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 the plant that exists.”
People spend approximately 90% of their time indoors, working, eating, or relaxing, frequently exposing them to indoor air pollutants, including volatile organic compounds (VOCs), some of which can cause short- and long-term health effects.

Purpose
The purpose of this study was to determine the effect of adding indoor plants to decrease the level of indoor VOCs and formaldehyde analysis.

Method
Two buildings (2008) and one older building (1976) may be due to a rise in outdoor temperature as well as increased proximity to construction, amount of traffic in and out of the offices, and items brought into the offices.

Three plants were placed in each room including:

- Rubber Fig Ficus elastica
- Dumb Cane Dieffenbachia
- Golden Pothos Epipremnum aureum

VOC levels in the Newer Building

VOC levels in the Older Building

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.

Discussion
- OSHA sets enforceable permissible exposure limits (PELs) to protect workers against exposure to hazardous substances. PELs are regulatory limits on the amount or concentration of a substance in the air.
- The majority of VOC levels in both buildings were reduced by the 4th week.
- An increase in levels during the 4th week of the newer building (2008) may be due to a rise in outdoor temperature as well as increased proximity to construction, amount of traffic in and out of the offices, and items brought into the offices.
- Limitations to the study include the following:
  - In the United States, people spend approximately 90% of their time indoors, working, eating, or relaxing, frequently exposing them to indoor air pollutants, including volatile organic compounds (VOCs), some of which can cause short- and long-term health effects.
  - The majority of VOC levels in both buildings were reduced by the 4th week.
  - An increase in levels during the 4th week of the newer building (2008) may be due to a rise in outdoor temperature as well as increased proximity to construction, amount of traffic in and out of the offices, and items brought into the offices.

References
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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 atrophy3-4-5.

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 levels.

• 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 levels.

• Results are reported as Parts Per Billion (PPB).

Discussion

• “OSHA sets enforceable permissible exposure limits (PELs) to prevent worker's against the health effects of exposure to hazardous substances. PELs are regulatory limits on the amount or concentration of a substance in the air."6-7

• 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 5-10 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 basis.

• 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 occur.

• 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


