

A CRESTech-supported Research Project

# Indoor Air Biofilters



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## PROJECT HISTORY

North Americans spend over 85% of their time indoors. With increasing energy costs, the maintenance of an adequate indoor condition is becoming **very expensive**. Since 1996 the University of Guelph has investigated biofiltration as an alternative means of indoor air quality control. In 2001, Dr. Alan Darlington (a co-investigator on the project) was awarded the **Martin Walmsley Fellowship** to commercialize the technology.

## THE PROBLEM

- Canada has an extreme climate
- To provide adequate environment, buildings are air tight



Canada has harsh cold winters.

- Sealing the building allows contaminants to accumulate
- Contaminants arise from materials used indoors

PRODUCT	TVOC EMISSION FACTOR (24 hr) mg m <sup>-2</sup> h <sup>-1</sup>
Office Furniture (workstations)	12 - 17 (mg/WS h)
Office Chairs	0.2 - 7.2 (mg/chair h)
Carpet	0.02 - 1.2
Floor Adhesives (Low VOC)	0.8 - 2.3
Latex Paint	2.1
Vinyl Composition Tile (VCT)	0.03 - 16.0

Some emission levels from "Low-Emitting" products (Black, 1997)

- If not removed, contaminants may accumulate to the point of influencing the **well-being** of occupants

PRODUCT	COMMON VOCs
Wall Coverings	TXIB, Naphthalene, Toluene
Floor Coverings	Styrene, 2-Ethyl-1-hexanol, Trimethylbenzenes
Paints	Propylene glycol, Butyl propionate, Butanone
Textiles	Formaldehyde, Hexanal, Nonanal
Ceiling Tile	Formaldehyde, Acetic acid, Hexanal
Office Furniture	Formaldehyde, Acetone, Cyclohexanes

VOCs frequently found indoors and their sources (Black, 1997)

## Traditional Solution

- Contaminants removed by ventilation
- Displace indoor air with new outside air
- This new air is often too hot or cold,
- Air must be 'conditioned' before use
- Requires considerable energy and cost

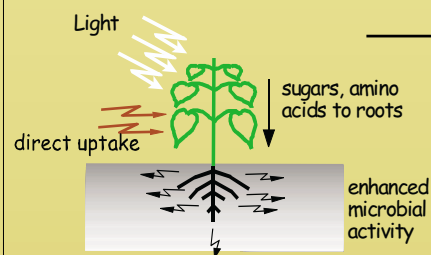
## THE SOLUTION

- BIOFILTRATION of Indoor Air

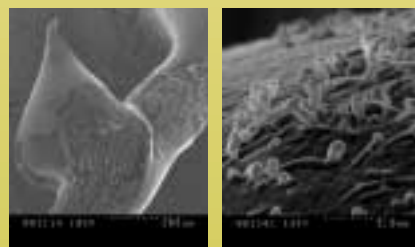
## HOW DOES IT WORK?

- Air drawn through wet "biomass"
- Contaminants move from air to water
- Broken down by biologicals
- Green plants improve effectiveness
- Reduces need for outside 'fresh air'

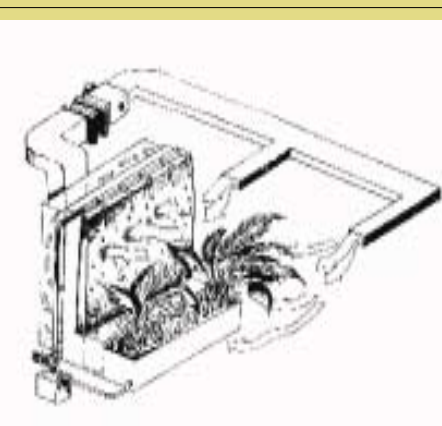
A concept drawing of the biofilter initially being produced. Air is cleaned by drawing it through the plant covered walls by an on-board fan system. The cleaned air is returned to the room out of the top of the unit. This cleaning process reduces the need to go outside to get 'fresh air' to maintain indoor air quality



Plants improve the efficiency of the biofilter through direct uptake of pollutants and improving microbial activity.



Living plants such as moss (shown on the left) are used as packing material for the biofilters. The plants can remove some pollutants but the bulk of the degradation is due to microbes that cover the plant surface as shown on the right.



An artist representation of our original research venue at the **Canada Life Environmental Room** (Toronto, ON). Air from the room is drawn through the biofilter and then returned to the room. (Drawing courtesy of Canada Life Assurance)



Our initial research venue at CANADA LIFE ASSURANCE Toronto Head office commissioned with semi-tropical house plants.



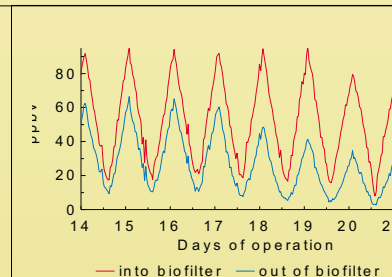
The new biofilter being constructed at NORCAT (Northern Centre for Advanced Technology) in Sudbury Ontario. This biofilter was commissioned with northern Boreal species.

## THE BENEFITS OF BIOFILTERS.

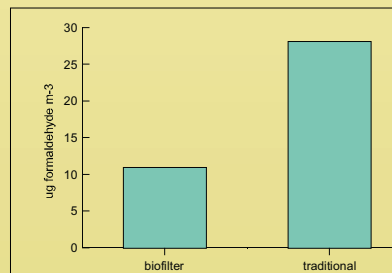
- Improved air quality
- Reduced energy consumption
- No hazardous waste disposal issues
- Easily retrofitted into existing building
- Aesthetic appeal
- Wide range of application
- A safe technology
- Airborne spores not a problem

## HOW WELL DOES IT WORK?

- Contact time less than 1 second
- Single pass removes
- >90% formaldehyde
- >50% toluene
- May require some acclimation
- Able to remove 'new' VOCs without changing system
- Able to maintain air quality in 'sealed' indoor spaces



The removal the VOC MEK as it passes through the biofilter during the start-up phase of operation



The impact of biofilters on the formaldehyde levels in indoor spaces

## WHAT SIZE OF BIOFILTER IS NEEDED?

- Depending the site, 1 m<sup>2</sup> of biofilter will cleanse between 50 and 100 m<sup>2</sup> of floor space
- For larger areas, multiple biofilters can be used or larger custom units can be designed

## CURRENT PRODUCTS

- Onboard air-handling system
- 4 m<sup>2</sup> of 'biofilter'
- 75 litre aquarium
- 0.5 m<sup>2</sup> of hydroponic planting
- Automated controls

## FUTURE PRODUCTS

- Industry
- Agriculture
- Residential
- Large scale systems
- Military
- Space

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