Basement Filtration System Report

Proposed Project – "Acme - Ozone"

At

Gut No. 61/1/1, 61/1/2,3,4 & 61/2/1,2,3
Village Chitalsar –Manpada,
Taluka & District - Thane
Proposed by

M/s. Acme Realties Pvt Ltd

Prepared by

Enviro Policy Research India Pvt Ltd (EPRI)

9B, 1st Floor, Ramanand Premises,
Naupada, Gokhale Road,
Opp. Mango Showroom,
Thane (W) – 400601, Maharashtra
Phone: 022 - 25450210
Email: manager@eprindia.com;
Website: www.eprindia.com

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1.1 Basement Filtration System

Photo-catalysis is the increased rate of photoreaction in the presence of a catalyst. Generally, speaking in a photo-catalytic process, light absorbed by the catalyst, leads to the production of oxidative radicals such as hydroxyl radicals. These radicals can react with chemical species such as organic pollutants and destructs them. Air pollutants such as NO_x, hydrocarbons, volatile organic compounds, CO can undergo photo catalytic induced advanced oxidation, thereby converting into harmless molecules of CO_2, H_2O and N_2. The photo – catalysis reaction is shown diagrammatically in **Figure 1.1**

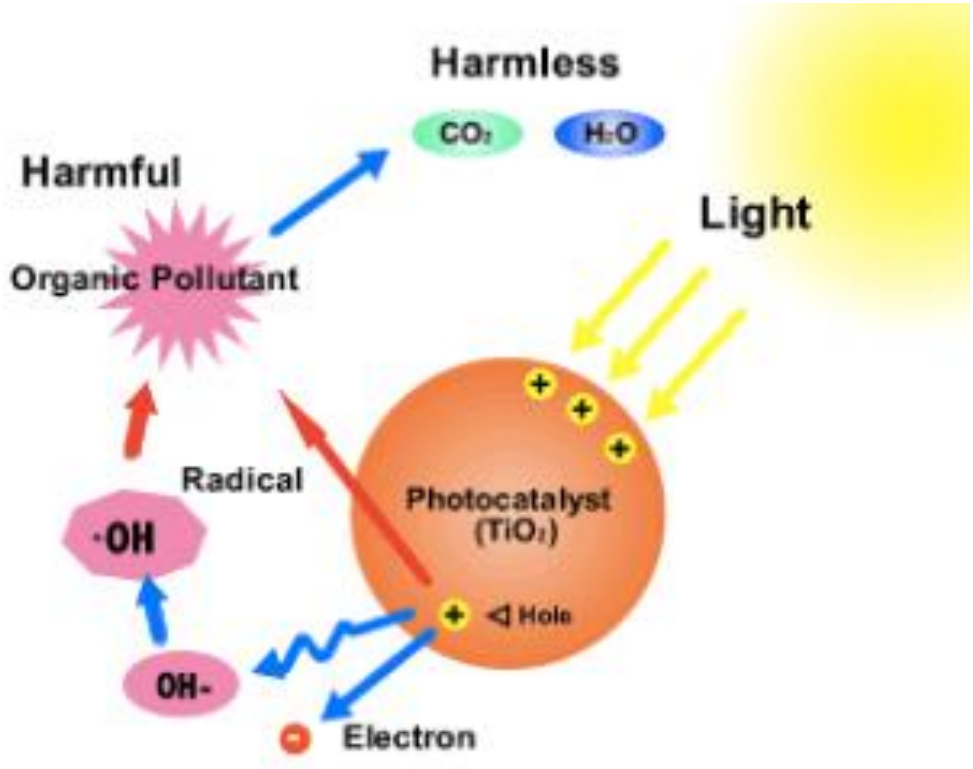


Figure 1.1: Diagrammatic representation of photo-catalysis reaction

TiO2 is the most suitable material for photo-catalysis, among the many. It has the most efficient photo-catalytic activity, highest stability and cheap. It has been used from the ancient time and guarantees human and environment safety. TiO2 surface irradiated with UV light proceeds to two photochemical reactions.

i. Photo induced hydrophilic conversion of TiO2

ii. Photo induced redox reactions of adsorbed molecules.

The above reactions are shown diagrammatically in **figure 1.2** It gives detail overview of the reactions of Photo induced hydrophilic conversion of TiO2 and Photo induced redox reaction of absorbed molecule.

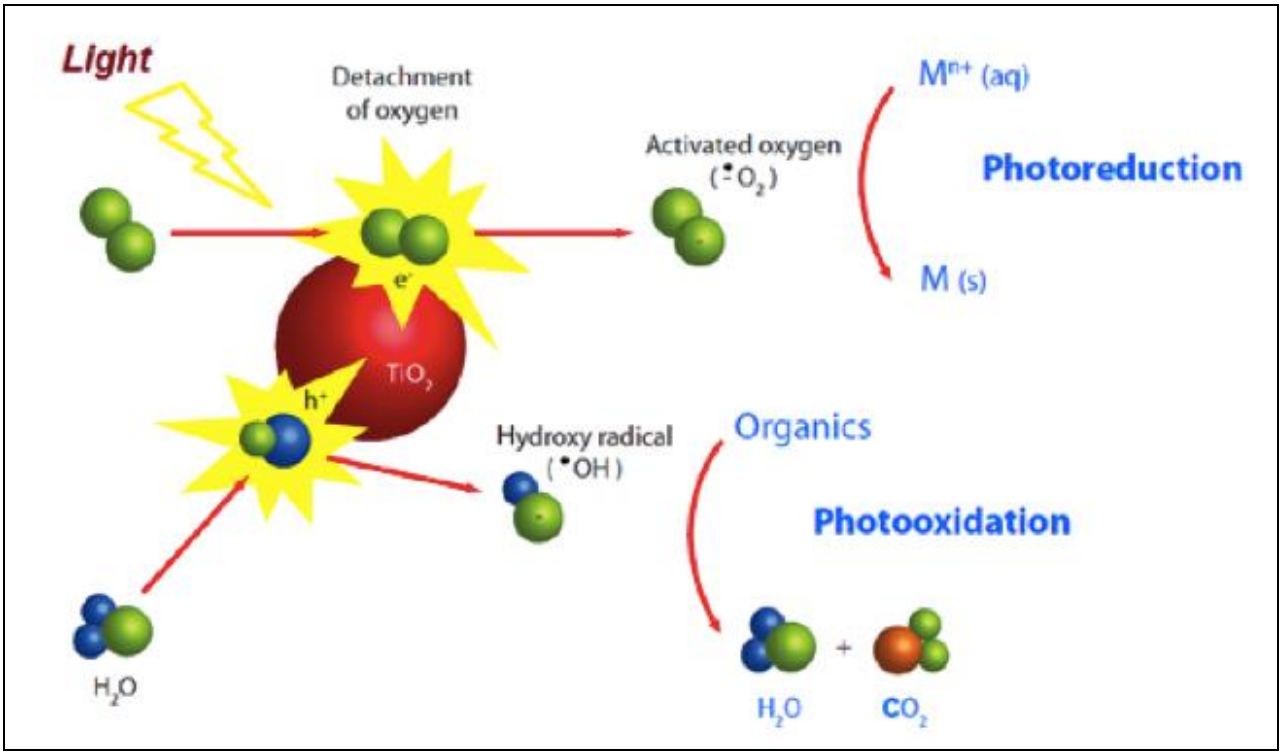


Figure 1.2: Diagrammatic representation of the two photochemical reactions that happens on the TiO_2 nano-particles surface.

Illumination of the TiO_2 surfaces induces the separation of two carriers, an electron (e^-) and a hole (h^+), as shown in equation 1

$TiO_2 + hv \rightarrow h^+ + e^-$ .....……..equation1

The photo-induced hole can either directly oxidize a donor molecule or oxidize water molecule to produce hydroxyl radicals, which ultimately oxidize donor molecules. The photo-induced electron can either reduce a chemical species or react with oxygen to form a superoxide ion ($^{\cdot}O_2^-$), which then ultimately oxidizes organic or donor molecules. Thus TiO_2 induced photo-catalysis is mainly advanced oxidation process that converts hydrocarbons and NO_x to H_2O, CO_2 and HNO_2/HNO_3. Thereby reducing the production of toxic and irritating criteria pollutant ozone

(O_3), which is a main constitute of photochemical smog. This way photo-catalysis provides a way for converting harmful air pollutants into harmless products.

1.2 Basement Filtration Design

The technology designed would consist of the following features:

1.2.1 Particulate Matter separation

Initially air enters on the left (black arrow) as shown in figure, through the front non-woven fabric pre-filter, which would capture large portions of dust and particulate matter of size up to 10 µm. Next it will pass through a fine filter with an MERV rating of 9 – 12, that can capture biological entities and fine particulate matter. For this system to work efficiently strength of the total air flow will determine the removal efficiency.

1.2.2 Advanced oxidation process

Filtered air will then enter into a cylindrical unit, where the advanced oxidation of air pollutants (VOC, hydrocarbons, NO_x) will occur. The cylindrical unit consists of an aluminium sheet with good UV reflectance and UV lamp. Aluminium sheet acts as the support material for the TiO_2 coating. Up on UV irradiance, OH radicals on the surface of TiO_2 will be generated, which would initiate the desired oxidation process.

1.2.3 CaCO3 neutralization

Following are the advanced oxidation reaction that takes place on the aluminum sheet

i. Photo catalytic oxidation of hydrocarbons

$$HC + {}^{\cdot}OH^{-} \rightarrow CO_2 + H_2O \text{.....} (equation 2)$$

ii. Photo catalytic oxidation of NO_x: This involves a series of oxidation step

$$NO + {}^{\cdot}OH^{-} \rightarrow HNO_2 \xrightarrow{{}^{\cdot}OH^{-}} NO_2 \xrightarrow{{}^{\cdot}OH^{-}} HNO_3 \text{.....} (equation 3)$$

iii. As a result NO_x gets ultimately converted to HNO_2 or HNO_3. To trap it within the filter unit, a $CaCO_3$ deposited pad will be kept beneath every cylindrical unit, such that the produced HNO_3/HNO_2 will react with $CaCO_3$ and form

$$HNO_3 + CaCO_3 \rightarrow Ca(NO_3)_2 + CO_2 + H_2O \text{.....} (equation 4)$$

1.2.4 Specification of basement filtration design

Below, **Table 1.1** provides the structural details of the TiO_2 nano-particles, with the efficiency obtained for the filtration unit. **Table 1.2** provides the details regarding the specifications of the filtration unit. Following **Figure 1.3** shows the systematic design of the basement filtration unit.

Table 1.1: Structural details of the TiO2 nano-particles

Properties	**Details**
Appearance	White
Purity	99.9%
Particle Size (mm)	< 10 mm
BET (m^2/g)	70 – 130
Crystal	Anatase
Reaction Efficiency	65% (can be increased)

Table 1.2: Specification of basement filtration unit

Sr. No.	**Details**	**Specifications**
1	Material of construction structure	Mild Steel
2	Flow rate:	1145 m^3/hr
3	Fibre filters (coarse filter):	30 inch x 26 inch
4	Fine filter (MERV rating 9 – 12):	30 inches x 26 inches
5	Doping of TiO2 with SiO_2	At a ratio of 1:1 with respect to concentration

This calculation holds good up to the limit of 1 unit installed per unit area of 510 m^2

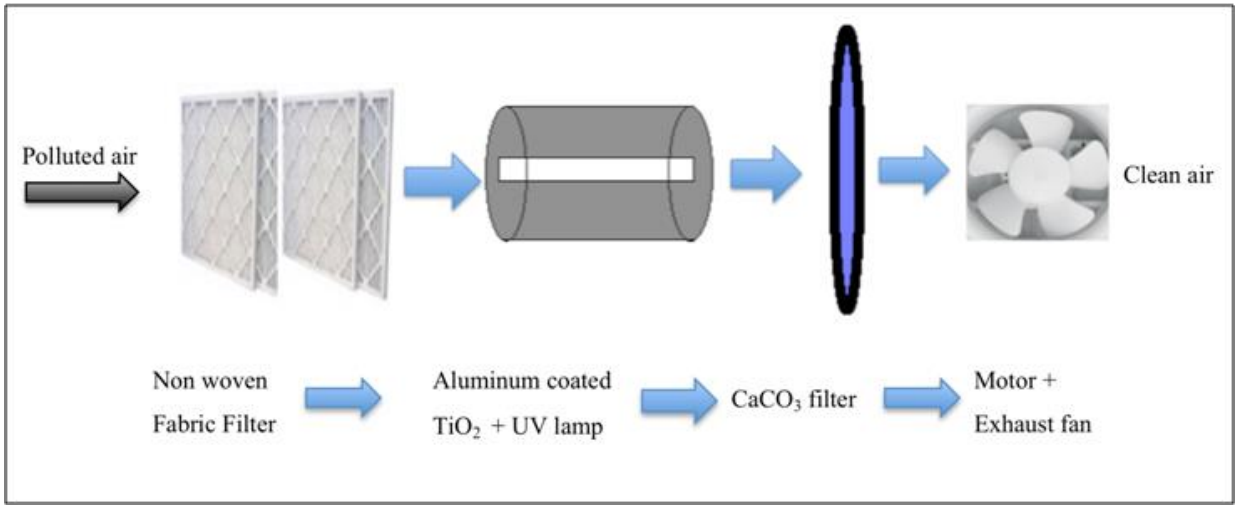


Figure 1.3: Systematic design of basement filtration unit

1.3 Basement Filtration Units:

The calculation holds good up to the limit of 1 unit installed per unit area of 510 m^2. For proposed project the number of units shown in **Table 1.3**

Table 1.3: Number of units proposed for the project

Sr. No.	Details		
		Plot A	
1	Floor	Basement 1	Basement 2
	No. of Parking	95	102
	Total Area (m^2)	7309.21	5308.51
	No. of Unit Proposed	14	10
2	No. of Parking in Basement	197	
3	Total no. of units proposed	24	
4	Unit Cost	Rs. 2.5 Lakhs	

5	Total Cost*	Rs. 60 Lakhs
6	O & M Cost	Rs.5.10 Lakhs

**The cost varies project to project and GDP*

Locations of Basement Filtration Unit shown in **Figure 1.4** and **Figure 1.5**

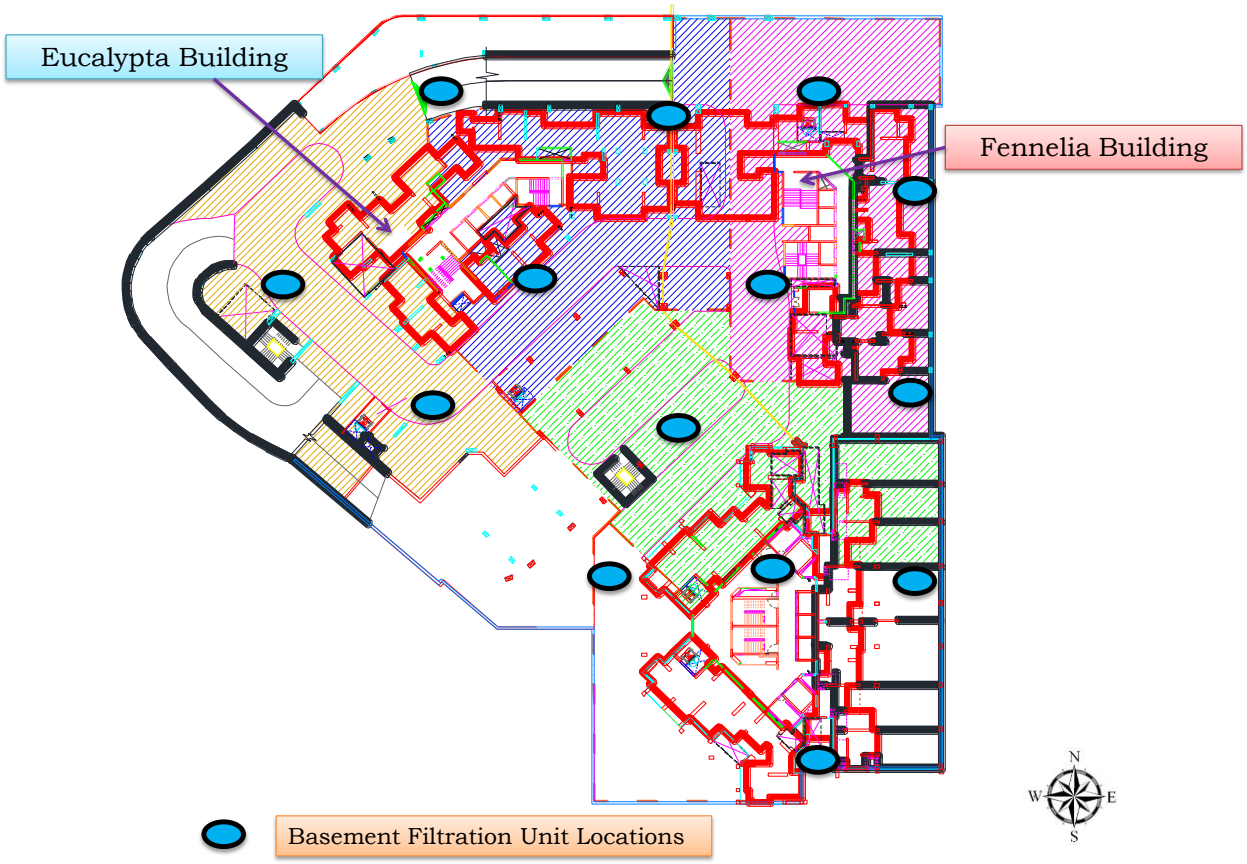


Figure 1.4: Locations of Basement Filtration Units in Basement 1 Floor

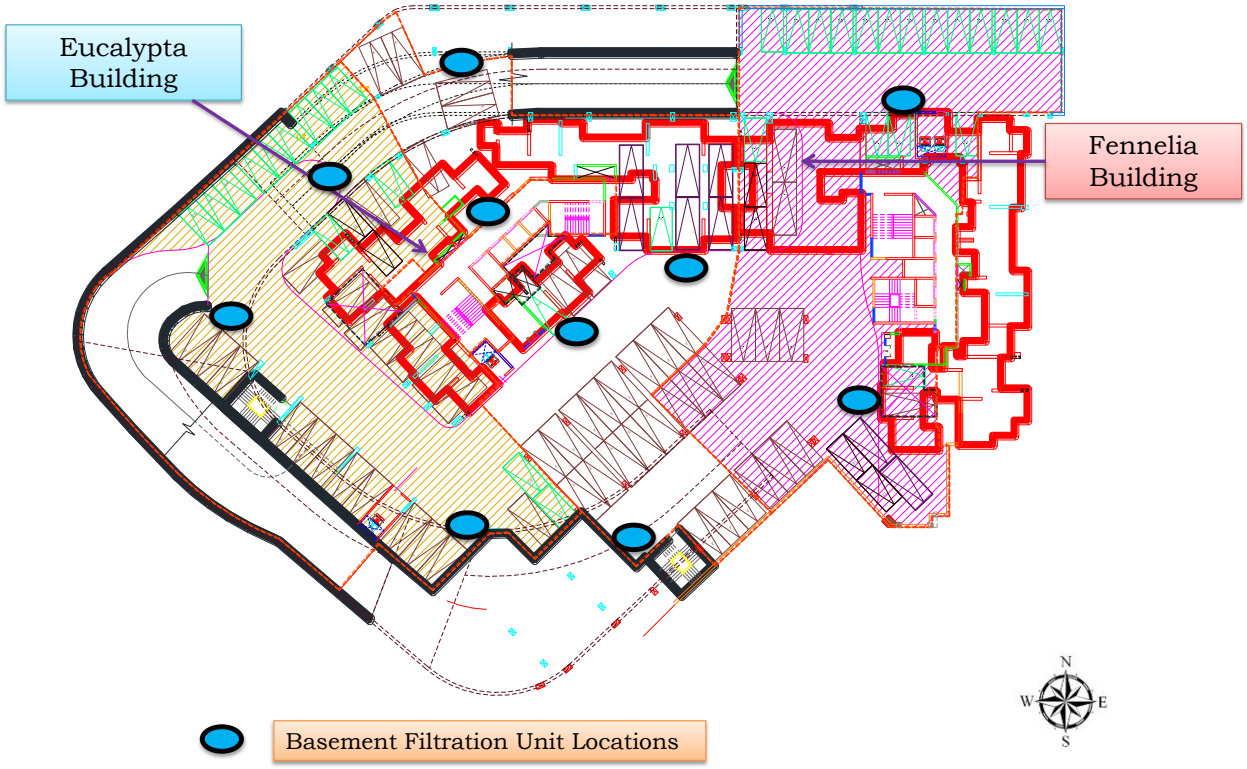


Figure 1.5: Locations of Basement Filtration Units in Basement 2 Floor