

# A STUDY ON REDUCTION EFFECT OF INDOOR AIR POLLUTANTS IN SPRING BY PLANTS

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## ABSTRACT

This study explored the reduction effect of indoor pollutants by the kinds of plant. The effect of reducing the concentration of air contaminants by three species of plants was studied in a full-scale mock-up model. *Aglaonema brevispathum*, *Pachira aquatica* and *Ficus benjamiana* were used. Their positions and amount were controlled. Field measurements were performed in models where the plants were placed and were not. The dimensions of the two models were equal. The concentration of Benzene, Toluene, Ethylbenzene, Formaldehyde were monitored, since they were known as most toxic materials. The concentration of VOCs was monitored three hours after the plants were placed and three days after the plants were placed.

As a consequence, the reduction effect of pollutants was indicated as being great at the room with plants. At experiment by grown plant volume, the more the plant grown volume was, the greater the concentration reduction effect was, and at experiment in grown plant arrangement, the effect was the greatest when they were placed at the place close to the window. Of them when *Ficus benjamiana* was planted, Toluene was reduced by 45.45  $\mu\text{g}/\text{m}^3$ , where the effect was the best, and Formaldehyde was reduced by 375.42  $\mu\text{g}/\text{m}^3$ . Among lost pollutants, the effect of *Ficus benjamiana* and *Aglaonema* was very good. The effect of *Pachira* worked, but its reduction effect was the least, which were the most difficult to manage.

## KEYWORDS

Plant, Indoor Air Quality, Volatile Organic Compounds(VOCs), Formaldehyde

## INTRODUCTION

It has been already known that air can be purified using plants. Currently, some experiment certify this in each area such as architecture, environment etc. has been being conducted, which our country has attracted popular concern, and been in progress stage. Thus this study carried out an experiment as to whether air is purified or not using plants. The effect was confirmed with that experiment, on which three plants having good effect were selected. The initial experiment to the three kinds of plants was conducted in order to reduce the concentration reduction of VOCs produced in spring. The plants applied to the experiment were. *Aglaonema brevispathum*, *Pachira aquatica* and *Ficus benjamiana*, which was conducted in Mar. to May, spring. To certify what plant is effective in spring, the plant volume was changed, the experiment conducted changing its placement.

## METHOD OF EXPERIMENT

This experiment measured the concentration change of VOCs in the room with plants, and that without them in order to seize the VOCs reduction effect by plants. The kinds of measured VOCs were Benzene, Toluene, Ethylbenzene, Formaldehyde, on the measured results of which for three days

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reduction effect was grasped. The experiment room measures 3.5m wide, 5m long, and 2.4m long in a form of reduced apartment, which had a living room and a veranda, with the plants arranged based on the veranda part.

In the experiment regarding planting and growing amount, the plants were divided by 10% and 5% of the experiment space, and that to the placement of planting and growing, sunny spot placement close to the veranda part, and scattered placement were measured respectively. The measurement was made on the apartment measuring method (process testing method) at three in the afternoon for three days in a row after 5 hour closed state for 5 hours after ventilation for 30 minutes in the morning.

The experiment room was not operative with an air-conditioner, with the condition of both rooms in all the same. Benzene, Toluene, Ethylbenzene was sampled with a Charcoal tube, and analyzed using GC-FIID, and HCHO was sampled with a DNPH-cartridge, and analyzed using HPLC.

Figure 1 shows the ground plan of the laboratory, and Figure 2 shows the planting amount and placement.

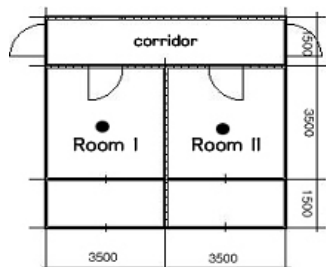


Figure 1. Plan of the space

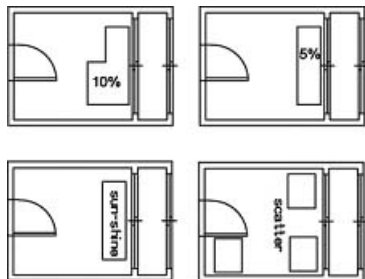


Figure 2. Layout of plant

## RESULTS ANALYSIS

### (1) Assessment to Planting and Growing Amount

The results by 10% and 5% planting and growing showed high effect in the 10% of the experiment room space, which evidenced the case with plants is more effective than that without plants. Also the comparative experiment with 3% planting and growing as an additional experiment found at least 5% or more has good effect. Each material in VOCs indicated high concentration ratio in Toluene and Formaldehyde.

The effect found the most reduction in both materials when *Ficus benjamina* was set up. Also setting up *Aglaonema brevispathum* was effective in reduction. Formaldehyde was most reduced by  $375.42 \mu\text{g}/\text{m}^3$  in which *Ficus benjamina* was set up by 10%, and in other case, reduced by  $114.17\sim 375.42 \mu\text{g}/\text{m}^3$ . Toluene was most effective when *Ficus benjamina* was set up by 10%, in which it was reduced by  $45.45 \mu\text{g}/\text{m}^3$ .

The decrease of Benzene concentration is shown in Fig.3, Toluene is shown in Fig.4, Ethylbenzene is shown in Fig.5 and Formaldehyde is shown in Fig.6.

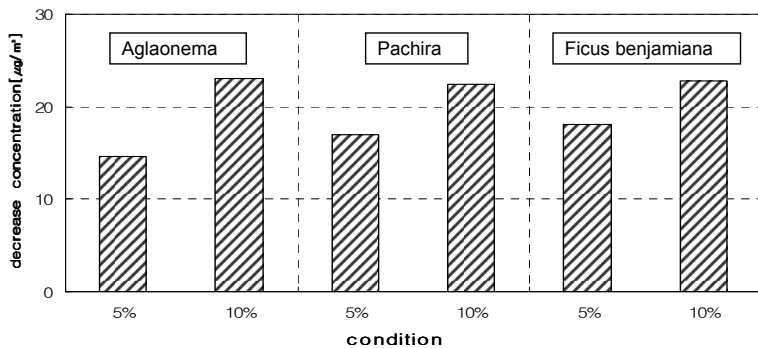


Figure 3. Decrease of Benzene concentration according to the amount of plant

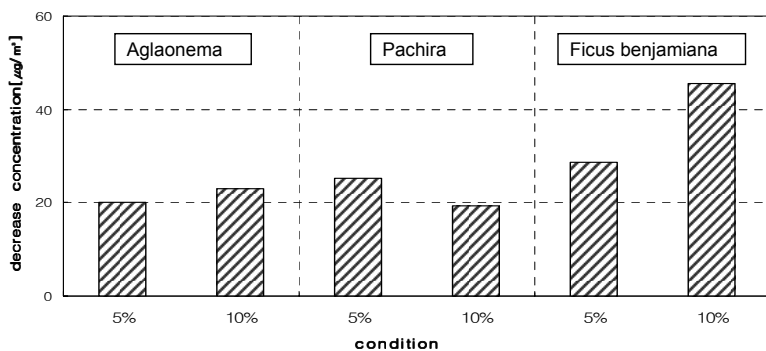


Figure 4. Decrease of Toluene concentration according to the amount of plant

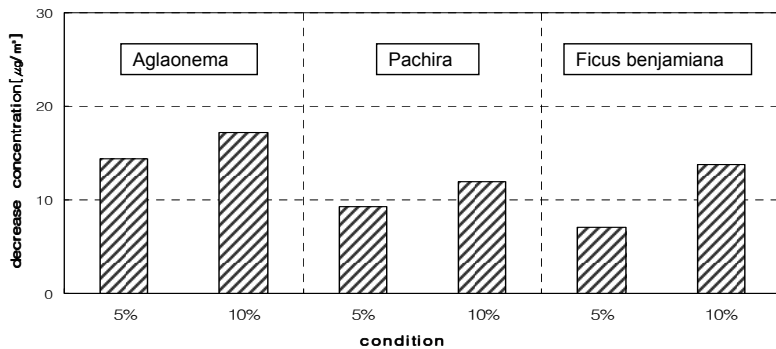


Figure 5. Decrease of Ethylbenzene concentration according to the amount of plant

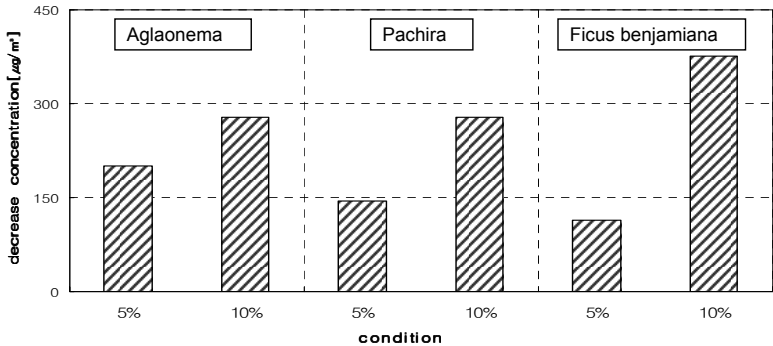


Figure 6. Decrease of Formaldehyde concentration according to the amount of plant

## (2) Assessment to Planting and Growing Placement

Planting and growing placement was experimented dividing the sunny spot placed close to the veranda part and scattered placement. Of the both experiments, the effect of sunny spot placement was excellent, which is presumed the sun light may have had a good effect on the air purifying effect of plants.

Each material in VOCs indicated higher reduction effect in the spot with plants set up, and that without them, in most sunny spot placement of which was more excellent in effect. Formaldehyde was the most effective with *Aglaonema brevispathum* set up.

It indicated at least  $55.83 \mu\text{g}/\text{m}^3$  or more reduction volume. Toluene was most effective with *Ficus benjamina* set up, and in general, nearly all VOCs materials, the effect of *Ficus benjamina* was excellent.

The variation of Benzene concentration is shown in Fig.7, Toluene is shown in Fig.8, Ethylbenzene is shown in Fig.9 and Formaldehyde is shown in Fig.10. VOCs concentration is shown in Table 1.

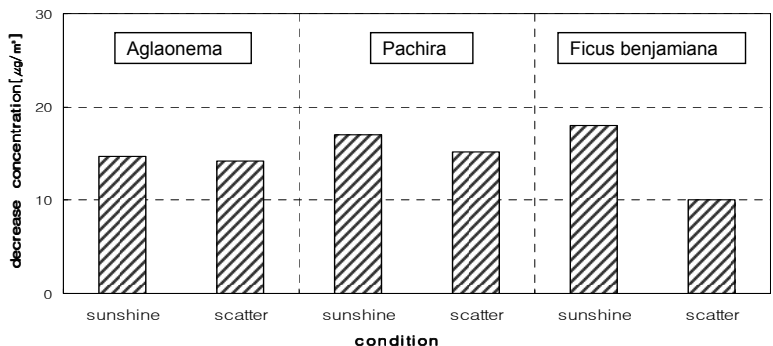


Figure 7. Decrease of Benzene according to the positioning of plants

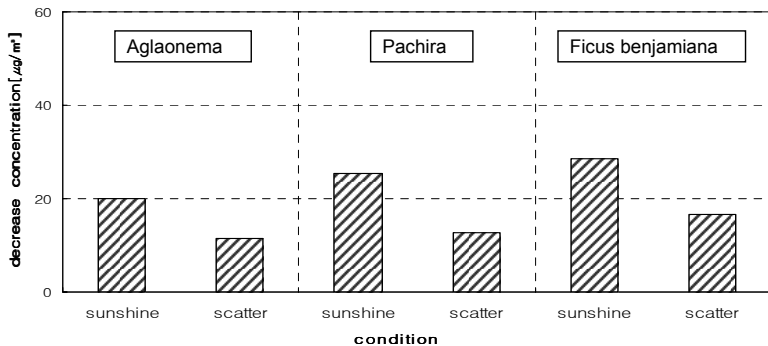


Figure 8. Decrease of Toluene according to the positioning of plants

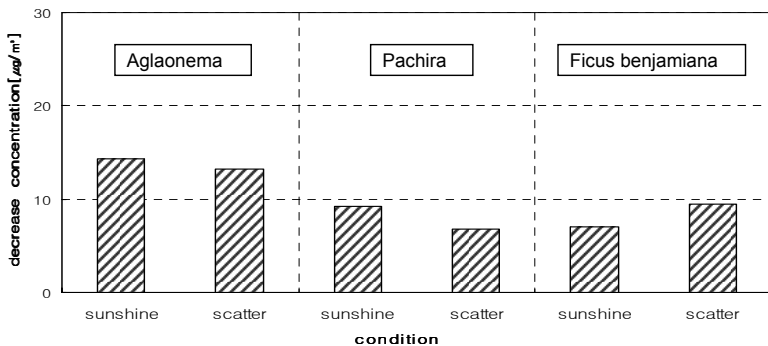


Figure 9. Decrease of Ethylbenzen according to the positioning of plants

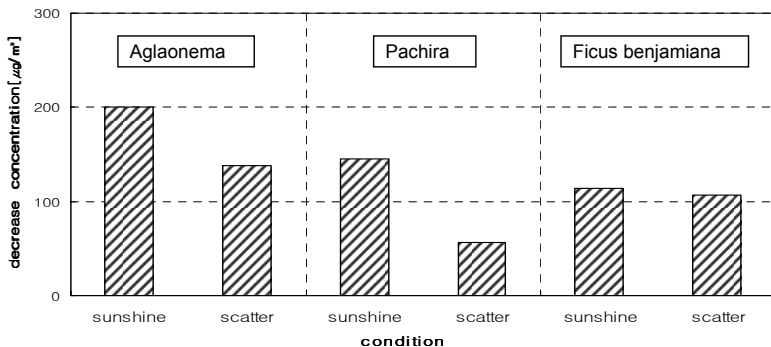


Figure 10. Decrease of Formaldehyde according to the positioning of plants

Table 1 VOCs concentration according to the amount of plant and the positioning of plant [ $\mu\text{g}/\text{m}^3$ ]

		Aglaonema		Pachira		Benjamin	
		start	end	start	end	start	end
The amount of plant (10%)	Benzene	38.6	23.1	45.9	22.4	32.6	22.7
	Toluene	96.1	22.9	89.5	19.3	97.1	45.4
	Ethylbenzene	36.1	17.1	40.6	11.9	29.3	13.8
	Formaldehyde	876.7	279.2	722.1	278.7	836.6	375.4
The positioning of plant (sunshine)	Benzene	39.5	14.6	41.7	16.9	29.5	18.1
	Toluene	95.5	19.9	90.2	25.2	77.9	28.6
	Ethylbenzene	39.8	14.3	35.0	9.2	26.9	7.1
	Formaldehyde	804.2	200.0	764.2	145.0	775.4	114.2

## CONCLUSIONS

This research explored in what type placement was effective to the three kinds of air purifying plants in spring. The experiment findings are as follows.

- (1) All experiments displayed higher VOCs reduction effect in the plants-set up room compared to those-not set up room.
- (2) The plating and growing amount experiment was most effective with *Ficus benjamiana* set up by 10% of the experiment room space.
- (3) In the plating and growing placement experiment, the sunny-spot placement of *Ficus benjamiana* was most effective, and in reduction of Formaldehyde, *Aglaonema brevispathum* was effective.
- (4) In all experiments, mostly the air purifying effect of *Ficus benjamiana* was most excellent. On which it is thought that placement at sunny-spot by 10% of the space would have a huge effect.

## ACKNOWLEDGEMENTS

This work was supported by the Ministry of Environment of the Republic of Korea (013-061-039) and The Sustainable Building Research Center of Hanyang University which was supported by the SRC/ERC program of MOST (R11-2005-056-02002-1)

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