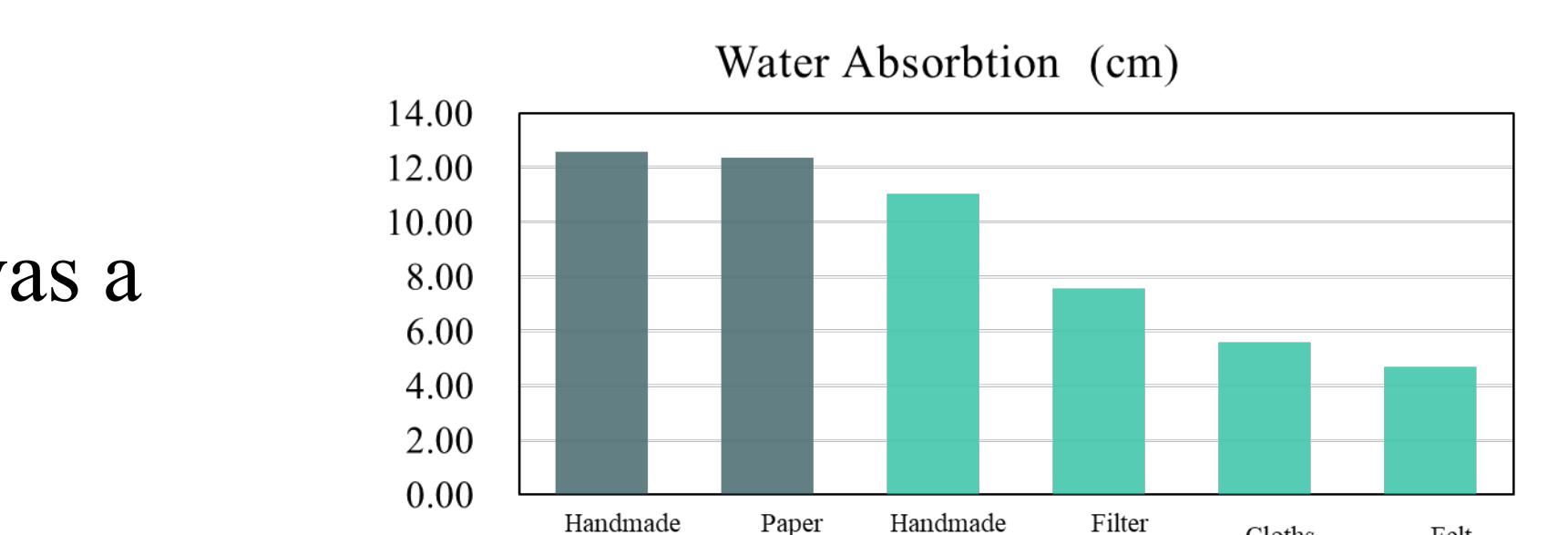
Find the kind of cation that is best for making a alginate gel



Ca²⁺ is durable and eco-friendly

Find the kind of material best for gel support

- Needed the paper to absorb as much water
- Korean paper and paper towel showed the best absorption rate, but Korean paper was more expensive.



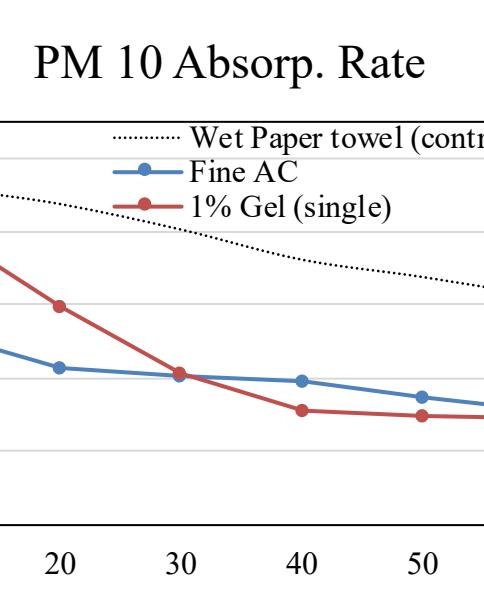
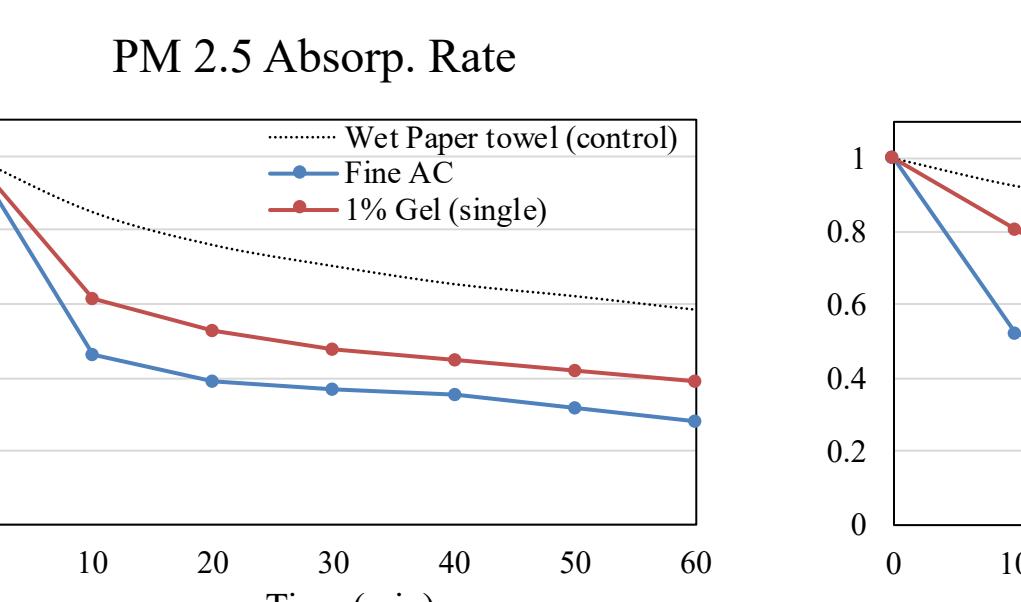
Paper towel is low-cost and absorbs water well

Experiment 4

Comparing efficiency with activated carbon



Compare the adsorption ability of alginate and activated carbon which is widely used as a commercial adsorbent.



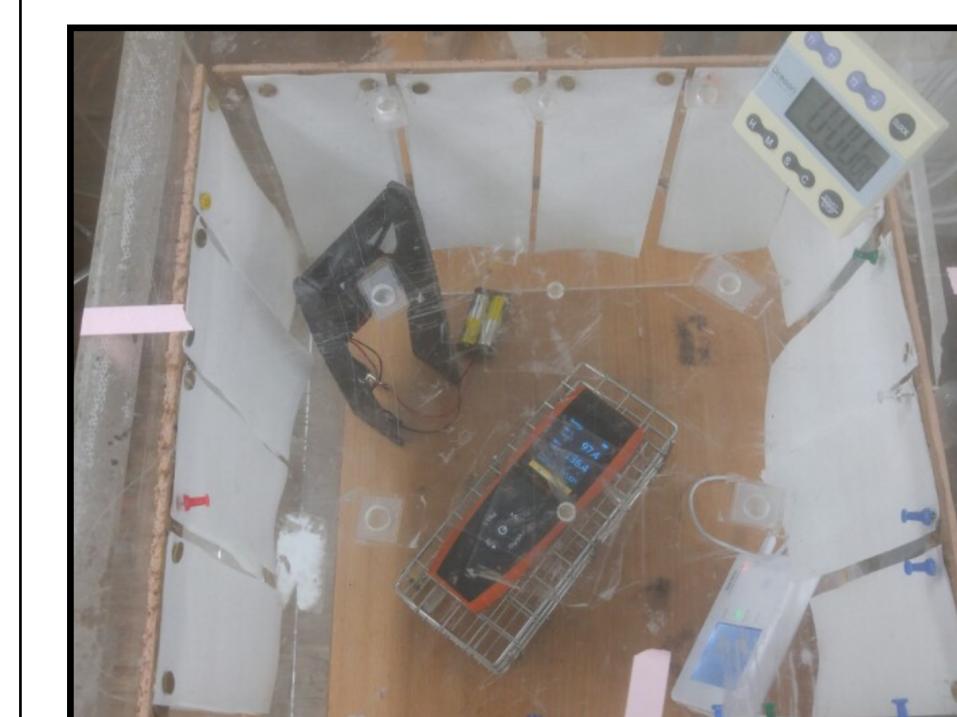
There was no significant difference of adsorption rate between 1% gel and activated carbon.

Overall Schematic of Alginate Gel Manufacturing



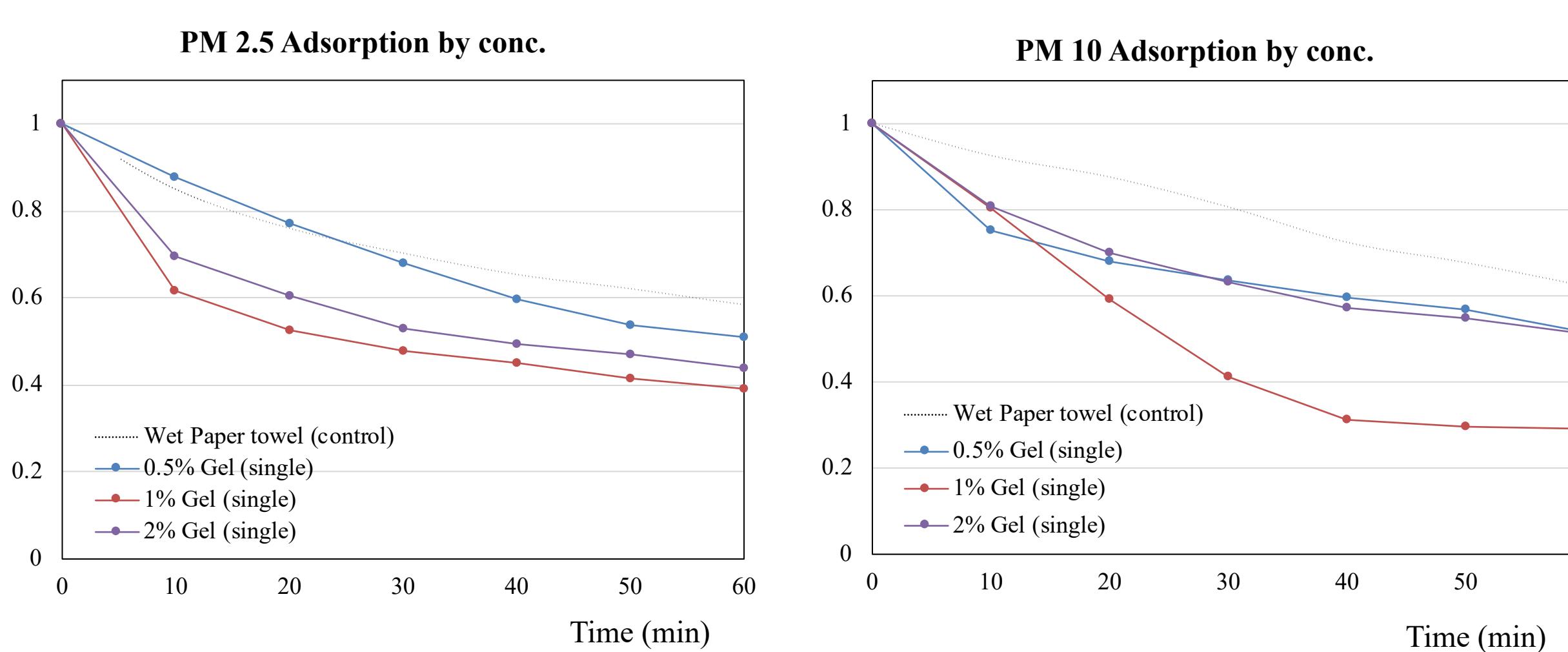
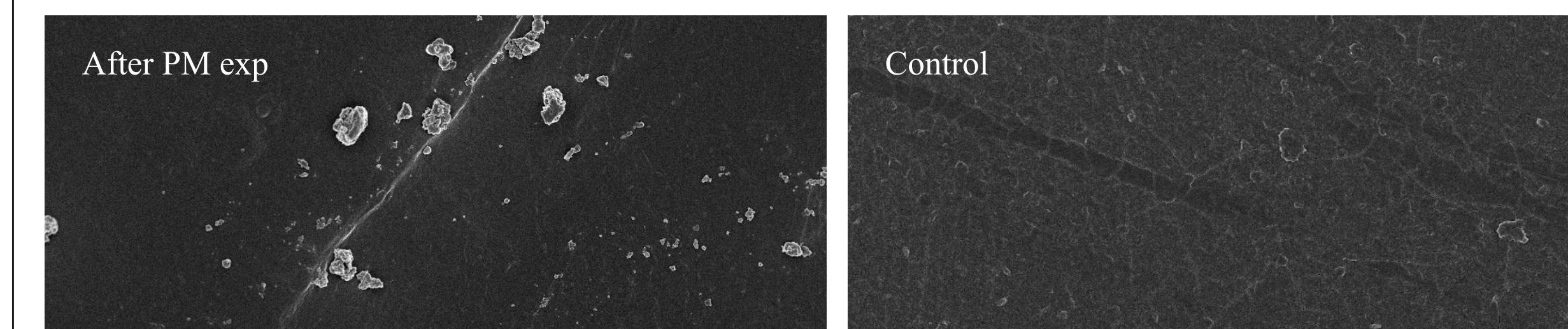
Experiment 2

Measuring the PM adsorption efficiency of alginate gel



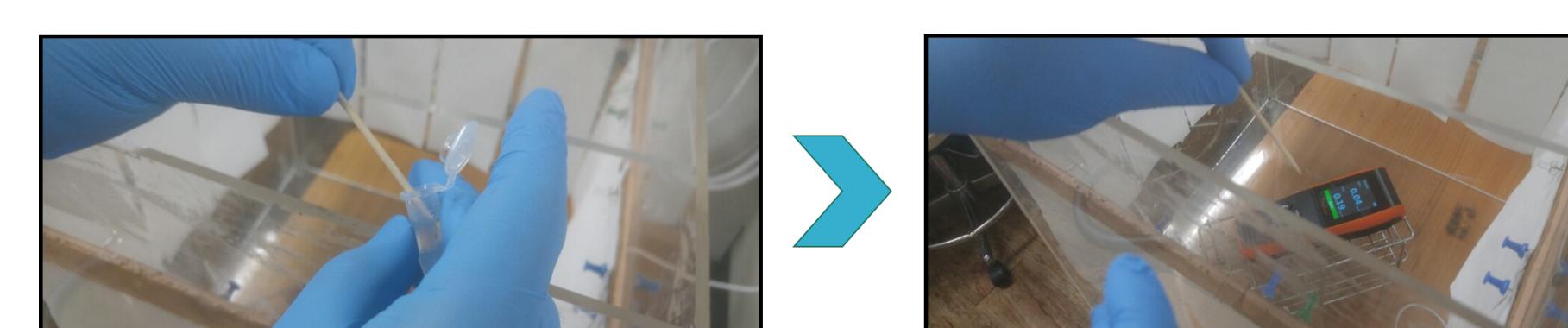
1. Cigarette smoke was trapped inside an acrylic box with the size of 40x40x40.
2. Concentration of PM was measured for 60 min

SEM images of alginate gel surface

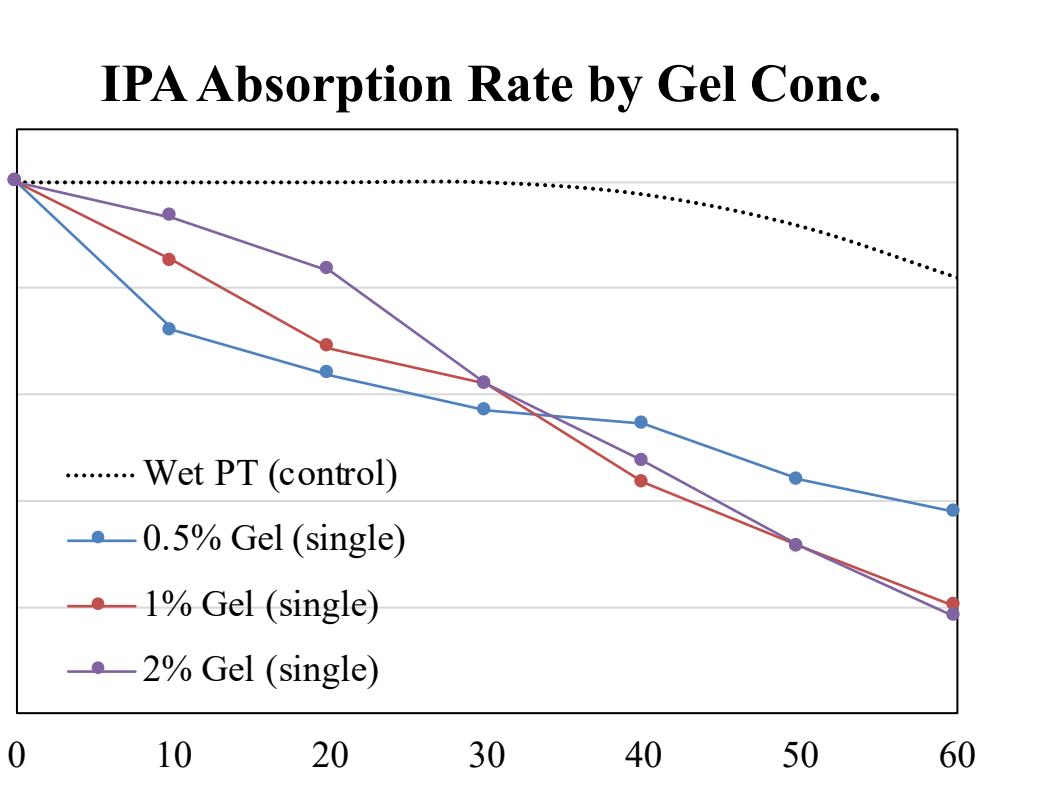


Experiment 3

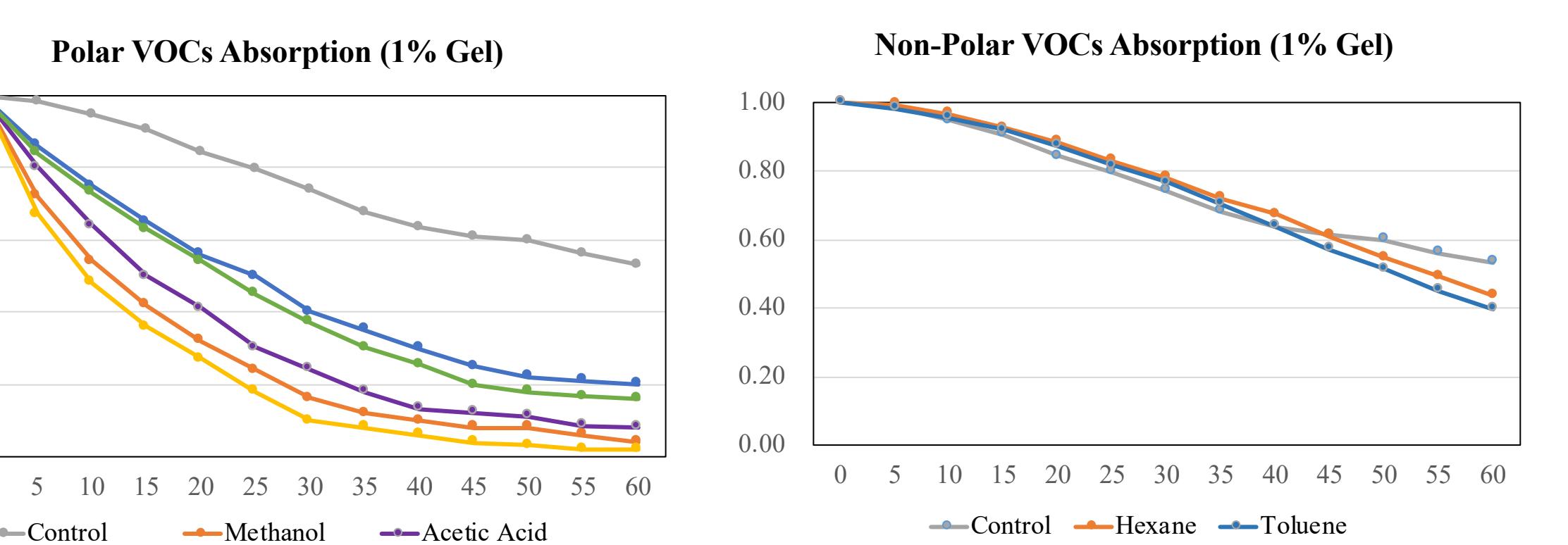
Measuring the VOCs adsorption efficiency of alginate gel



1. Toothpick tip with IPA was trapped inside an acrylic box
2. Concentration of IPA was measured for 60 min



Experiments on various VOCs



Due to its hydrophilic property, the alginate gel showed a definite tendency to adsorb to VOCs that are polar, but not adsorbed to nonpolar VOCs

IV. Conclusion



Alginate gel can be an effective solution of purifying the air



The manufacturing material costs only about a cent

- The alginate gel air purifier prototype is robust and excellent in adsorption ability.
- According to the results of the study, 1% alginate gel showed the best results in terms of economy and efficiency and could be a good substitute of activated carbon.
- As a result of examining the performance of the prototype, it was found that its ability of adsorbing harmful substances and watering were enough to be used in actual living space.

- [1] Lin, Y., et al. (2005). Removal of organic compounds by alginate gel beads with entrapped activated carbon. *Journal of Hazardous Materials*, 120(1-3), 237-241.
- [2] Jeon, C. (2017). Adsorption characteristics of heavy metals using alginic acid. *Journal of Korean Geo-Environmental Society*, 2017(9), 93-94.
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