

# IAQ

## Proof Of Concept (POC)

– Cross-contaminations | Surface BIOFILMS

IAQ | PM 2.5,10 | VOCs | Formaldehyde | Ozone

### 202 Case Study – IAQ, Mumbai

#### PROJECT INFORMATION:

Site: Corporate Office, Mumbai.

POC By: Team Chemtronics &  
Team Airfab

#### SOLUTION

*Penetrate & Treat*

#### DATE OF EXPERIMENT:

27.07.2021 to 28.10.2021

(3 months)

Testing Lab: Equinox Labs  
(NABL Accredited)

#### Test Parameters:

Surface:

Total Bacterial Count (TBC)

Air:

Total Bacterial Count (TBC).

PM 2.5, PM 10, CO2, VOCs,  
Formaldehyde & Ambient Ozone.

Experiment Location: Office

Workspace Area: 2,250 sq.ft

#### OBJECTIVE:

Is to verify the performance of ECOBOI on Indoor Air Quality (IAQ), cross contaminations & Surface BIOFILM for the safety & comfort of the office staff and environment. At the same time, observe the harmful chemical residues in the indoor environment, like TVOCs, Formaldehyde, CO2, and Ambient Ozone.

#### EXPERIMENT PROTOCOL:

**Step 1:** Collect initial (without any treatment) surface & air sample as a reference before starting the ECOBOI generator.

**Step 2:** Start the ECOBOI generator & collect the test data after 30 days & 90 days from the date of installation & commission.

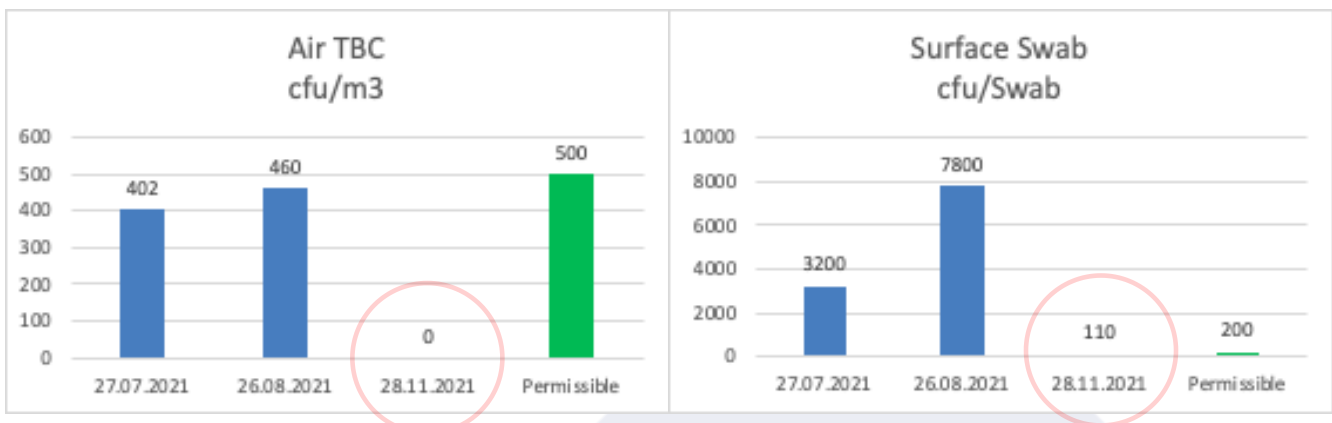
**Step 3:** Summarise all collected data in tabular form & generate the report.

## EXPERIMENT ANALYSIS SUMMARY:

Sample Collected by Equinox Lab (NABL Accredited)									
Sampling Location	Parameters Date	Air TBC	Surface Swab	PM 2.5	Pm 10	CO2	TVOC	Formaldehyde	Ambient O3
	Units	cfu/m <sup>3</sup>	cfu/swab	ppm	ppm	ppm	ppb	ppm	ppm
	Limits	500	200	35	150	5,000	500	2	0.1
Open Work Space	27.07.2021	402	3,200	143.91	177.06	400	213	1.3	0
	26.08.2021	460	7,800	32.9	64.06	500	0	0	0
	28.10.2021	0	110	0.43	0.45	800	0	0	0

## OBSERVATION:

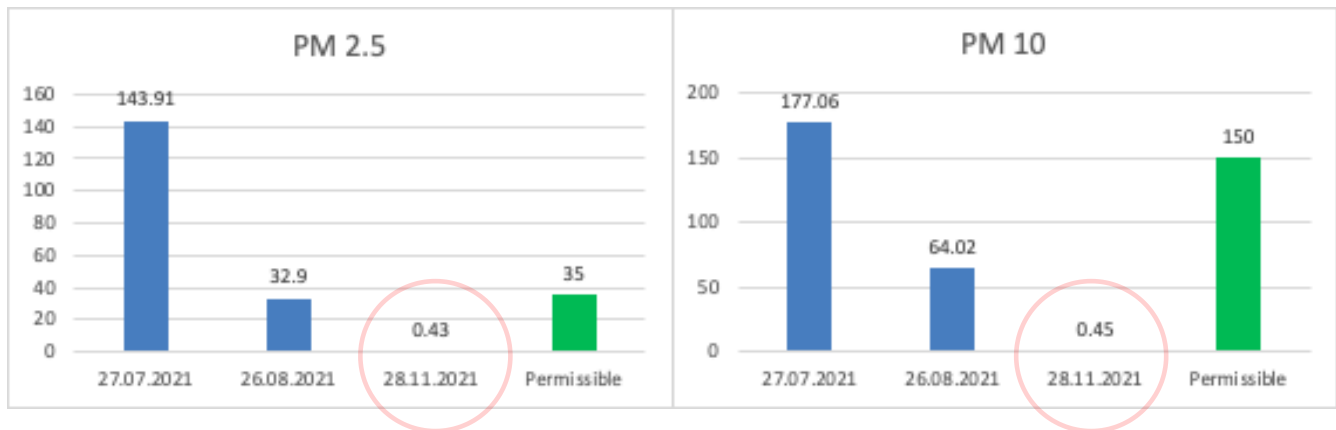
### a. Air & Surface Microbiological colonies:



Microorganisms are the root cause of the cross contaminations. Initial Total Bacterial count in air & surface were 402 cfu/m<sup>3</sup> and 3,200 cfu/swab respectively. After 30 days of operation of ECOBOI, the hidden bacteria & viruses under biofilm got exposed & the count increased to 460 cfu/m<sup>3</sup> & 7,800 cfu/swab respectively of air & surface. The increase of TBC on the surface is due to oxidation of BIOFILMS & microorganisms got exposed. With continual oxidation, the air count of total bacteria reduced to zero cfu/m<sup>3</sup> & surface count reduced to 110 cfu/swab. Permissible count of TBC in air is 500 cfu/m<sup>3</sup> & on surface is 200 cfu/swab.

The root cause of cross-contamination is bacteria & viruses. The bacteria grow & multiply under the protective layers of BIOFILM. Refer to Annexure 01, which explains the life cycle of BIOFILM & can be seen how bacteria are protected under the BIOFILM even after chemical cleaning.

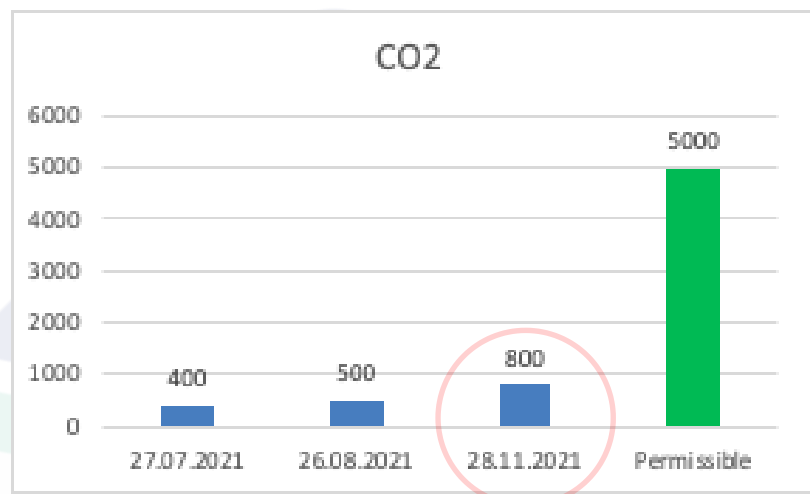
## b. Particulate Mattres PM 2.5 & PM 10:



PM stands for Particulate Matters in the ambient air; these are colloidal suspended particles. PM 2.5 is smaller than or equal to 2.5 microns in size, and PM 10 is smaller than 10 microns. Initial observation of PM 2.5 & PM 10 were 143 ppm & 177 ppm respectively. These levels decreased to 0.43 ppm & 0.45 ppm, respectively, over 90 days, which is a significant reduction measuring 99.70 % & 99.97 %. Prescribed levels of PM 2.5 & PM 10 for good IAQ are 35 ppm & 150 ppm. This significant reduction is due to the combined effect of Bipolar Oxygen Ions & air filters. Control of PM 2.5 & PM 10 helps reduce allergies & the surfaces where microorganisms like bacteria, viruses, mould and spores can stick.

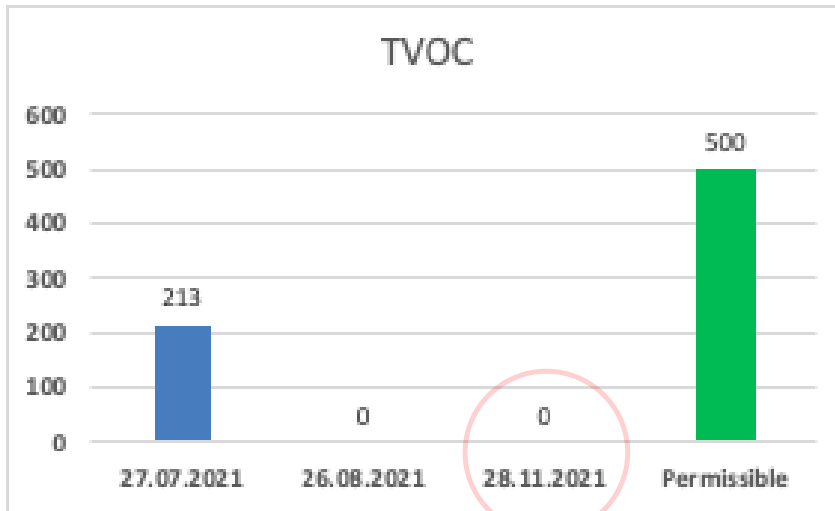
## c. Carbon Dioxide (CO<sub>2</sub>):

CO<sub>2</sub> stands for Carbon Dioxide levels in the indoor atmosphere. The primary source of indoor CO<sub>2</sub> is the air exhaled by humans. Initial readings of CO<sub>2</sub> level was 400 ppm & these levels gradually increased to 500 ppm in 30 days & 800 ppm in 90 days. This is due to the presence of staff, who are releasing CO<sub>2</sub>. The safe indoor permissible levels by OSHA are 5,000 ppm. Generally, good indoor CO<sub>2</sub> levels should be below 1,200 to 1,500 ppm depending on the



activities and no. of occupants per unit area. CO<sub>2</sub> can not be treated, it has to be replaced by oxygen in the fresh air, and the equivalent quantity of CO<sub>2</sub> should be exhausted. Oxidising chemical contaminations reduces the oxygen demand & more oxygen is left out, which is suitable for the occupants. Increased CO<sub>2</sub> levels can reduce an individual's concentration and drowsy, dizzy, have headaches, and visual & hearing disfunction,

#### d. Total Volatile Organic Carbon (TVOC):

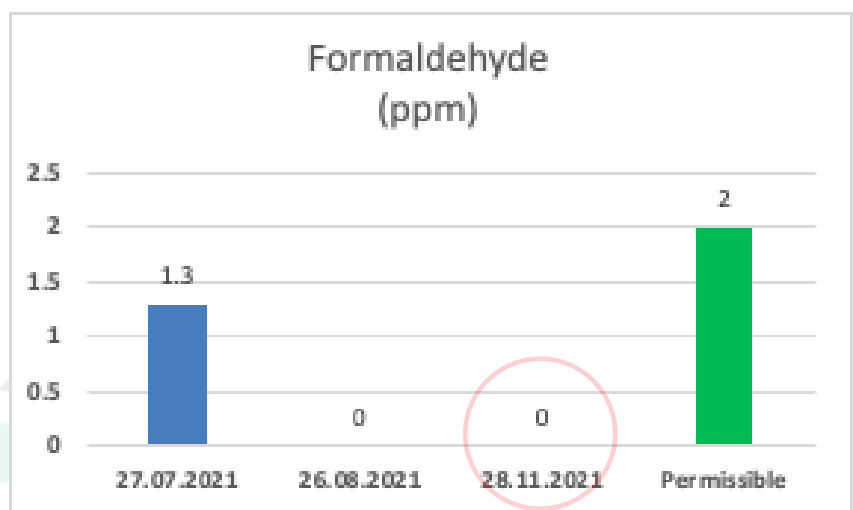


VOC is a cumulative value of all diversified organic volatile chemical fumes, pest control chemical fumes, housekeeping Chemical fumes, paint, varnish adhesives, synthetic interior materials, body odour, ointment, perfumes, other personal care chemicals. The initial level of TVOC was 233 ppb. With the continuous operation of ECOBOI, TVOC levels are maintained as low as zero. Permissible levels for

The indoor atmosphere is 500 ppb. There are estimated more than 5,000 known different kinds of VOCs. These VOCs can pose mild to severe health disorders and discomfort and irritation to the eyes, skin, throat & mucus membrane. These include allergies, vomiting, nausea, headache & many more. Sick Building Syndrome (SBS) is commonly known for VOCs adverse effects.

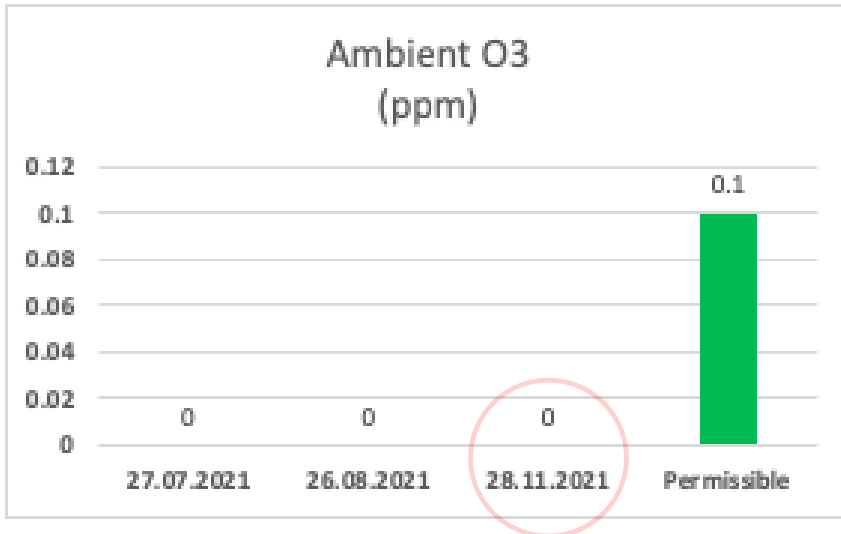
#### d. Formaldehyde:

Formaldehyde is a colourless and irritating toxic gas. It is easily soluble in water and methanol. Before the start of ECOBOI was 1.3 ppm, which eventually became zero with control oxidation from ECOBOI. The permissible limits are 2.0 ppm. It has a disinfecting and antiseptic effect, which also has a stimulating effect on human mucosal tissue. When up to a specific concentration,



It stimulates the eyes, nose and throat, coughing, fatigue, rash, and allergies will occur. The primary indoor sources of emissions are pressed wood products, adhesives, particle boards, medium-density fibreboard, and other finishing materials. In addition, burning cigarettes and other combustion sources, such as gas stoves, fire water heating devices, or certain consumer goods such as paper products and cosmetics, will also emit formaldehyde.

### e. Ambient Ozone O3:



Ozone has three molecules of oxygen, ozone is also called a nature's cleaning and disinfection agent. The greatest advantage of ozone is that its by-products are harmless to humans & the environment. Also, residual excess ozone naturally disintegrates to oxygen without any effort. But there are minimum prescribed levels of ozone which has to be

maintained in an indoor environment where humans and pets are present. The safe permissible level is 0.1 ppm for 8 hours. The test readings show zero ppm presence of ozone in the indoor atmosphere, even with continuous operation of the ECOBOI generator.

### Conclusion:

With this POC, done in a newly renovated corporate office work station, it is observed that the ECOBOI generator installed in AHU provides a high degree of microbiological safety & thus prevents cross contaminations. Also, chemical pollutants like TVOCs, formaldehyde, & ambient ozone are reduced to practically zero levels. Carbon Dioxide is also under healthy levels.

The ECOBOI generator is capable of reducing & controlling all three physical, chemical and microbiological contaminations. As a result, the indoor CO<sub>2</sub> levels are kept at a low level, and fresh mechanical air can be reduced by maybe around 5 %, depending on application and no. of occupants per unit area.

### Recommendation:

We strongly recommend installing the prescribed model of ECOBOI generator in offices, schools, banks, hotels, and hospital premises, The density of people is high & there are strong possibilities of cross contaminations.