

The Level of Volatile Organic Compounds Exposure in New Buildings: Can Adding Indoor Potted Plants Reduce Exposure?

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Introduction

Nightingale, "the connection between the dwelling of the population is important that exists."¹

People spend approximately 90% of their time with a typical work week of 40 hours, frequently exposing themselves to indoor air, including volatile organic compounds (VOCs), some of which can cause short-term and long-term adverse health effects².

Symptoms in what has been termed "Sick Building Syndrome," which can cause health effects such as headache, nausea, irritation of eyes, nose, and throat, fatigue, asthma, coughing, and skin irritation. Other long-term effects include reproductive toxicity, stillbirth, congenital abnormalities, premature birth, and Alzheimer's Disease, CNS dysfunction, and cerebral atrophy^{3, 4, 5}.

Purpose

The purpose of adding indoor plants to the level of indoor VOCs and

Method

The study was conducted in a newer building (2008) and an older college campus in the United States, initial VOC levels were measured in two separate faculty offices.

An Advanced Chemical Vapor Monitor (Advanced CM), which measures 81 VOCs, was placed in each office before adding indoor plants.

The Advanced Chemical Vapor Monitor (Advanced CM) was placed for 48 hours in each office before adding indoor plants.

In each office, four and six indoor plants were placed in the offices, four and six plants.

The plants were placed on top of a cabinet, four feet

high in each room including: Rubber Fig, Ficus elastica, and Golden pothos

The Advanced Chemical Sensors were used for VOCs and

Analysis

- The majority of VOC levels in both buildings were reduced by the 4th week.
- Newer building's VOC levels that decreased by the 4th week are 2-Methylbutane, Acetone, Ethyl Alcohol, Isobutane, Toluene. Increases were seen in Butane and Formaldehyde. By the 6th week an increase was seen in all measured VOC level's.
- Older building's VOC levels that decreased by the 4th week are Formaldehyde and Toluene. Increases were seen in 2- Methylbutane, Acetone, Butane, Ethyl Alcohol, Isobutane and Methyl Ethyl Ketone. Results are pending for the 6th week VOC level's.

Plants

- Common indoor plants come in various prices, shapes, and sizes to fit any office or residential space.
- Out of the three plants used in this study, the Golden Pothos was easiest to care for.

Rubber Fig
Ficus elastica



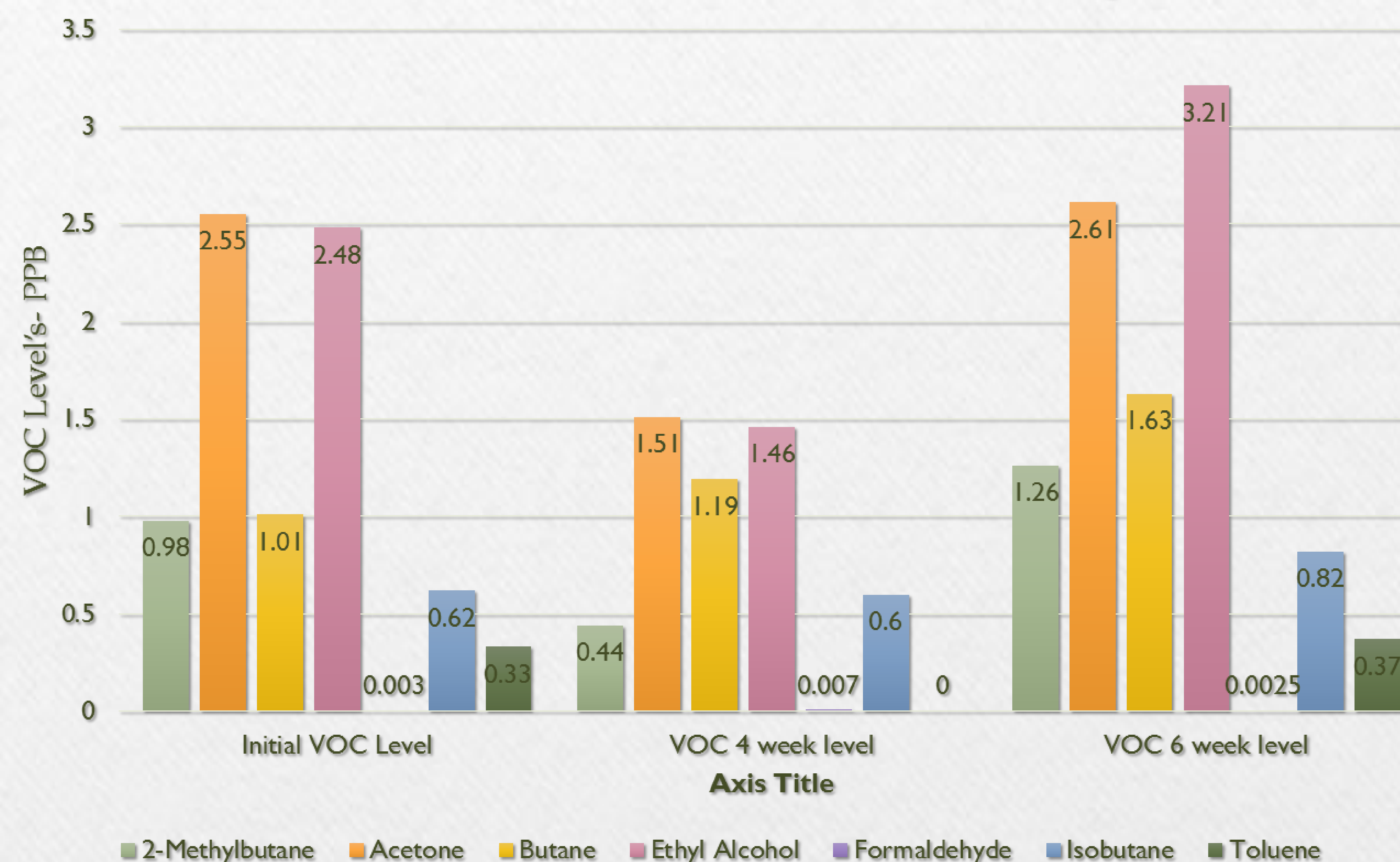
Dumb Cane
Dieffenbachia



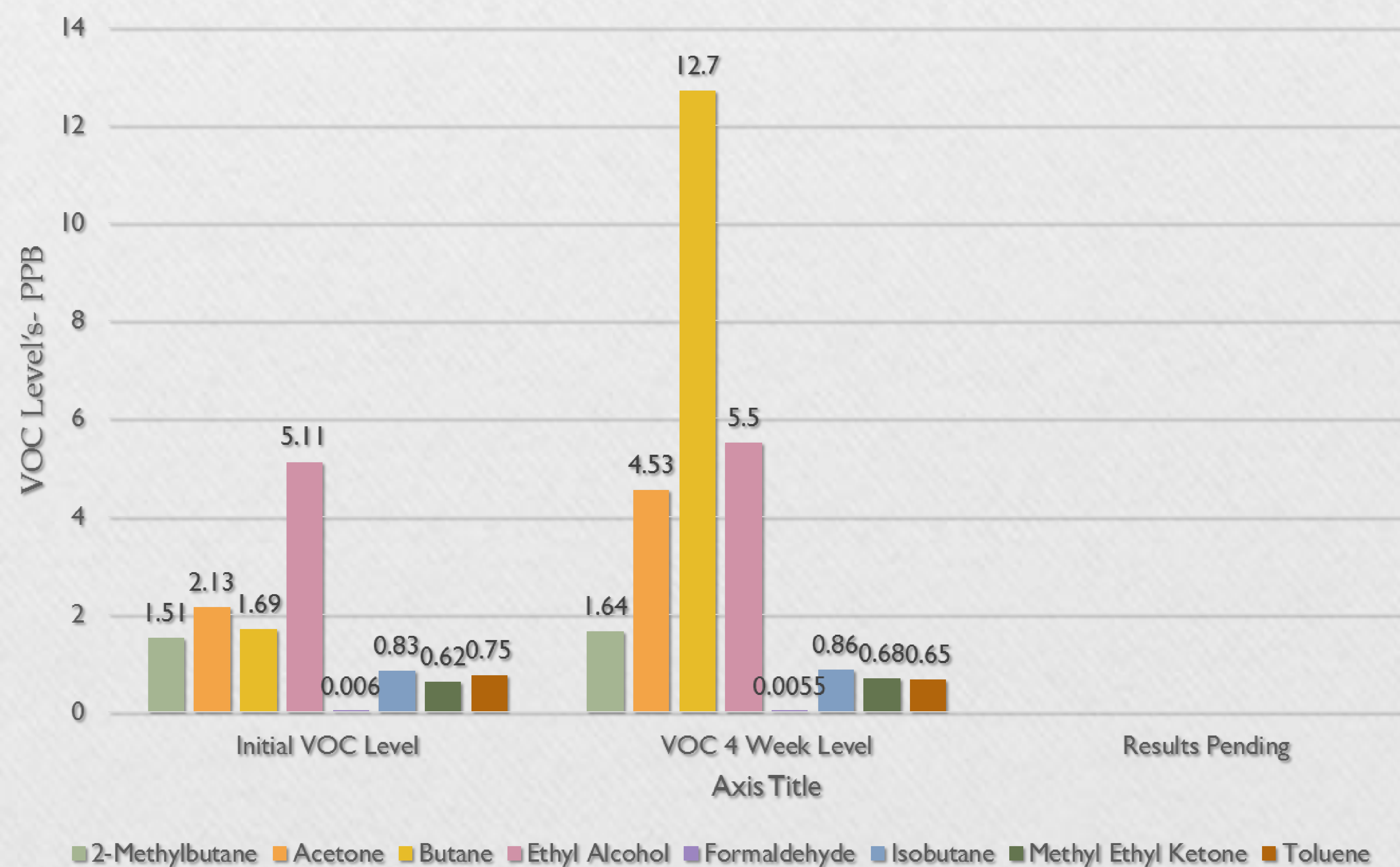
Golden Pothos
Epipremnum aureum



VOC levels in the Newer Building



VOC Levels in the Older Building



Discussion

- "OSHA sets enforceable permissible exposure limits (PELs) to protect workers against exposure to hazardous substances above the limits on the amount or concentration of the air."⁶
- The majority of VOC levels in both buildings were reduced by the 4th week.
- An increase in levels during the 6th week in the newer building (2008) may be due to temperature as well as increased occupancy.
- An increase in levels during the 6th week in the older building (1976) may be due to temperature, proximity to construction, and items brought into the offices, and items brought into the offices.
- Limitations to the study include temperature regulation, sunlight, proximity to construction, and items brought into the offices, and items brought into the offices.

Conclusion

- Since planet Earth's clean air is being polluted by green plants, the concept of decontaminating the inside of tightly sealed buildings by adding indoor air has a valid scientific basis.
- Environment is the umbrella of the Nightingale theory of nursing. The environment could be improved to improve conditions so that healing would allow healing to occur.
- With the use of this nursing theory, advocates for the people that work in buildings and ensure that they take necessary steps to be healthy. Nurses play an important role in education; therefore, nurses should incorporate techniques into their professional practice.

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Introduction

- According to Florence Nightingale, "the connection between health and the dwelling of the population is one of the most important that exists."¹
- In the United States, people spend approximately 90% of their time indoors with a typical work week consisting of 40 to 50 hours, frequently exposing them to indoor air pollutants, including volatile organic compounds (VOCs), some of which can cause short-term and long-term adverse health effects².
- VOCs are also constituents in what has been termed sick building syndrome, which can cause health effects including headache, nausea, irritation of eyes and mucous membranes, fatigue, asthma, coughing, wheezing, nausea, and skin irritation. Other long term effects include possible genotoxicity, abortion, still birth, congenital abnormalities, premature birth, leukemia in children, and Alzheimer's Disease, CNS depression, tremors, and cerebral atrophy^{3, 4, 5}.

Purpose

- To determine the effect of adding indoor plants to offices on decreasing the level of indoor VOCs and formaldehyde.

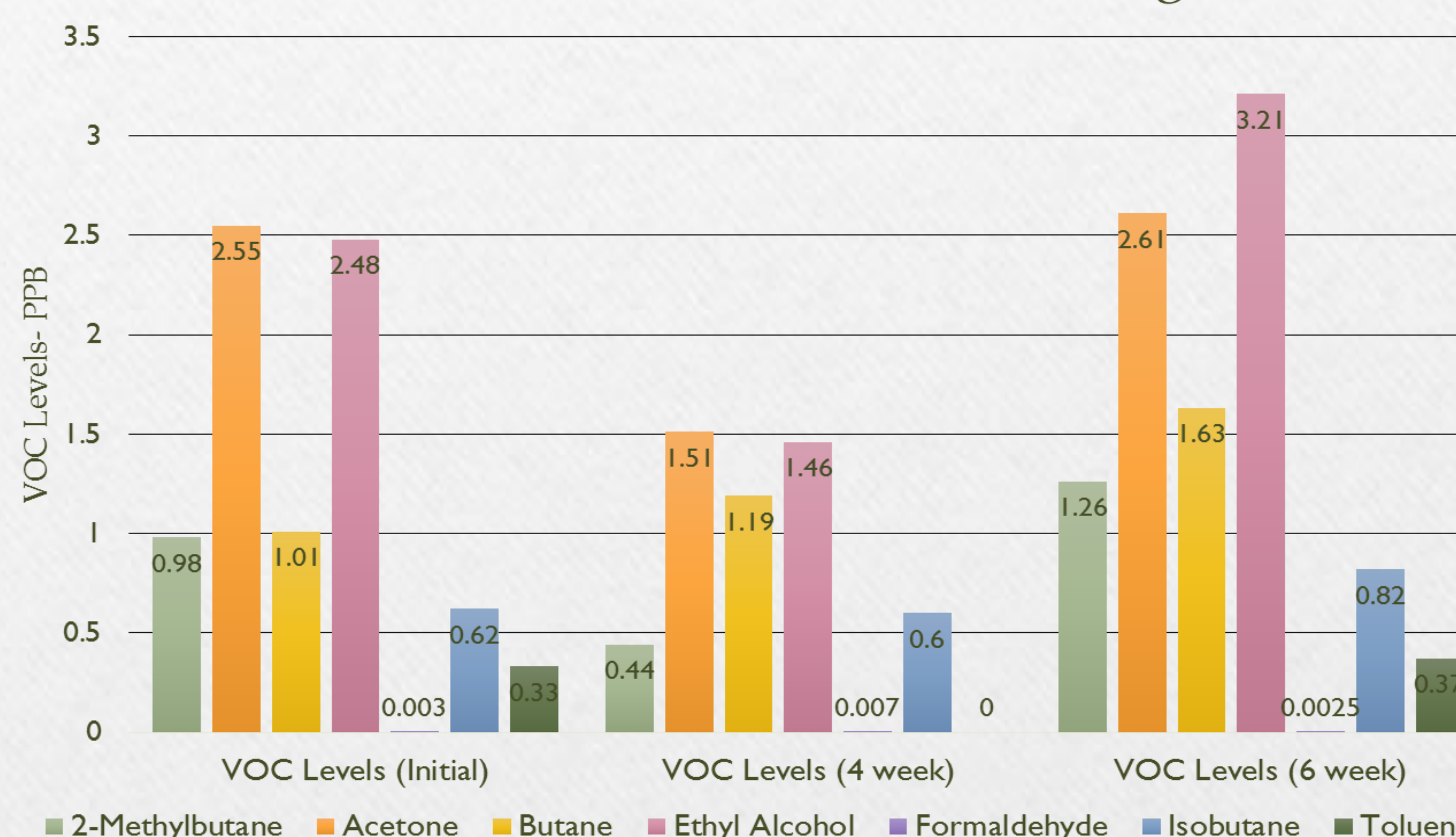
Method

- In a recently constructed building (2008) and an older building (1976), on a college campus in the Southeastern part of the United States, initial VOC levels were tested in four separate faculty offices.
- One Organic Full Scan Vapor Monitor (Advanced Chemical Sensors, Inc.), which measures 81 VOCs, was placed for 120 hours in each office before adding plants.
- One Formaldehyde Vapor Monitor (Advanced Chemical Sensors, Inc.) was placed for 48 hours in each office before adding plants.
- The monitors were placed in the offices, four and six weeks after adding plants.
- Each monitor was placed on top of a cabinet, four feet from the ceiling.
- Three plants were placed in each room including: Dieffenbachia, Ficus elastic, and Golden pothos (Epipremnum aureum).
- Monitors were sent to the Advanced Chemical Sensors lab, 2-3 days after collection for VOCs and formaldehyde analysis.

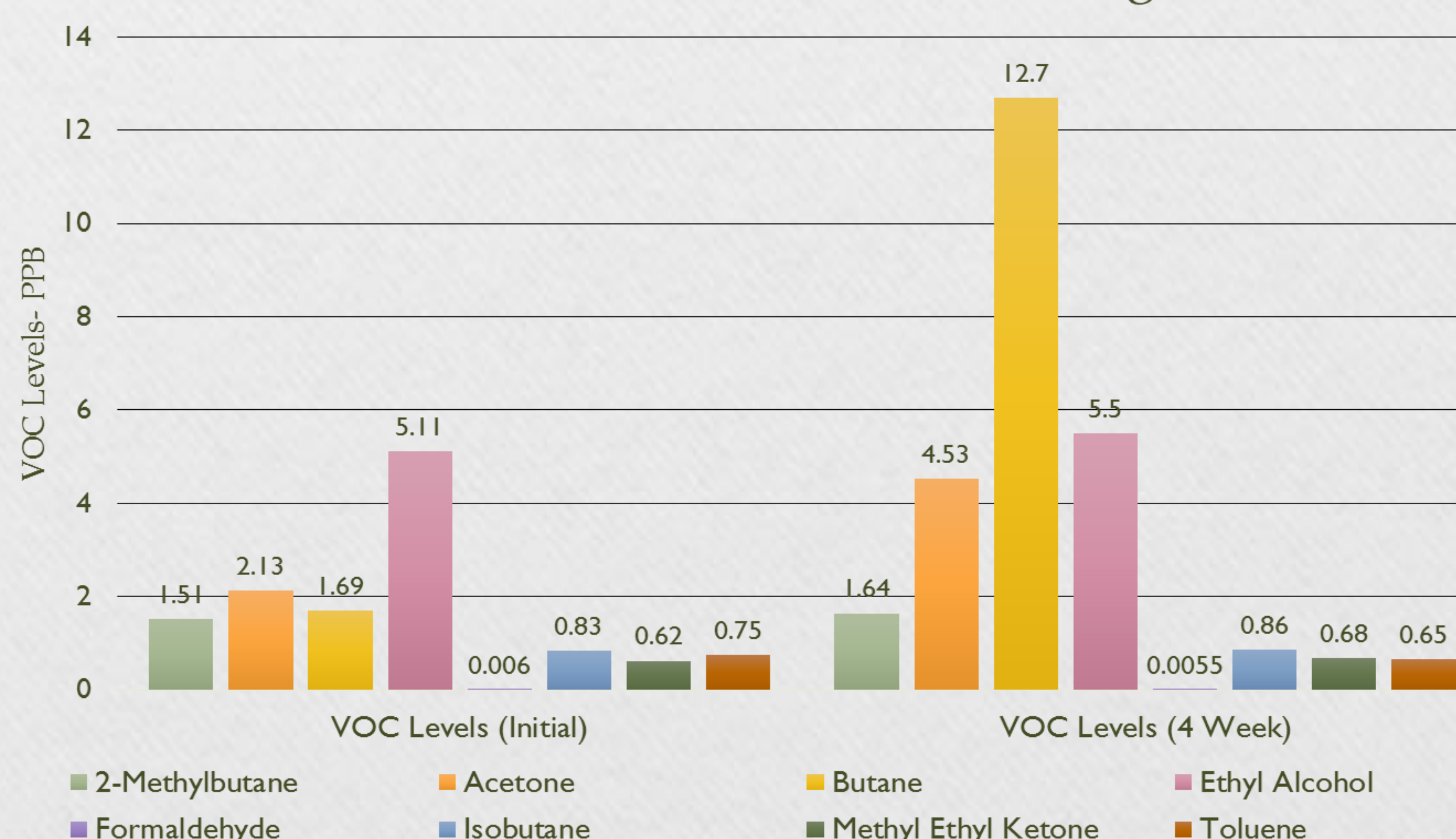
Analysis

- The majority of VOC levels in both buildings were reduced by the 4th week.
- Newer building's VOC levels that decreased by the 4th week are 2- Methylbutane, Acetone, Ethyl Alcohol, Isobutane, Toluene. Increases were seen in Butane and Formaldehyde. By the 6th week an increase was seen in all measured VOC level's.
- Older building's VOC levels that decreased by the 4th week are Formaldehyde and Toluene. Increases were seen in 2-Methylbutane, Acetone, Butane, Ethyl Alcohol, Isobutane and Methyl Ethyl Ketone. Results are pending for the 6th week VOC level's.
- Results are reported as Parts Per Billion (PPB).

VOC Levels in the Newer Building



VOC Levels in the Older Building



Discussion

- "OSHA sets enforceable permissible exposure limits (PELs) to protect workers against the health effects of exposure to hazardous substances. PELs are regulatory limits on the amount or concentration of a substance in the air."⁶
- The majority of VOC levels in both buildings were reduced by the 4th week.
- An increase in levels during the 6th week in the newer building (2008) may be due to a rise in outdoor temperature as well as increased sunlight exposure.
- An increase in levels during the 4th week in the older building (1976) may be due to a newly constructed building approximately +-50 feet away from the tested offices.
- Limitations to the study include the following: temperature regulation, sunlight exposure, close proximity to construction, amount of traffic in and out of the offices, and items brought into the offices.

Conclusion

- Since planet Earth's clean air originates from living, green plants, the concept of designing houseplants inside tightly sealed buildings to purify and revitalize indoor air has a valid scientific basis⁷.
- Environment is the umbrella concept in the Nightingale theory of nursing. It was her contention that the environment could be altered in such a manner as to improve conditions so that the natural laws would allow healing to occur⁸.
- With the use of this nursing model, nurses can be advocates for the people that work in office buildings and ensure that they take necessary precautions to be healthy. Nurses play an important role in patient education; therefore, nurses can incorporate teaching about the health risks of VOCs and reduction techniques into their profession.

References

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