P46. Comparison of charging mechanism, the efficiency of particle matter capture and generation of byproducts from different ionization based indoor pollution control technologies

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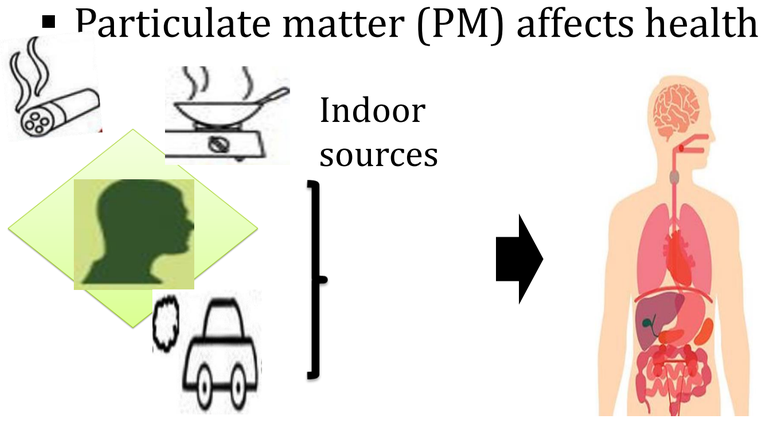
Aiswarya A Kumar, Manoranajan Sahu*

Corresponding author email id: mrsahu@iitb.ac.in, Aerosol and Nanotechnology Laboratory (ANTL) Environmental science and engineering, IIT Bombay

1.BACKGROUND AND MOTIVATION

- Pollutant exposure is higher in indoor environment as people spend 80-90% of time indoors
- Particulate matter (PM) affects health as well as climate



Why indoor PM control?

Heath hazards

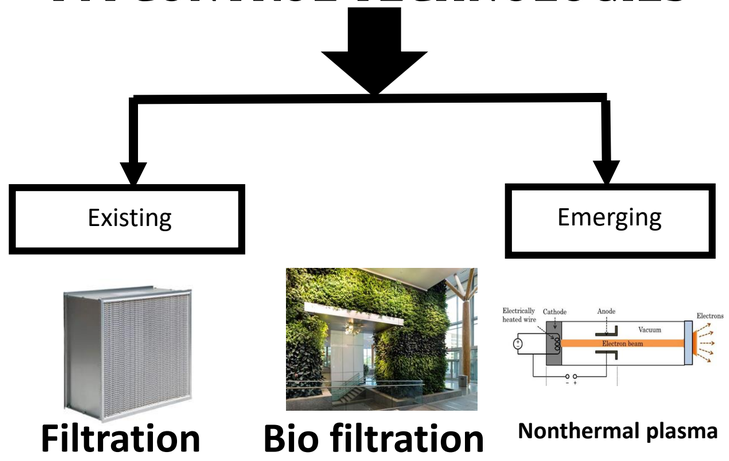
Asthma

Lung cancer

Cardiovascular

COPD

PM CONTROL TECHNOLOGIES



All standalone PM control technologies have several drawbacks in this regard ionization based technologies have multiple advantages

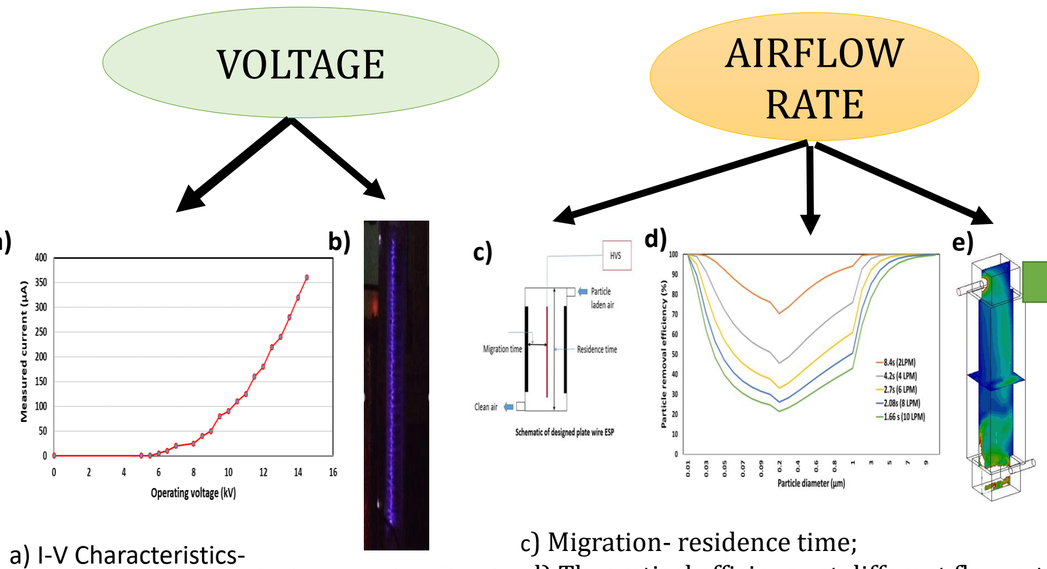
- **Objective:** Current study is on comparison of different ionization based PM control devices in terms of their charging mechanism and performance which enables in selection of most suited ionization based PM control technology in an indoor environment

2. APPROACH AND METHODOLOGY

a) Best performing ionization devices

Electrostatic precipitator(ESP 1) ESP 2 Static bar

b) Characterization



a) I-V Characteristics- Inception voltage

b) Corona visualization Breakdown voltage

c) Migration- residence time;
d) Theoretical efficiency at different flow rates;
e) Computational fluid dynamics- Velocity

C) PM Capture

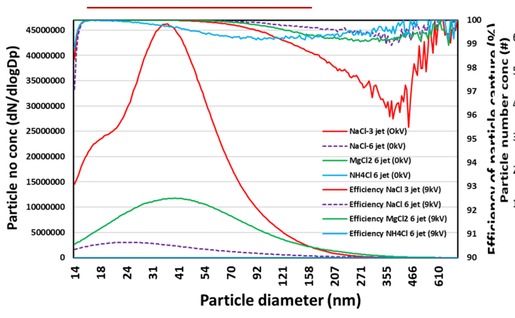
3. COMPARISON OF CONTROL DEVICES BASED ON PM CAPTURE

Ionizer	Particle no (#/l)	Total efficiency from 10 nm to 5 μm (%)
Control	1.12 x10^5	
I1	45052.54	59.60
I2	13502.33	87.89
ESP with discharge wire	10775.96	90.33
ESP with static bar	**`1670**	**98.50**

- ***'ESP with static bar'* is selected to be best performing in terms of capture in a particular PM size range.**

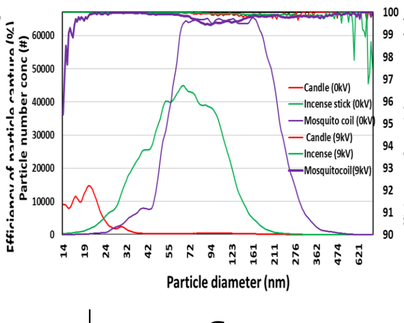
4. 'ESP WITH STATIC BAR' WITH DIFFERENT PM SOURCES

1) Standard aerosol



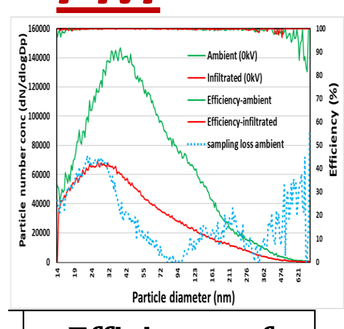
Standard aerosol	Efficiency of PM capture (%) (10nm to 5μm)
3 jet NaCl	99.88
6 jet NaCl	99.92
$MgCl_2$	99.90
NH_4Cl	99.62

2)Indoor source



Source	Efficiency of particle removal (%)
Candle	99.98
Incense	99.99
Mosquito coil	99.81
Ambient	99.81
Infiltrated	98.86

3) Infiltrated PM



- **'ESP with static bar' captures PM of different physical and chemical characteristics effectively.**

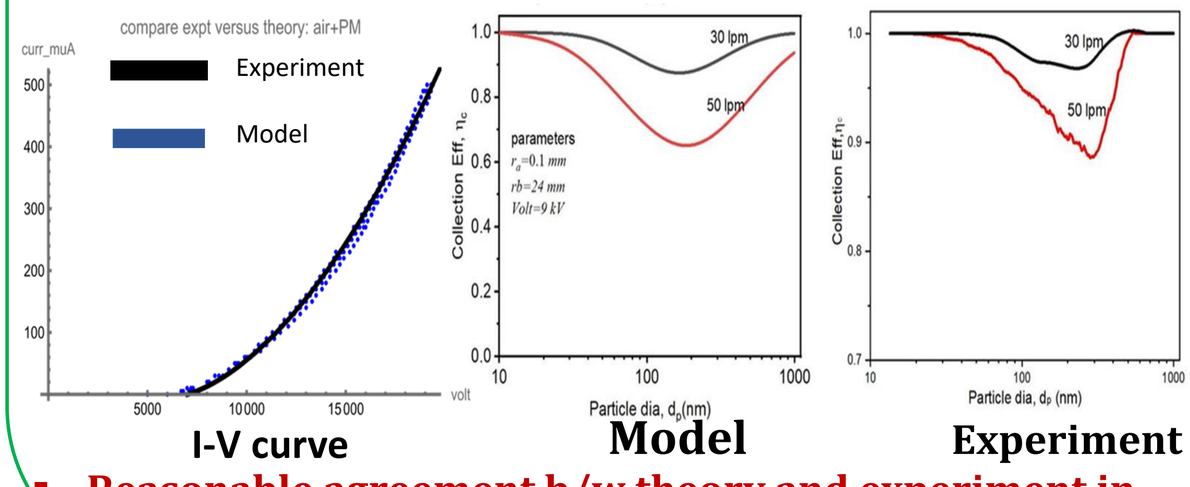
5. MODEL TO PEDICT PM CAPTURE-"Scale up"

Developed model considers

- Space charge
- Turbulence
- Corona

1. ***Characterization***

2. Capture



I-V curve Model Experiment

- **Reasonable agreement b/w theory and experiment in terms of I-V characteristics and PM capture.**

6. CONCLUSION AND FUTURE SCOPE

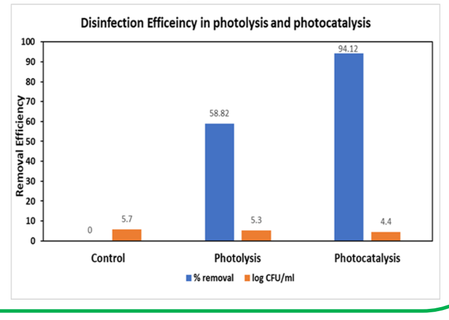
As PM capture results are promising in process of scaling up. It required consideration of secondary consequences

a) By product emission
(O_3, NO_2, ultrafine PM)

b) Multipollutant removal:
Degradation of TVOC (60%)
Deactivation of bio aerosols (96%)

c) Cost/CADR (energy consumption)

Preliminary results



Reference: Kumar, A., Malyan, V., & Sahu, M. (2023). Air Pollution Control Technologies for Indoor Particulate Matter Pollution: A Review. *Aerosol Science and Engineering*. https://doi.org/10.1007/s41810-023-00178-5