SICK BUILDING SYNDROME TREATMENT PLANT USING

TRATAREA SINDROMULUI CLADIRILOR BOLNAVE CU AJUTORUL PLANTELOR

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Abstract. *We daily breathe about 12 cubic meters of air, coming almost entirely in enclosed spaces where we spend about 80% of the time. These rooms evolve themselves or objects / installations that contain, a large amount of harmful substances. Plants can be very effective in treating the "sick buildings syndrome" - disease that is manifested by headache, cough, dizziness, lack of concentration, etc. and whose main cause is contamination with pollutants off some buildings (pollution by chemicals, electromagnetic waves, poor ventilation,etc.). In this context, this paper aims to investigate some ways we can purify the indoor air.*

Key words: air quality, depolutant plants, sick building syndrome (SBS).

Rezumat: *Zilnic respirăm circa 12 mc de aer, care provin aproape în întregime din spaţii închise, în care ne petrecem 80% din timp. Aceste încăperi emană, ele însele sau obiectele /instalaţiile pe care le conţin, o cantitate mare de substanţe nocive. Plantele pot fi foarte eficiente în tratarea sindromului clădirilor bolnave "sick buildings syndrome" – afecţiune ce se manifestă prin dureri de cap, tuse seacă, ameţeală, lipsa de concentrare etc. şi a cărei cauză principală este contaminarea cu poluanţi a anumitor clădiri (poluare prin substanţe chimice, unde electromagnetice, proasta ventilaţie, etc). În acest context, prezenta lucrare îşi propune să investigheze câteva modalităţi prin care putem transforma spaţiile închise în spaţii cu un aer mai curat.*

Cuvinte cheie: calitatea aerului, plante depoluante, sindromul clădirilor bolnave (SCB).

INTRODUCTION

Environmental quality is a major issue of concern to humanity at all levels of activity.

Although we care about the planet's health, would be good if, in the same time, we are working to keap our health and health of the areas in which we live and work.

We daily breathe about 12 m^3 of air, coming almost entirely indoors, where we spend 80% of the time. Given that these spaces evolve (themselves or objects they contain) a large amount of harmful substances in these work we intend to investigate ways in which to purify the air in buildings (http://eco-notes.over-blog.com/article-30321522.html).

Meeting hygiene, health and the environment requirements is directly related to areas of building ventilation, which allows:

- Discharge of harmful substances and maintain optimal levels of oxygen in the air;

- Maintenance of favorable levels of humidity and temperature;

- Reducing the concentration of radioactive aerosols (in rare cases).

If in the mainstream construction, buildings were provided with stoves connected to chimneys, which could retrieve and remove the nuisance of rooms and permeability of wood joinery windows allow an easier absorption of fresh air, in our days is not eligible for these conditions. Since been dropped heating stoves and chimneys default and traditional wood joinery is replaced with sealed glass windows with frame type PVC or wood, room ventilation is not only possible by opening windows, thus losing an excessive amount of heat in the winter season, resulting in additional energy consumption.

Settlement building ventilation is essential as is done for several generations, and initial solutions are hard to correct erroneous. Thus it became necessary that appropriate studies and projects to determine at the outset the possibility of natural or artificial ventilation, first way is preferred since it is not involves additional consumption of electricity. There are three categories of ventilation which may be provided separately or together, from the design phase of buildings:

• Natural ventilation - provided by temperature and pressure difference between inner and outer space, and / or by wind action, so the air entering or exiting through windows, leaks, holes and channels (Ştefanescu D., Velicu Cr., 2009);

• Mechanical ventilation - provided by the action of electro-mechanical equipment that causes forced movement of air currents;

• Joint ventilation - using both ways, continuously or intermittently.

Our concern relating to air quality that we breathe the plan remains generally two, especially because we consider ourselves safe from outdoor pollution, in our clean houses or offices, mostly by mechanical ventilated and humidified . Most people ignore the fact that these devices conditioning and / or humidification of air develops a number of microorganisms that cause respiratory illness to occupants of buildings (Chaudet Geneviève, Boixière Ariane, 2007).

Scientific studies have shown that there is a natural means of purification, cooling and humidifying the air, without some of the negative impact of modern technology. These usages of plants as living organisms to decontaminate indoor air. Since the 70s, when research is done first, and by the 90 air purification by plants becomes more widespread, experiments in this connection being made worldwide. Is discovered, inter alia (among other things), that plants can be very effective in treating sick building syndrome "sick buildings syndrome - condition that is manifested by headache, dry cough, dizziness, lack of concentration etc.. and whose main cause is contaminated with pollutants certain buildings (pollution by chemicals, electromagnetic waves, poor ventilation, etc.).

Other examples of application of "bio-cleansing" are organic gardens of some hospitals in Japan (where outside air purification plants have a beneficial

psychological effect on patients), or plant city walls which were intended to reduce noise and air pollution (http://eco-notes.over-blog.com/article-30321522.html).

MATERIAL AND METHOD

The concept of "indoor air quality" originally appeared in the U.S., in 1975, with studies conducted by Bill Wolverton, a research chemist, environmental scientists employed by NASA to study air quality from space for the crew of space rockets. Bill Wolverton was the first scientist who measured the influence of plants on air space where they are and their ability to absorb various chemicals. By creating the first biofilter (plant + an activated carbon vessel containing microorganisms) he realized that the whole plant involved in the process of air purification (both leaves and roots and microorganisms attached to his roots) and that some plants are more efficient than others in the absorption of pollutants (Wolverton B. C., 2007).

His work has inspired scientists around the world, from Canada and Europe. In the '90s, Germany and Switzerland are involved in research on the absorption of air pollutants by plants. In France, we studied whether the formation of an observer of air quality, but that will be created in 2001. Its mission was to conduct sampling of indoor air for analysis. In the Loire region, a group of enthusiasts (landscapers, architects, environmental consultants, florists, gardeners ...) create an association "Plant'Air" takeover of the association to target U.S. "Clean Air Council" that promotes the right of all fresh air.

In 2001, was born the 'Phytair, a meeting between the Faculty of Pharmacy of Lille, Association Plant'Air and Scientific and Technical Center Building (CSTB). In 2007 the program aims to establish a methodology to evaluate processes to remove volatile organic compounds, has been completed (http://www.lanutrition.fr/imprim_article.php?article=2862&dossier=29).

In this context, this paper aims to investigate some ways we can transform the enclosed spaces in areas with cleaner air.

RESULTS AND DISCUSSIONS

How does bio-treatment?

• through photosynthesis - the "equation of photosynthesis" follows: carbon dioxide + water + light energy → glucose + oxygen

• through perspiration - increases moisture in the atmosphere, increasing air quality limits

• the capture and storage in tissues of the leaves and roots of volatile toxic substances that surround them

• the absorption of toxic substances by microorganisms existing around plant roots (http://eco-notes.over-blog.com/article-30321522.html).

Many chemical pollutants are invariant almost any interior space, with serious health effects. Relatively recent studies (Chaudet Geneviève, Boixière Ariane, 2007) presents a complete list of pollutants that can be stored in our homes: volatile organic compounds (benzene, formaldehyde), fibers, mold, carbon monoxide and phthalates present in carpets, insulating walls, paint, paints and cleaning products, etc.. Although there are many sources of indoor pollution, studies have focused mainly on the solution to remove pollutants with plants.

The following volatile organic compounds (VOCs) in indoor meet frequently, evolve the Reversi pieces of furniture or household objects: formaldehyde, benzene, toluene, xylene and glycol ethers. Along with her other indoor air pollutants would be: carbon monoxide, phthalates, insecticides, mosquito products / ants, wood preservative products, mildew, mineral fibers. Also contributes to pollution rooms electromagnetic fields released from various devices currently used.

Table 1

Green filters to remove contaminants to various plants after 24 hours (%)

Plant	Formaldehyde	Benzol	Trichloroethylene
Banana	89	–	–
Bowstring hemp	–	53	13
Chrysanthemums	61	54	41
Dracoena dereménsis (Janet-Craig)	–	78	18
Dracoena dereménsis (Warneckii)	50	70	20
Dracoena dereménsis (massangeana)	70	–	13
Dracoena dereménsis (yellow-variegated)	–	79	13
True aloe	90	–	–
Ivy	–	90	11
Devil's ivy	67	73	9
Spathe flower	–	80	23
Creeping hairy spurge	67	–	–
Ficus benjamina	–	–	11
Gerbera	50	68	35
Green lily	86	81	–
Chinese evergreen (Aglaonema)	–	48	–
Philodendron (domesticum)	86	–	–
Philodendron (oxycardium)	71	–	–
Philodendron (selloum)	76	–	–

In the context of green building, would be ideal, just use green plants to achieve and maintain comfortable room temperatures and humidity and to remove contaminants, without recourse to technical or mechanical means. Extent that this may be possible has been studied at ETH Zurich, referring to a previous research project at NASA. Studies have targeted the plant due to evaporation - cooling by evaporation process, the production of oxygen and removal of contaminants (http://www.lanutrition.fr/imprim_article.php?article=2862&dossier=29). NASA studies on different plants on contaminant removal formaldehyde, benzene, trichlorethylene.

The table 1 shows the rates of elimination of these substances, the percentage for different plants, after 24 hours. It is notable that the removal is initially rapid but slows after a period of two hours. Cologne Botanical Institute is currently exploring the ability of plants or micro-organisms in the soil to purify room air. Despite the measurements, is still unclear whether elimination process reaches a saturation point, in other words, if it falls significantly or even cease altogether after a few days because all studies so far have been conducted for a period of 24 hours (Hindrichs D. U., Daniels Klaus).

To determine the real behavior of plant long-term studies are needed.

According to information from the table above (table 1), some plants are particularly well adapted to remove contaminants. For example, one day in an office, a species of ivy is able to remove 90% of benzol content delivered by tobacco smoke, synthetic fibers, or dyes and plastics. *Aloe vera*, banana, spider plants and philodendron are effective against the agents of formaldehyde from foam insulation and particle board. Trichlorethylene in lakes and glues are better removed with *Chrysanthemum* and *Gerbera*.

Experiments have clearly demonstrated that not plants themselves but the roots of plants and symbiotic microbes in the root system are largely responsible for removing the contaminants.

Figure 1 shows the moisture released by the one of plants in the study, all of them suited to use in office and living areas, depending upon surrounding temperature and humidity as well as the illumination strenght in lx, SI unit of illumination. All the plant give off more moisture in relation to illumination strenght, i.e. the brighter the room the more moisture is released by the plants.

Higher surrounding temperatures further encouraje the moisture is released by the plants, is in some circumstances, negligible. The volumes of moisture release indicated in the diagrams correspond to a water volume of g/mp leaf surface. To better appreciate the dimensions involved, imagine that approx. 1mp of ivy leaf surface corresponds to approx. 5% of the wall surfaces in a average office room. The evaporated volumes of water differ greatly from plant to plant. Peak values exist for the papyrus plant, which evaporates approximately 2,000g of water per day when the plant is approx. 1.5m high.

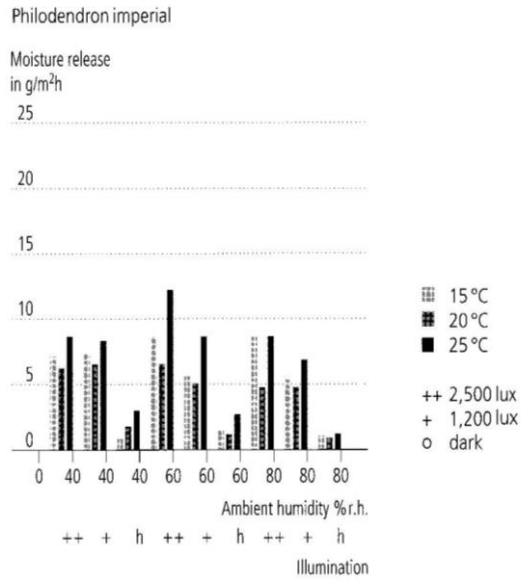

Fig. 1. Moisture released by plants, depending on surrounding temperature and humidity as well as the illumination.

Regarding humidifiers, plants are better than agents humidifiers air powered, even combined with air-conditioning systems, because vegetation does not provide a favorable ground for breeding bacteria.

To determine which plants are able to create a healthy climate chamber studies were performed with five different types of plants. The research team examined the quantities of water evaporated from plants such as *Ficus benjamina,*

Hedera helix, *Dizygotheca castor*, *Dracena*, *deremensis* "Warneckii and imperial *Philodendron* (Hindrichs D. U., Daniels Klaus).

CONCLUSIONS

It was found that plants can only create a loss due to temperature during the summer when all the surrounding areas, except windows, are covered by a large percentage of indoor green plants. However, plants should be used more in future buildings as the overall effects are certainly positive, especially the psychological effect of green plants on the occupants. Experiments have revealed the fact that plants need an environment that provides more than the minimum level of survival (i.e. compensation point between photosynthesis and respiration). This can be achieved by proper choice of the most resistant plants and locations and combining plants that have longer life expectancy. Light source as photosynthesis, plants should be used particularly well naturally lighted spaces, for example, the winter garden atrium sites in windowed office space in hallways and large rooms, open, etc. When lighting conditions are poor, when the plants are forced to grow in an environment less than the compensation point, they start to fade and die after some time (Hindrichs D. U., Daniels Klaus).

Tests and studies have shown that not all plants have the same power of the air filter, not all absorb the same pollutants and not all moisten at the same proportion. Also, each room of the house has some pollutants in excess of other plant so a sharing of the rooms is very useful.

Because experiments were done on a limited number of species, yet detailed studies are needed to detect both specialization and potencies of several species.

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