Technology Solutions to Industries and Regulators

Knowledge Lens
Accelerating Actionable Insights

G Lens Innovation Labs Pvt Ltd.
for a greener tomorrow

Dr.S.Suresh Kumar
Technical Director

Selection of Online Monitoring Systems

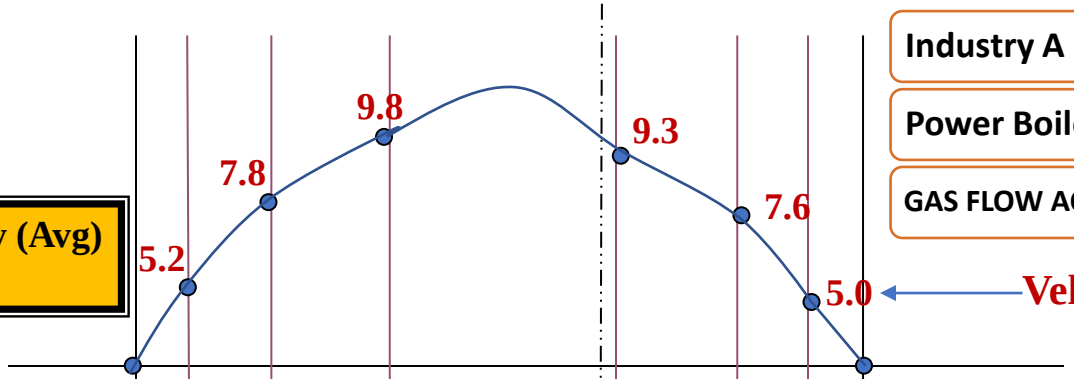
- Emission Limit Value
- Concentration Range / Calibration Range
- Certified / Approved Analyser
- Principle of Analyser based on Flue gas Characteristic
- Location of Analyser
- Proper sampling port, Ref sampling port, Homogenize profile
- IQ, OQ, PQ
- Calibration / Drifts
- Proper concentration and analyte Standard gas cylinder
- Training
- Approved DAHS
- Reporting values should be national standard requirements
- Data Validation
- Critical Spares Availability at site

Industry A

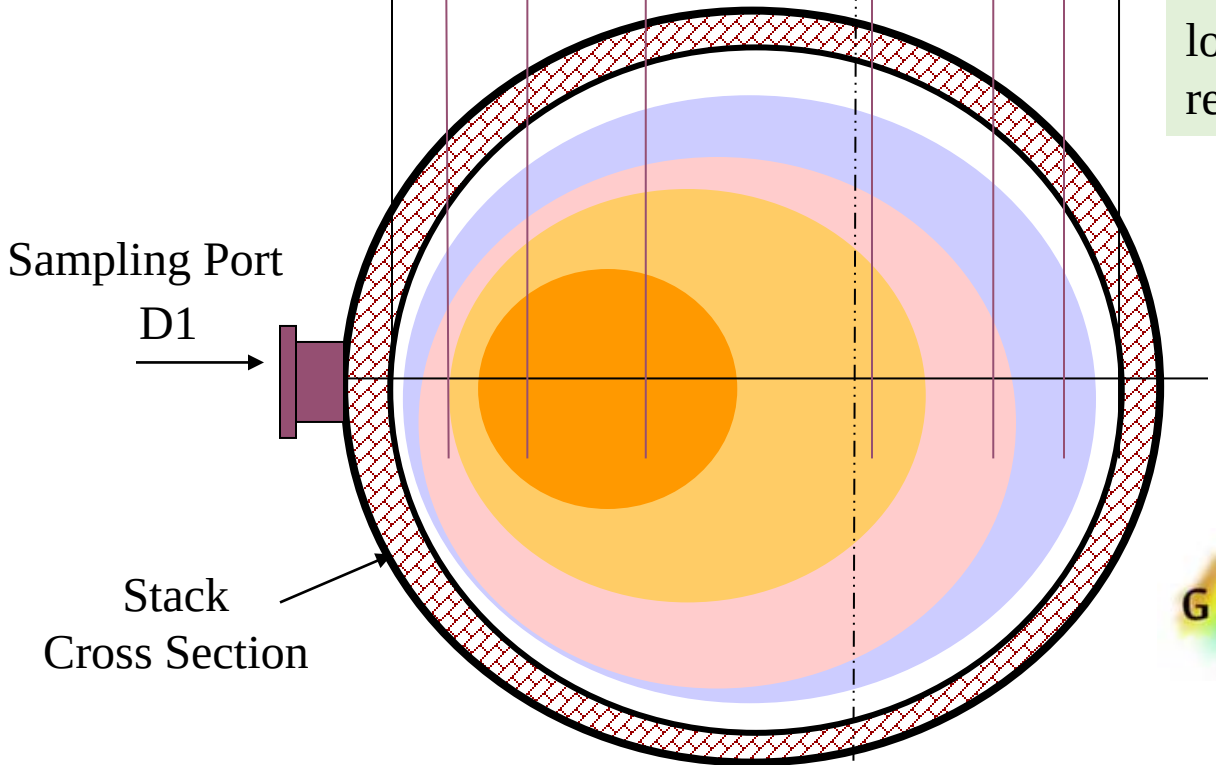
Power Boiler – IV

GAS FLOW ACROSS CIRCULAR DUCT

Average Velocity (Avg)
9.6 M/Sec



The flow at the measurement location is stabilized and no reverse or cyclonic flow observed



Conducted By

Lens Innovation Labs Pvt Ltd.

PRINCIPLES OF PM MEASUREMENT

(i) Light scattering

(ii) Probe electrification

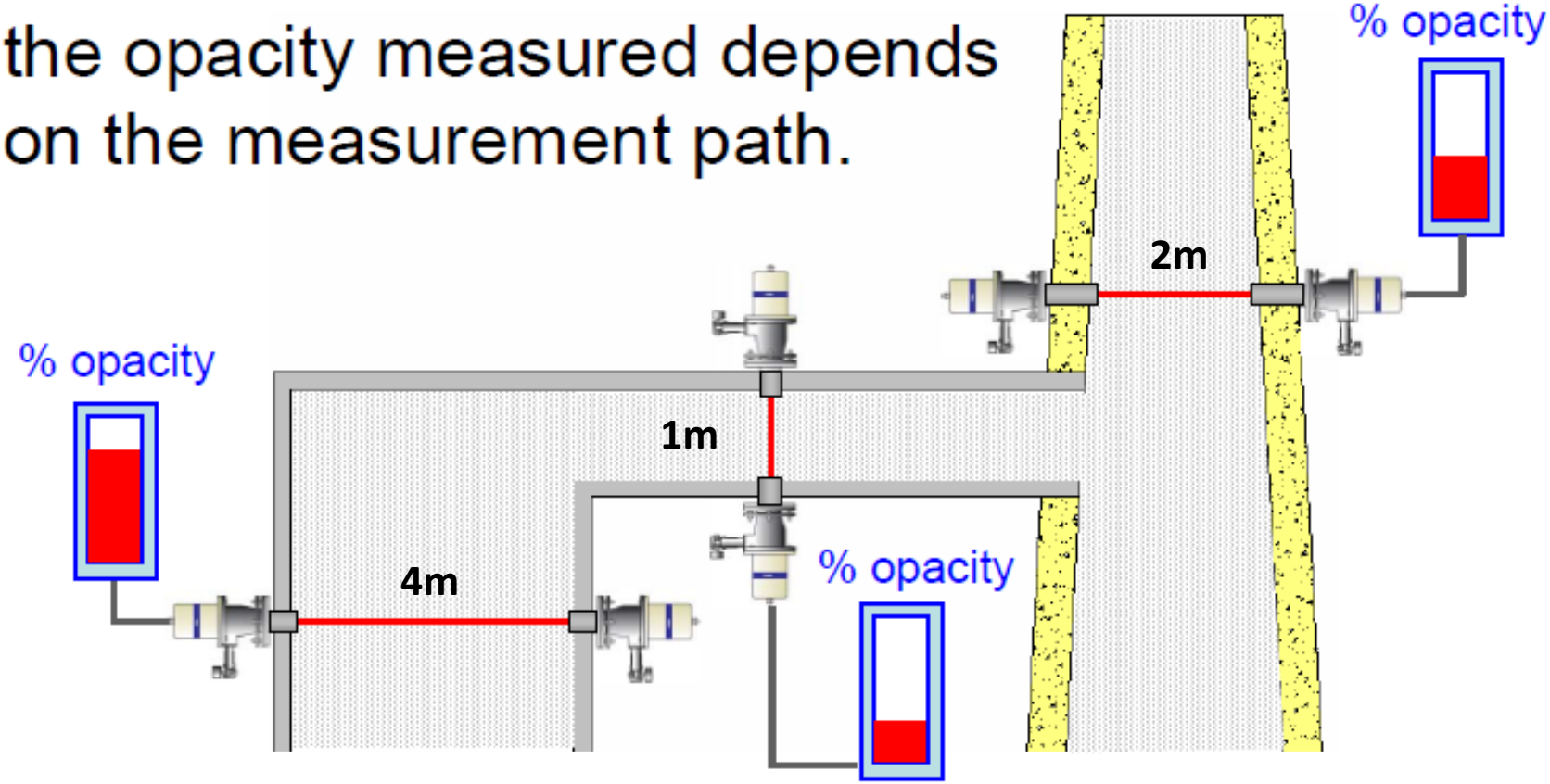
(iii) Light extinction

(iv) Optical scintillation

(v) Beta attenuation

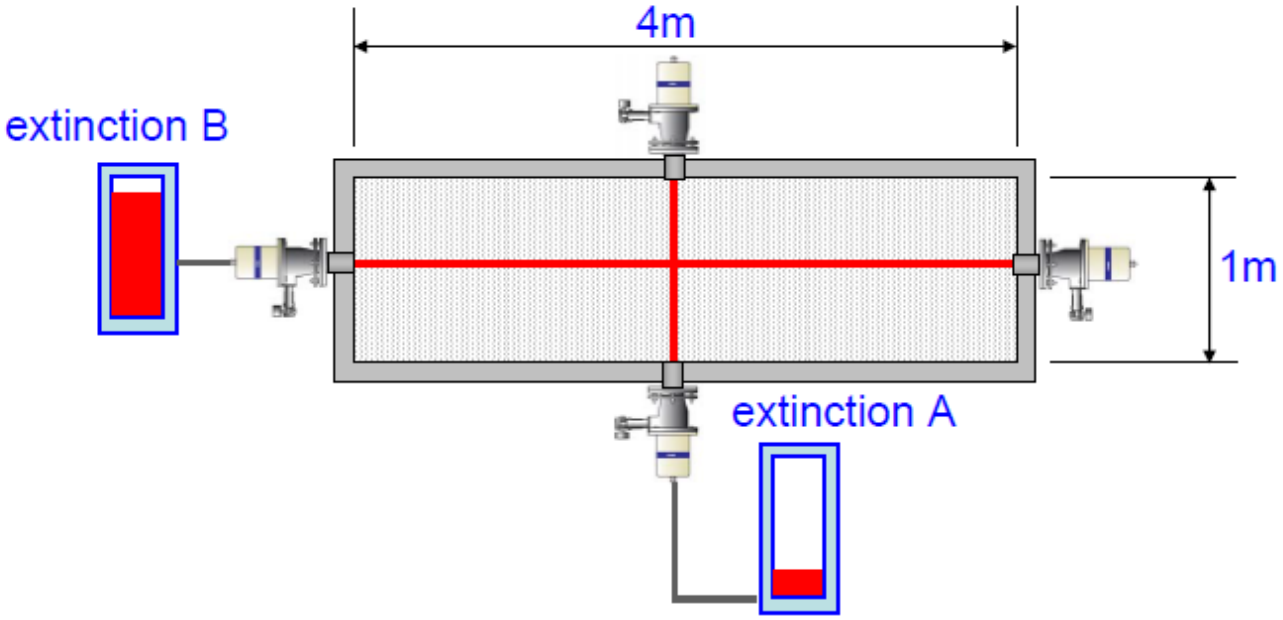
Characteristics of Opacity

With a uniform dust concentration the opacity measured depends on the measurement path.



Extinction

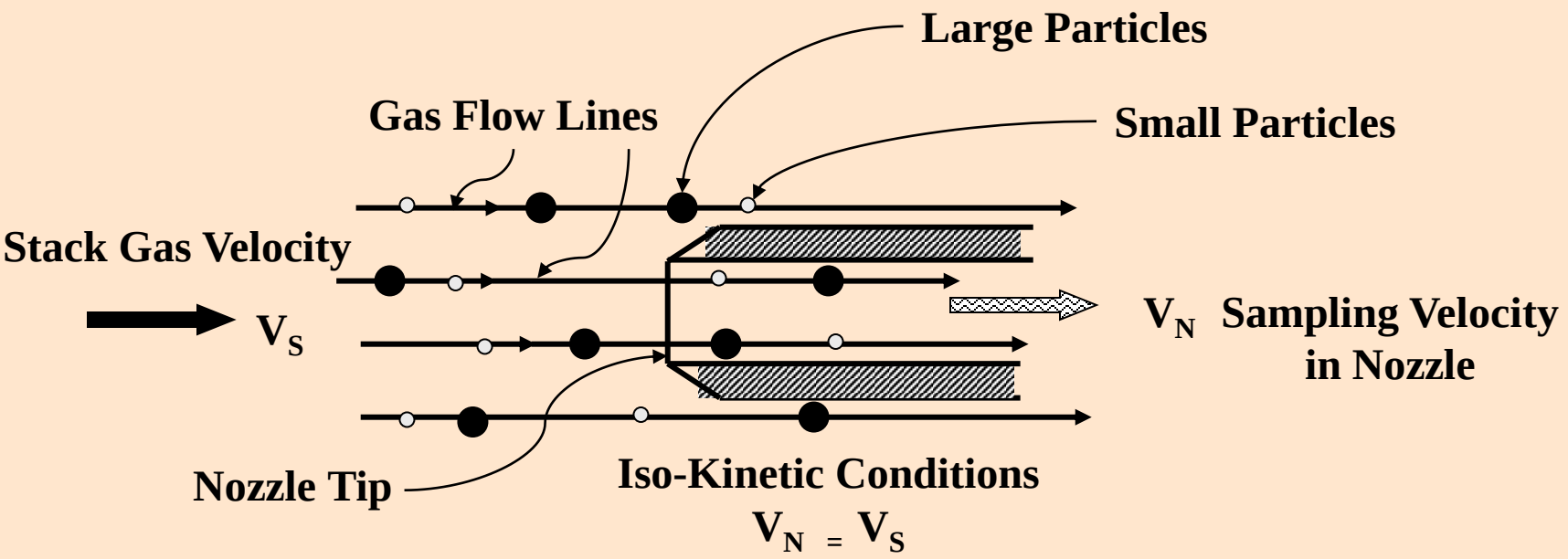
- Extinction is linearly proportional to the number of particles in the measured path and to the pathlength.
- **If 'A'is 0.3 extinction, 'B'will be 4x0.3=1.2 extinction**

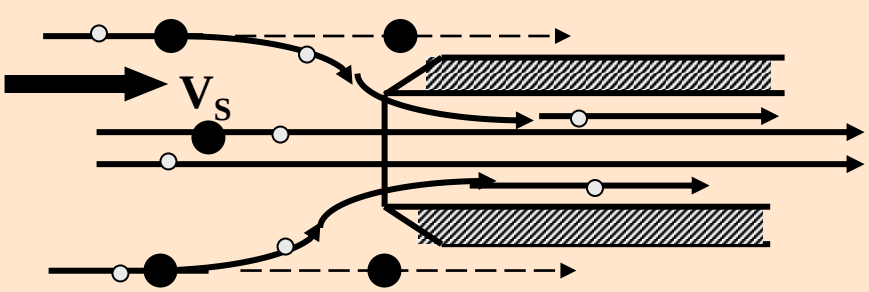


Suitability of PM- CEMS

Measurement Technology		Stack Diameter (m)	Concentration mg/m³		APC device	Min. certification. range	Dry	Humid	Wet	Velocity Dependant
			Min	Max						
Probe Electrification	Electrodynamic	0.1 -3 (6m with multiple probes)	< 0.1	250	Bag, Cyclone, Drier,	0 to7.5mg/m3 (QAL1 to EN-15267-3)	√	√	x	Not in 8 - 18m/s range
	AC Tribo	0.1 - 3	< 1	250	Bag, Cyclone	0 - 15mg/m3	√	x	x	Yes
	Tribo	0.1-3	< 1	250	Bag, Cyclone	qualitative bag leak	√	x	x	Yes
Transmissometry	Dynamic Opacity / Scintilation	0.5 - 10	10 10 (5m stack) 25 (2m stack)	1000	Cyclone, ESP, None	0- 150mg/m3	√	x	x	No
	Opacity/ Extinction	1 - 15	10 (at 5m) 50 (at 1m)	1000	Bag, Cyclone, ESP, None	0- 50mg/m3	√	x	x	No
		0.5-12	< 30	1000	ESP, None	None	√	x	x	No
In-situ Light Scatter	Scattered Light (Fwd)	1 - 3	< 0.1	300	Bag, ESP, None	0-15mg/m3	√	x	x	No
	Scattered Light (Back)	2 - 10	<0.5	500	Bag , ESP, None	0-7.5mg/m3	√	x	x	No
Extractive light scatter		0.5 - 10	0.1	100	Wet collector (wet FGD)		√	√	√	N/A
Extractive Beta		0.5 -10	0.5	< 150	Wet collector (wet FGD)		√	√	√	N/A

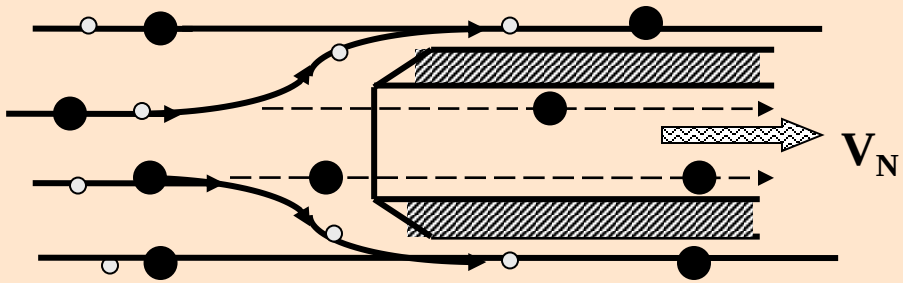
Particulate Matter Collection - Iso-Kinetic Conditions





Super Iso-Kinetic Conditions

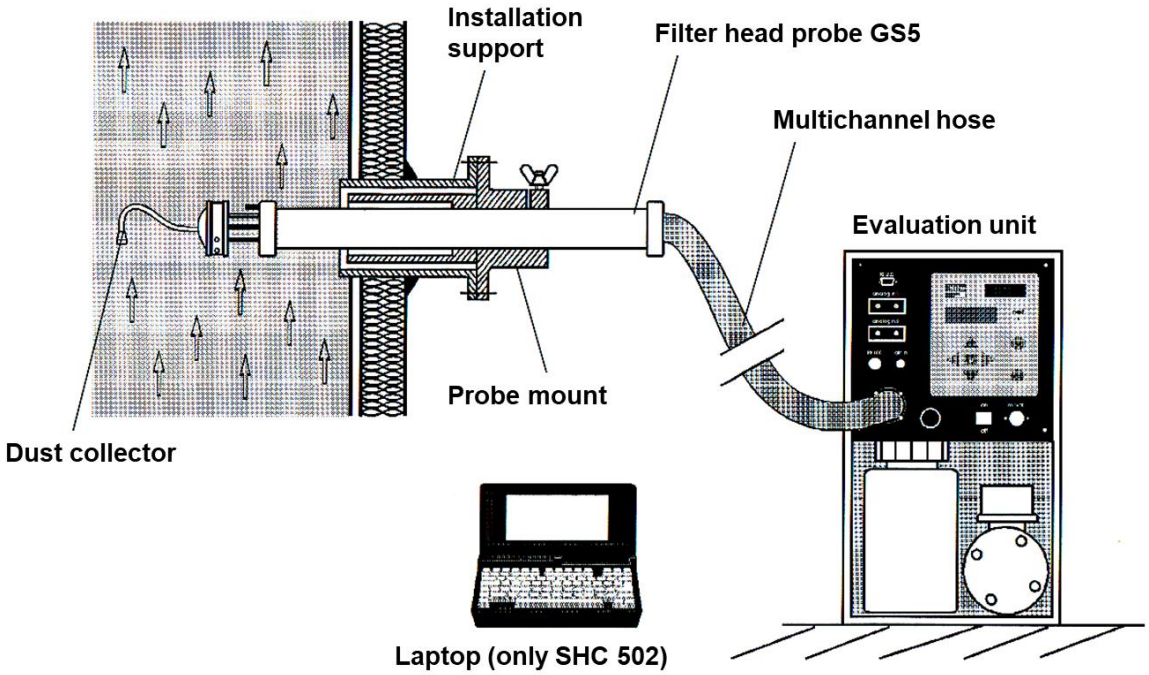
$V_N >> V_S$



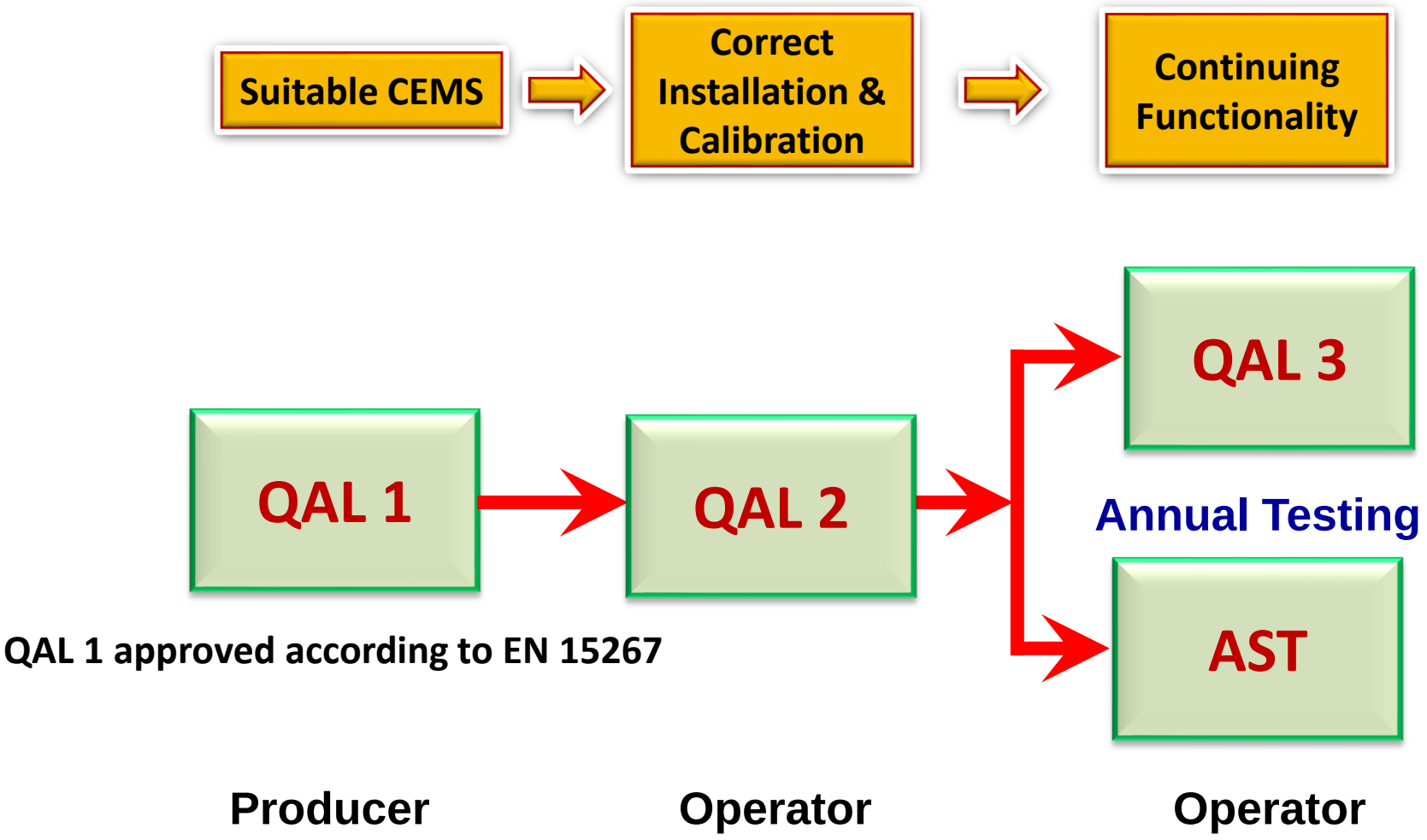
Sub Iso-Kinetic Conditions

$V_N << V_S$

Gravimetric Measurement – Reference Measurement

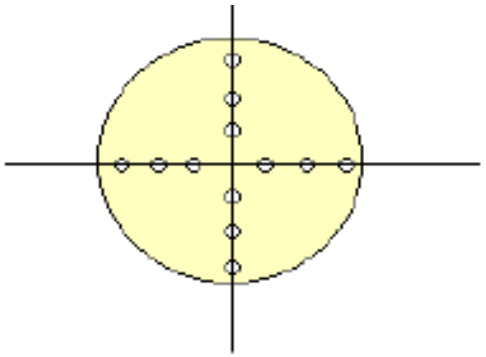


EN 14181 - SIMPLIFIED

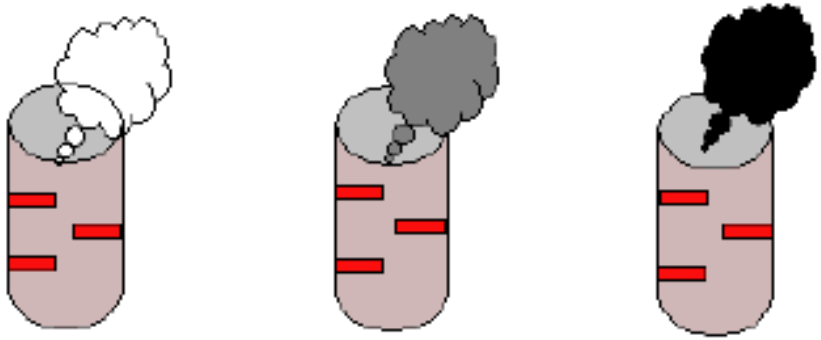


PM CEMS Calibration

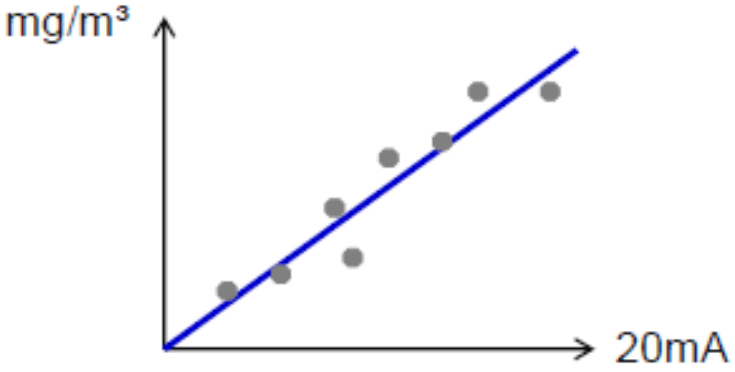
- Profile measurements has to be considered



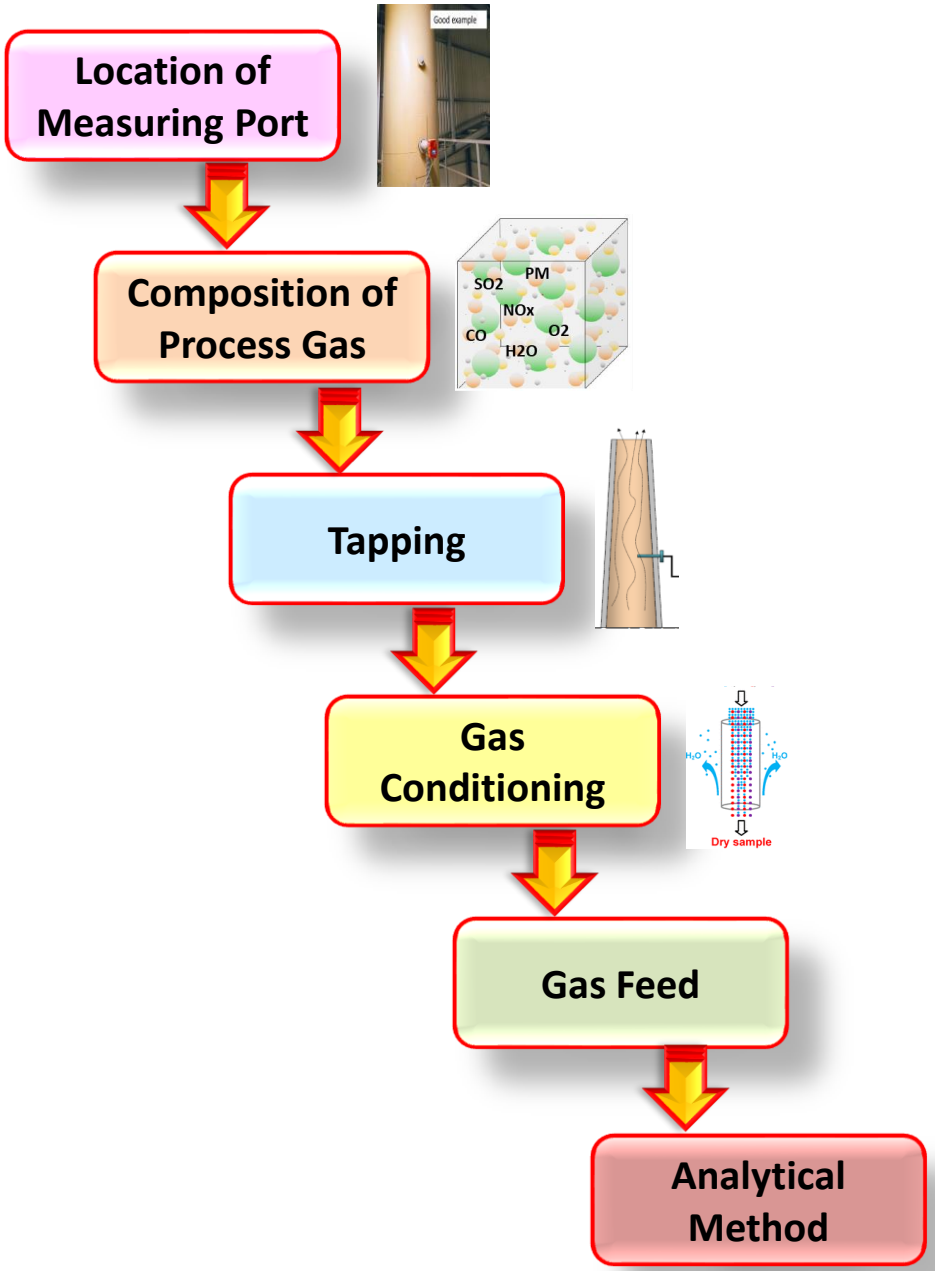
- Calibration is performed under different plant operation and conditions to achieve different dust load.



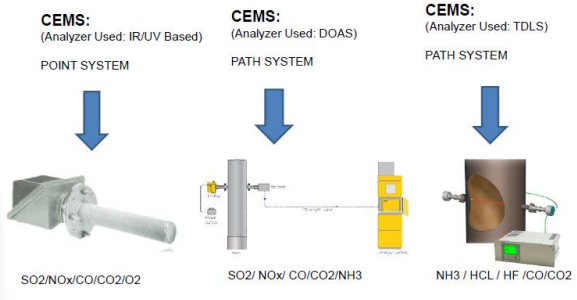
- Relationship between dust concentration in mg/m³ and monitor output in mA



Analyser Technology Process to Emission



- Temperature
- Pressure
- Flue Gas Composition
- Moisture Content
- Location of the Analyser



CONFIDENCE COEFFICIENT (CC)

LINEARITY ERROR [LE]

CALIBRATION DRIFT [CD]

ZERO DRIFT (ZD)

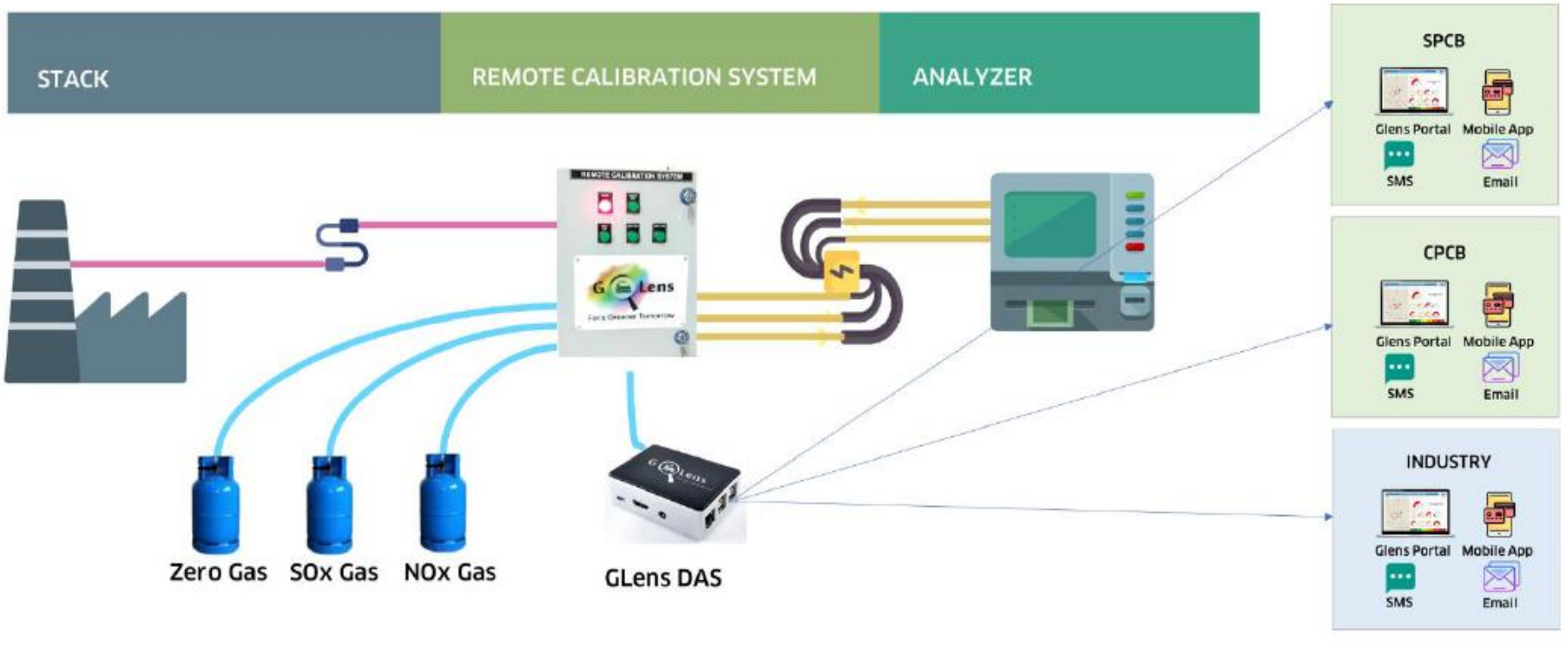
CALIBRATION ERROR [CE]
For New CEMS

RELATIVE ACCURACY TEST AUDIT (RATA)

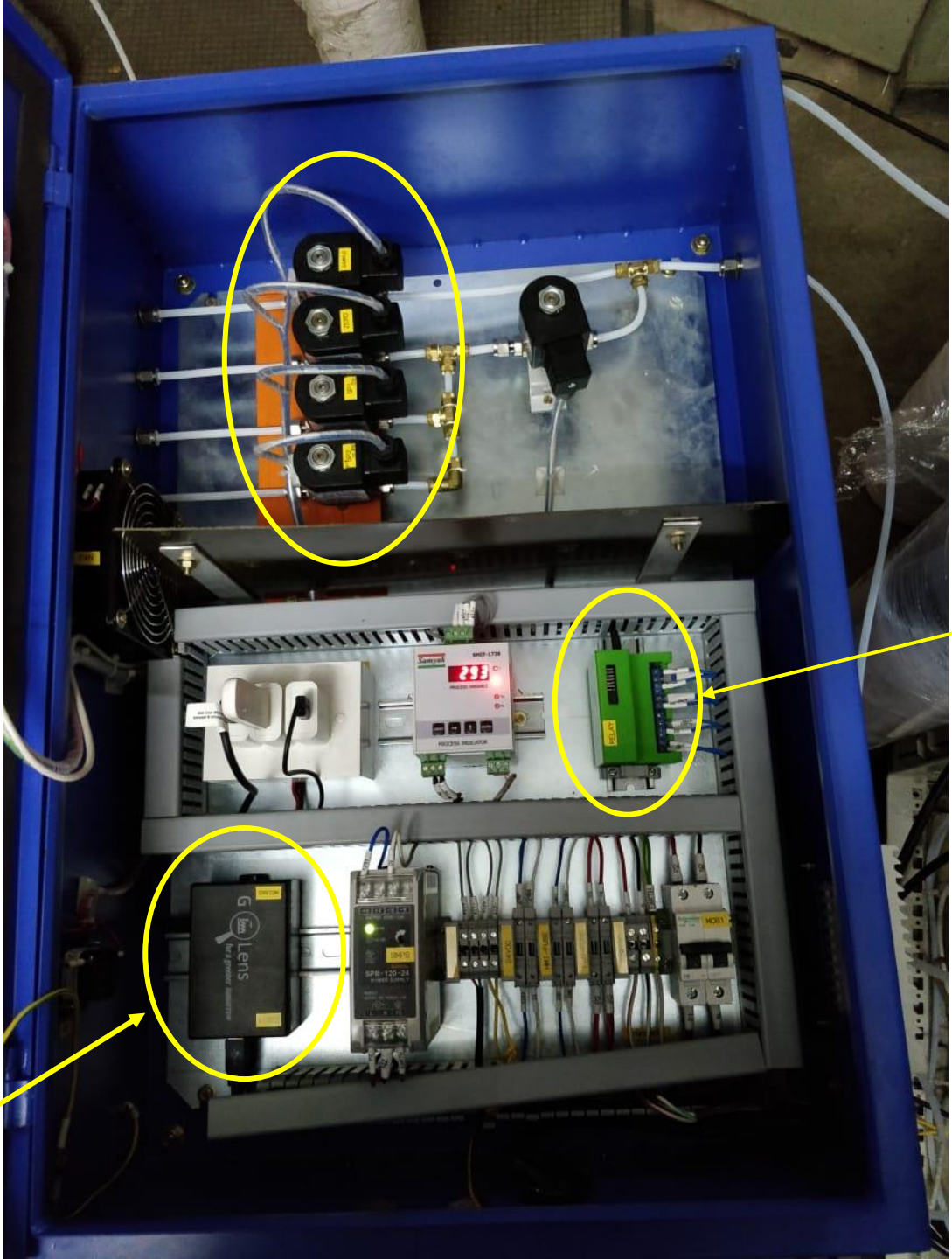
INTERFERENCES IN CEMS ANALYSERS

TECHNIQUE	TYPICAL INTERFERENCES
IR : SO2, NO, CO2, CO	H2O, CO2, CO, Temperature
Luminescence : SO2, NO2	H2O, Hydrocarbons
UV : SO2 NO	NO SO2
Paramagnetic : O2	NO

Remote Calibration Conceptual Architecture



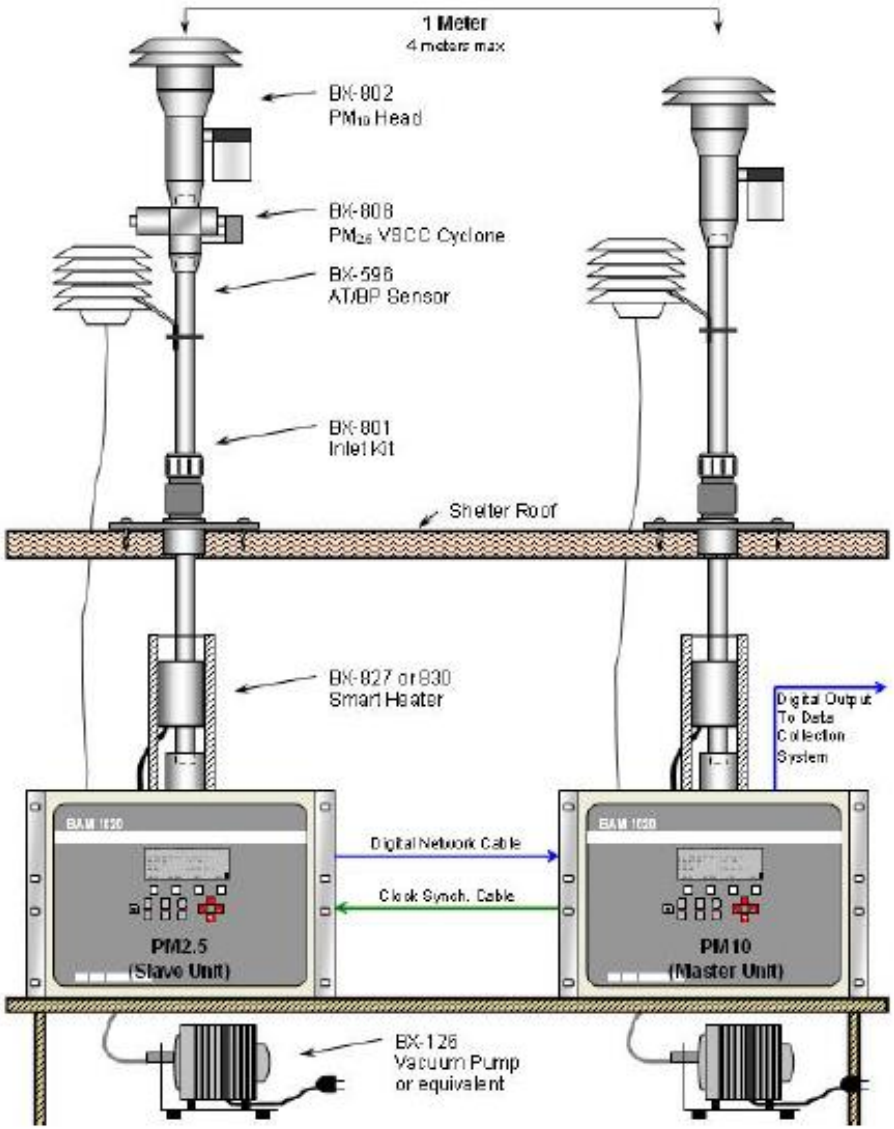
Programmable Solenoid Valve



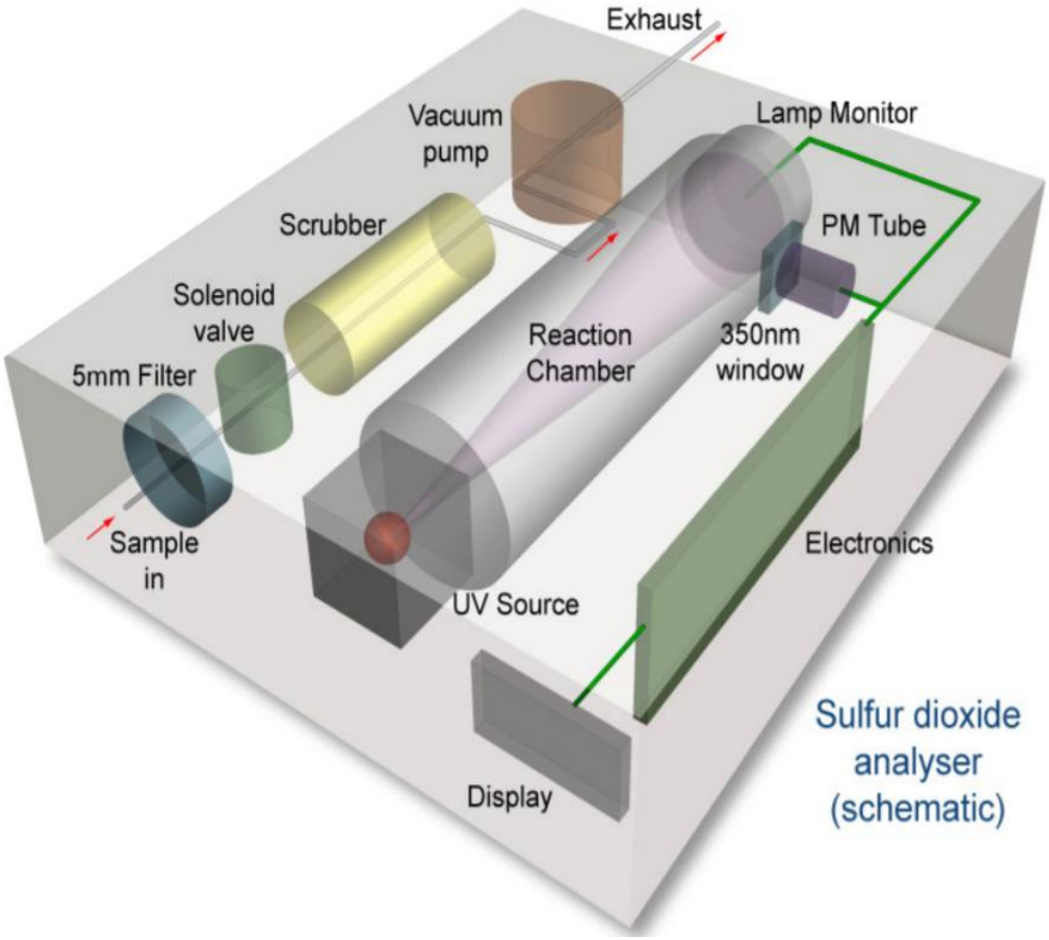
CAAQMS Station

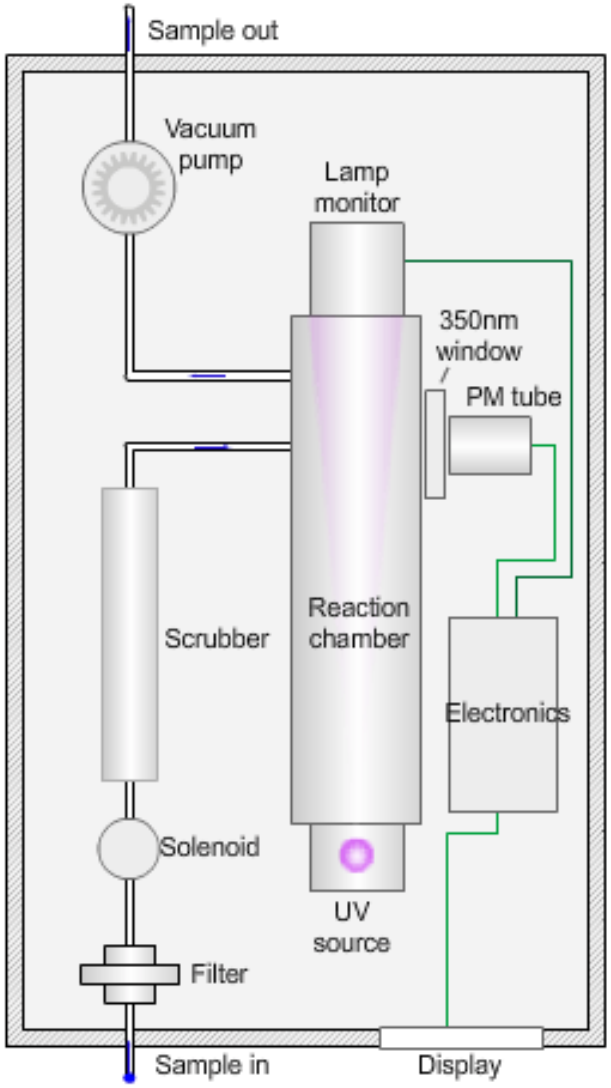
BAM for Particulates

- The first U.S. EPA designated method for $PM_{10-2.5}$ continuous monitoring.
- Both units are identical except for the BGI VSCC cyclone on the $PM_{2.5}$ inlet.
- The coarse firmware has a simple menu setting that determines which unit is the PM_{10} master or $PM_{2.5}$ slave in the system.
- Each unit has its own 16.7 lpm flow system, pump, and AT/BP sensor.
- The master unit synchronizes the slave clock automatically.
- PM_{10} data and flow volumes are stored in both standard and actual conditions!
- Any errors or alarms in either unit are visible in the master data file.



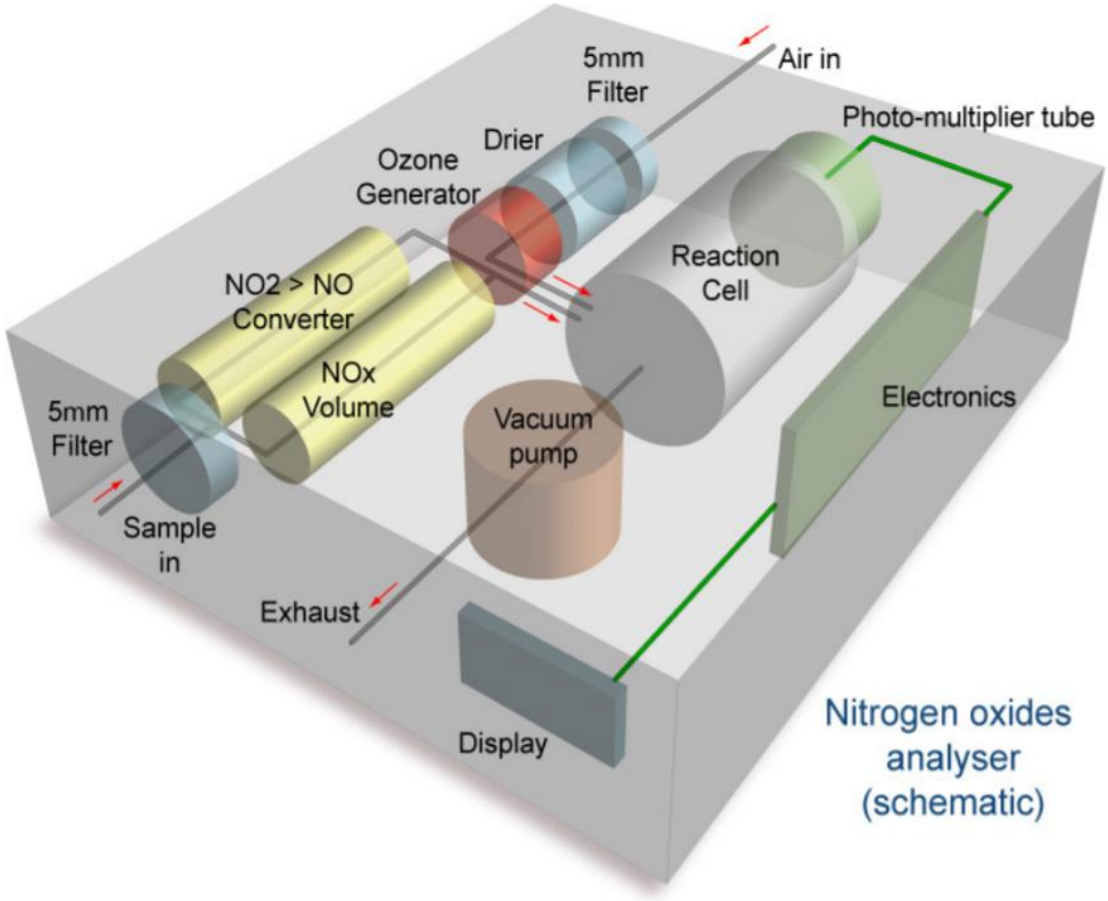
Measurement of SO2 by UV Fluorescence



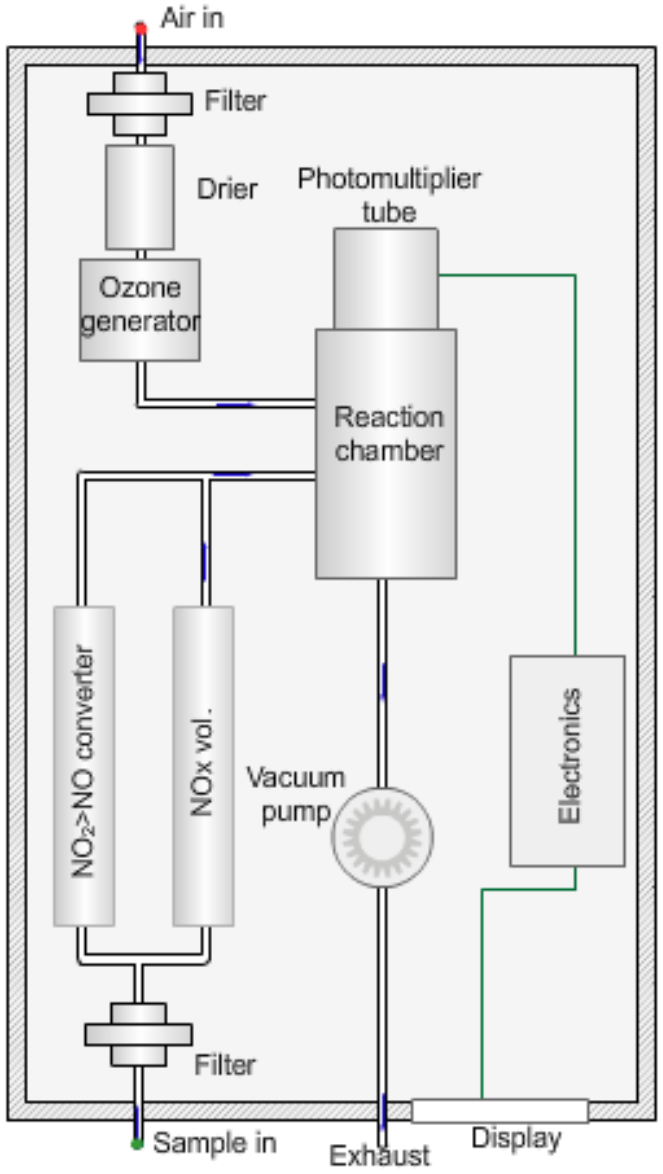


The UV source, a zinc discharge lamp, radiates ultraviolet light at 215 nm into the reaction chamber where it interacts with the SO2

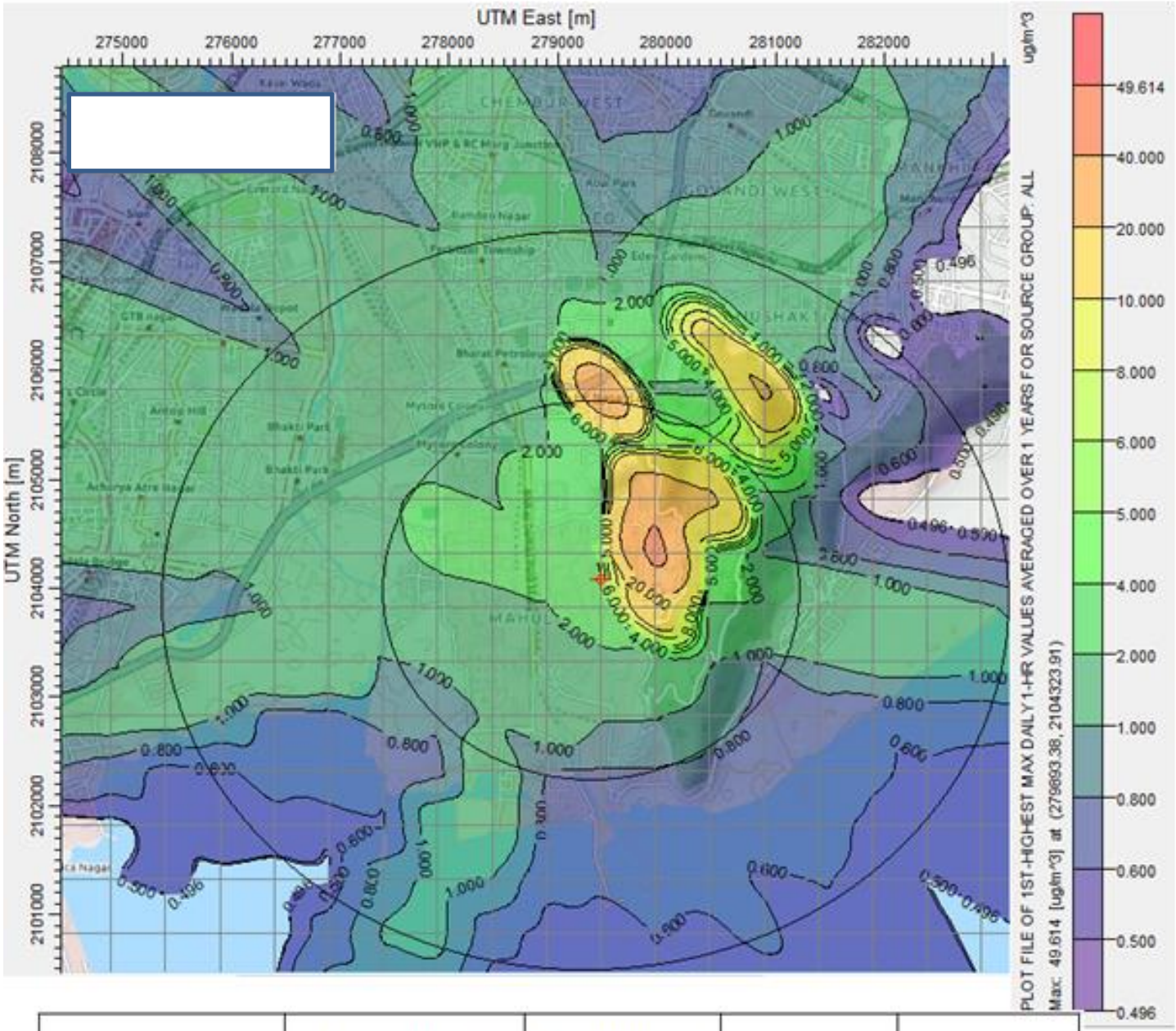
Nitrogen Oxides Analyser



Nitrogen oxides analyser (schematic)

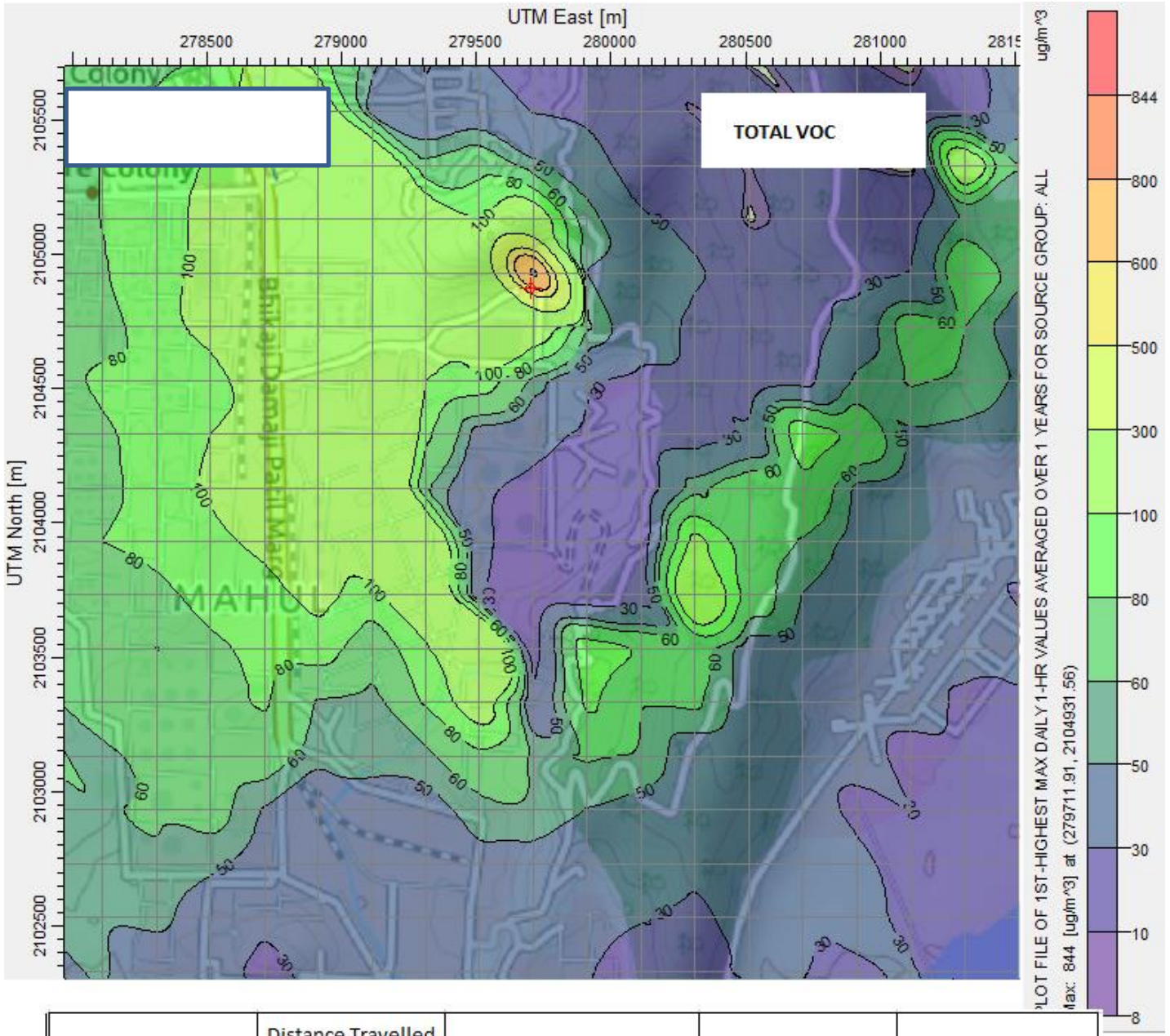


STACK EMISSION DISPERSION MODELLING



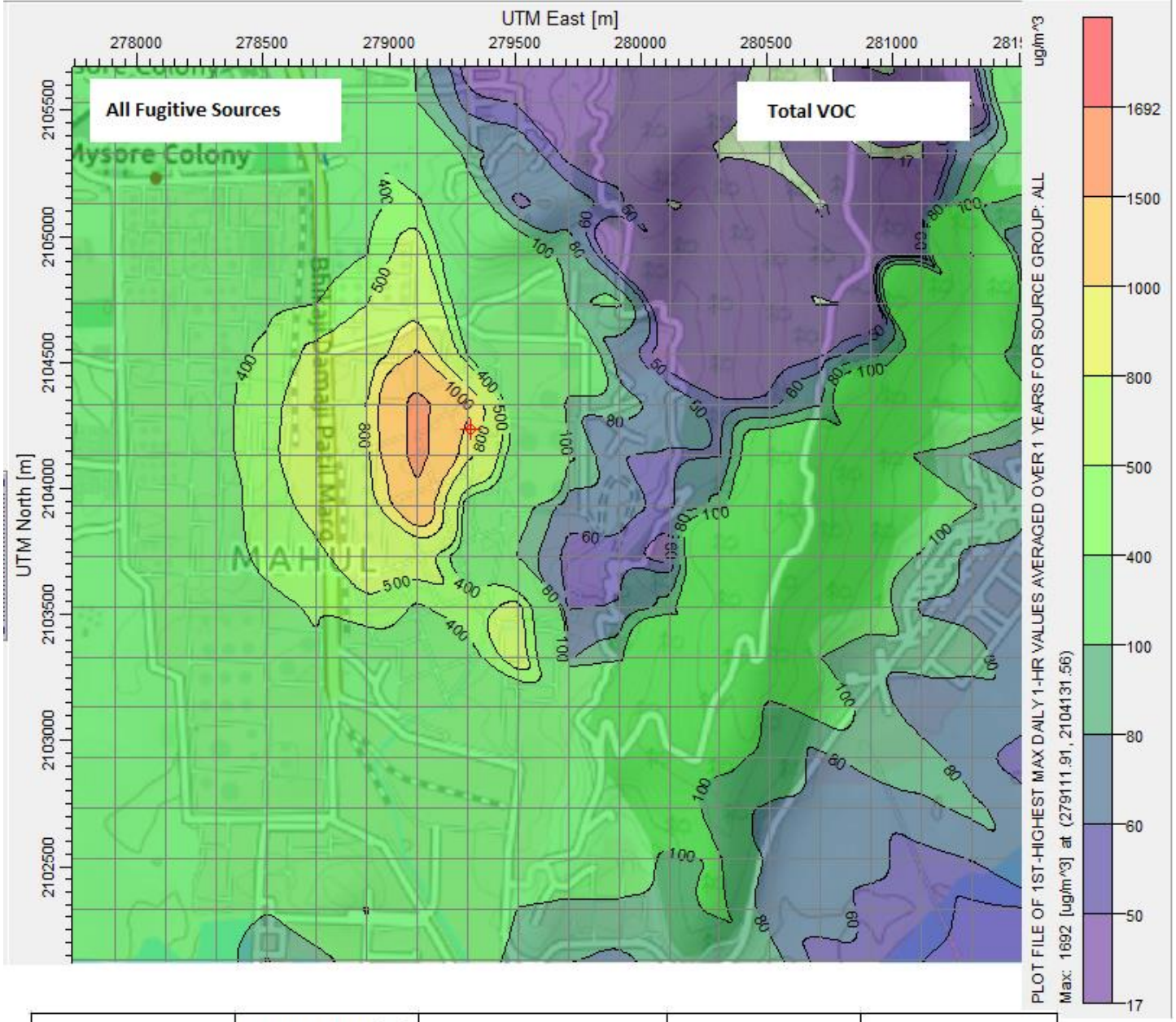
Conc. At the source (Milligram/m3)	Distance Travelled to Maximum Ground Level Conc. (km)	Maximum Ground Level Concentration (Microgm/m3)	Avg. Conc at 2 km (Microgm/m3)	Avg. Conc at 5 km (Microgm/m3)
55.61	0.83	49.614	11.18	0.09561

FUGITIVE EMISSION DISPERSION MODELLING



Conc. At the source (Microgram/m3)	Distance Travelled to Maximum Ground Level Conc. (km)	Maximum Ground Level Concentration (Microgram/m3)	Avg.Conc at 1 km (Microgram/m3)	Avg.Conc at 2 km (Microgram/m3)
4621.01	0.17	844	181	23

FUGITIVE EMISSION DISPERSION MODELLING

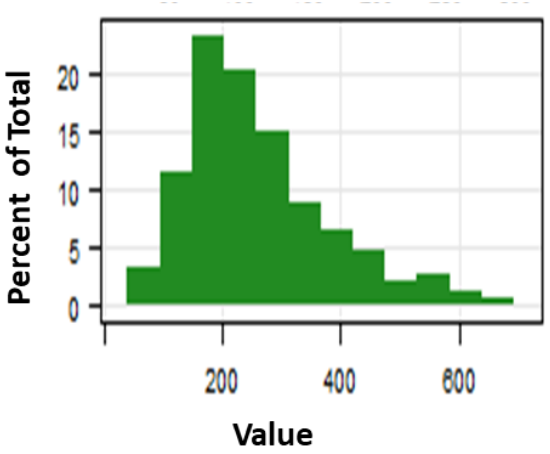


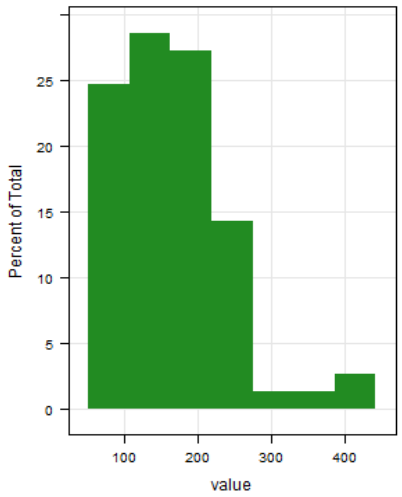
Conc. At the source (Microgram/m3)	Distance Travelled to Maximum Ground Level Conc. (km)	Maximum Ground Level Concentration (Microgram/m3)	Avg.Conc at 1 km (Microgram/m3)	Avg.Conc at 2 km (Microgram/m3)
6603.72	0.23	1692	430.35	5.832

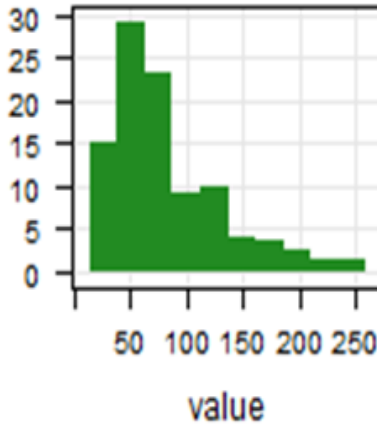
CAAQMS Data Interpretations

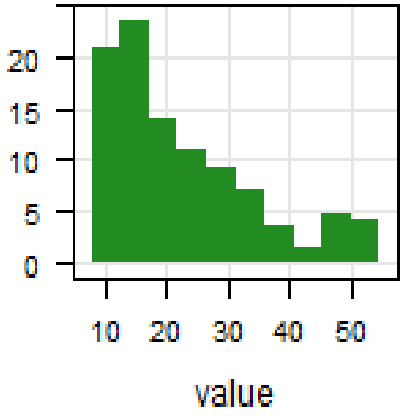
Anand Vihar (Before and After Lockdown)

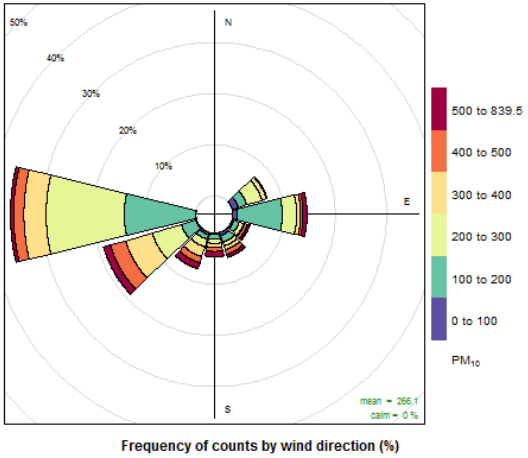
Comparison Between Feb 2020 & March 2020 – PM10



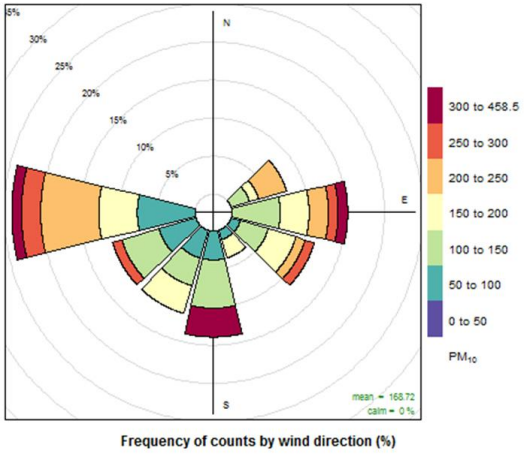




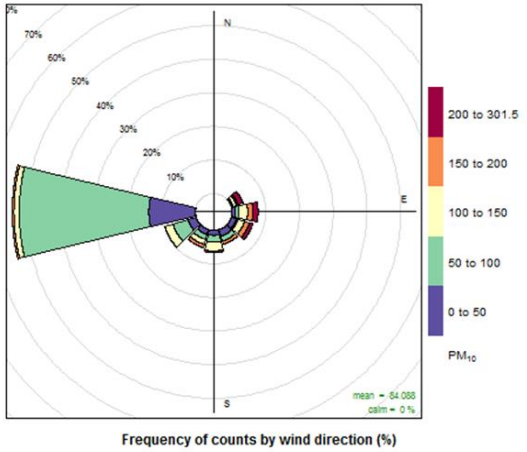




PM10 - February

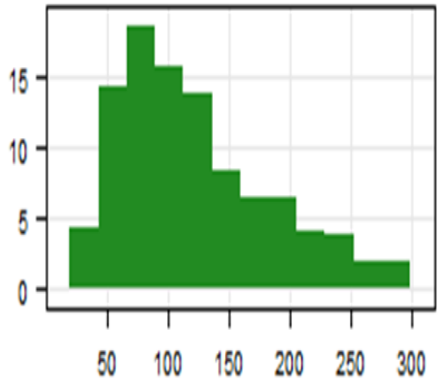


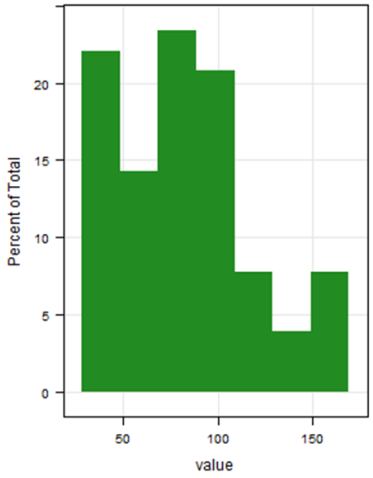
PM10 – March 2nd week

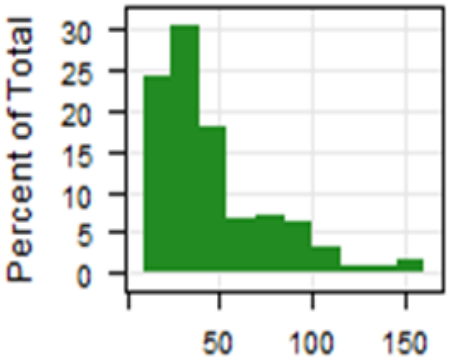


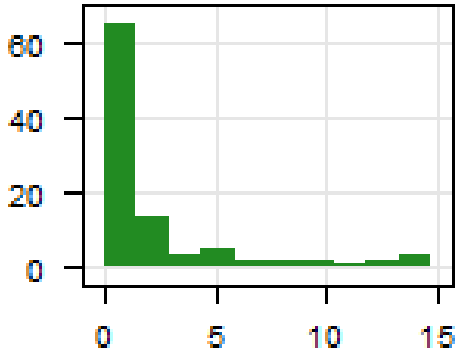
PM10 – March 3rd & 4th Week

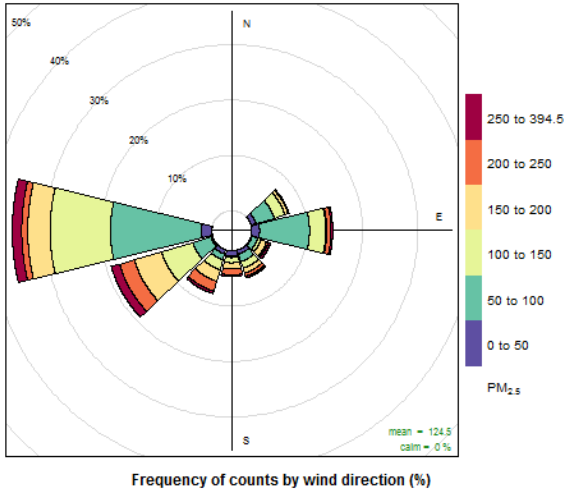
Comparison Between Feb 2020 & March 2020 – PM2.5



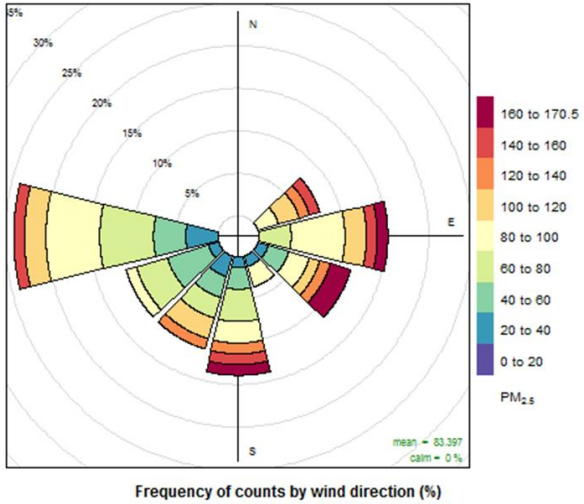




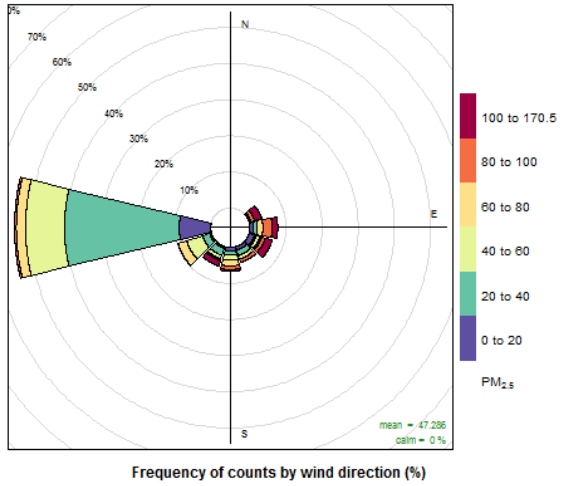




PM10 - February

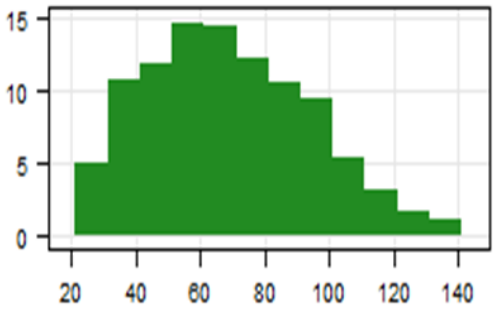


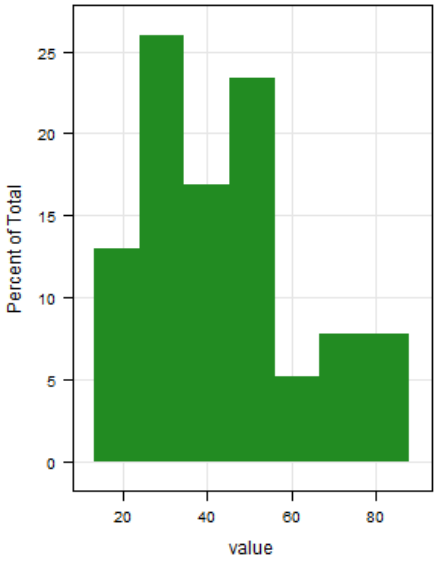
PM10 – March 2nd Week

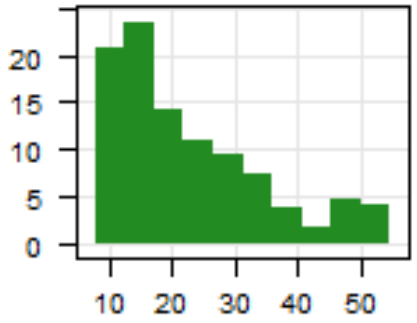


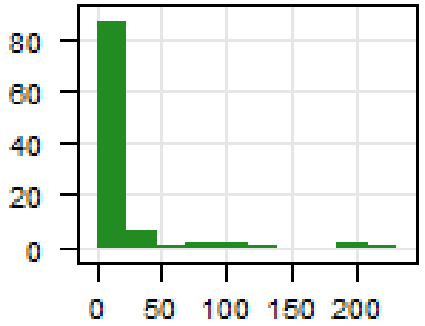
PM10 – March 3rd and 4th Week

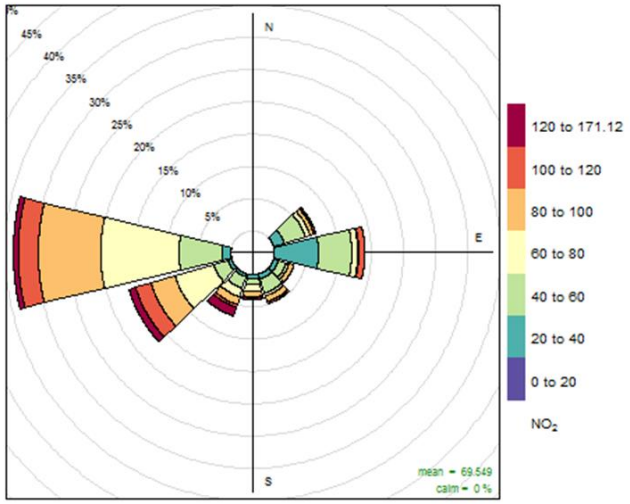
Comparison Between Feb 2020 & March 2020 – NO2



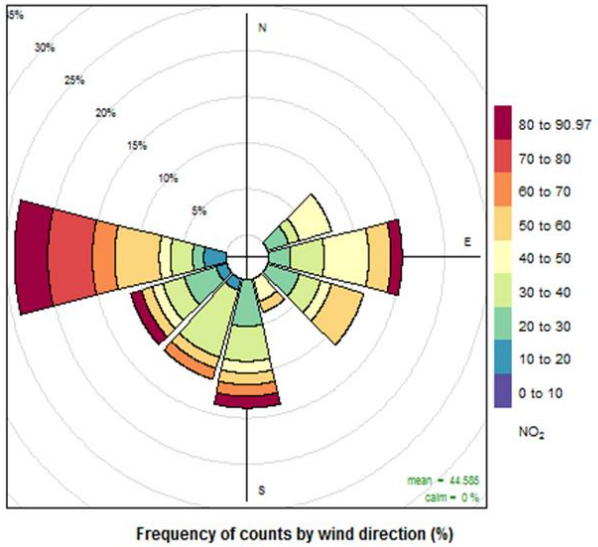




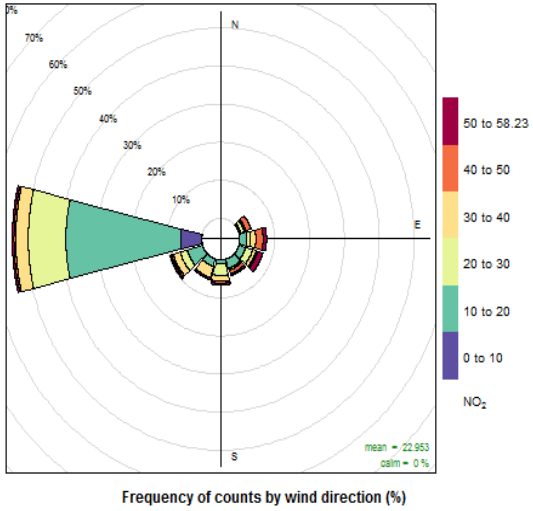




PM10 - February

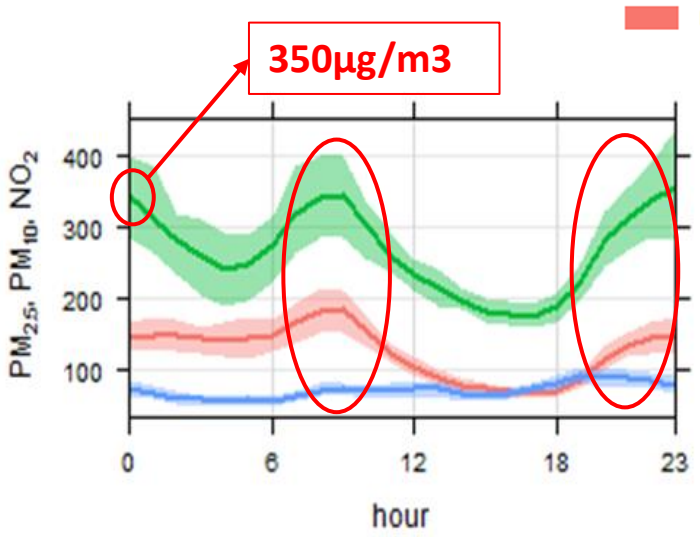


PM10 – March 1st Week

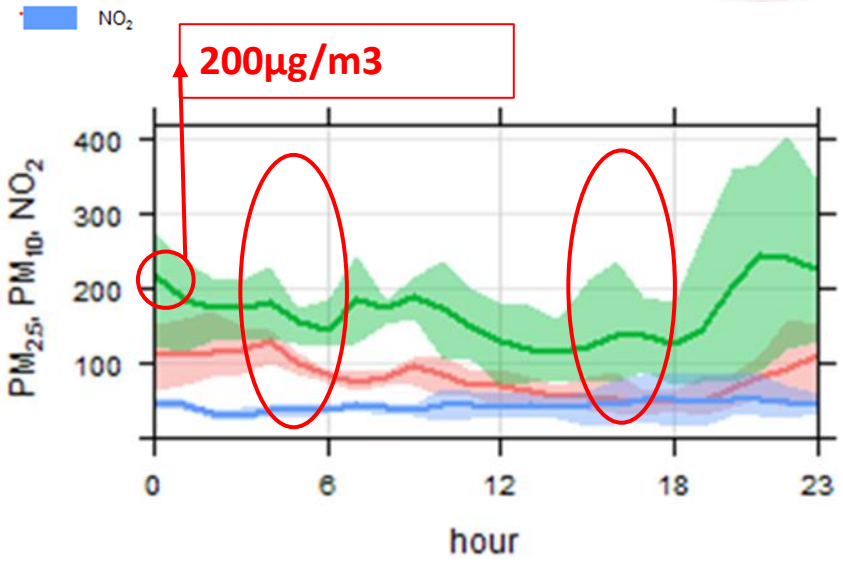


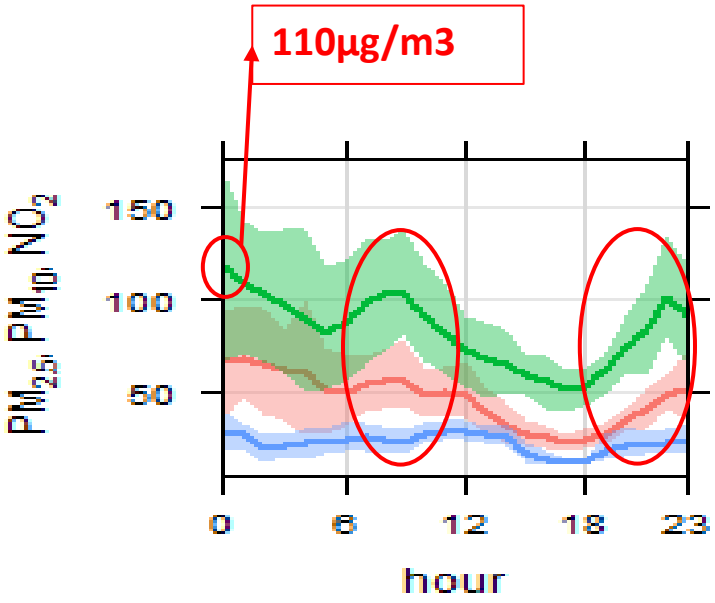
PM10 – March 2nd & 3rd Week

Concentration variation between February and March 2020

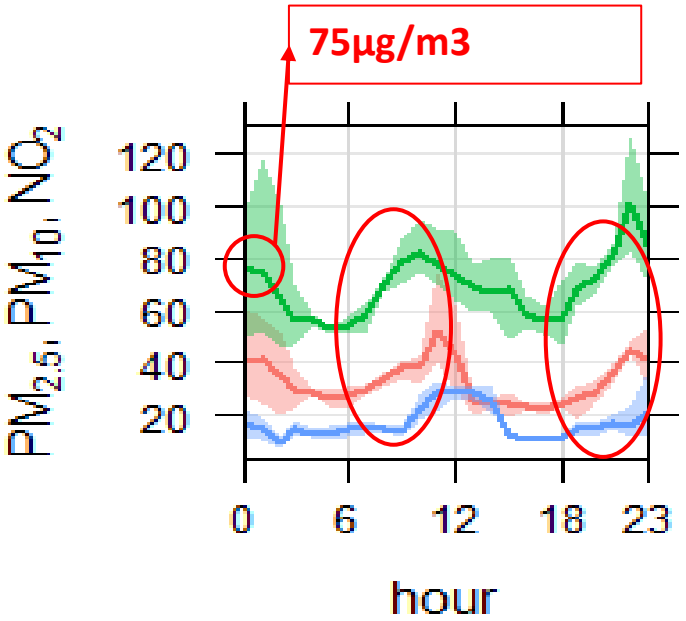


February 2020





March 3rd Week 2020



March 4th Week 2020

PM10 Concentration Trend between February and March 2020

Concentration Range [µg/m3]	PM10 – February [%]	March 1st Week [%]	March 3rd Week [%]	March 4th Week [%]
<100	0	25	100	100
100 – 200	35	55	0	0
200 – 300	50	15	0	0
<300	15	5	0	0

Comparison between February & March on PM10 concentrations are well reduced due to lockdown in Delhi and the vehicular emissions are drastically reduced. Mostly on March the maximum concentration range between 0 - 50µg/m3 are 100%. Where as on February the higher concentrations i.e more than 200µg/m3 is 65%.

Pollutants Concentration Trend between February and March 2020

Period	Peak Concentration [µg/m3]		
	PM10	PM2.5	NO2
PM10 – February	650	280	140
March 1st Week	420	160	85
March 3rd Week	250	110	52.5
March 4th Week	55	15	30

The concentration levels are reduced due to lockdown and the % reduction on peak concentration was higher. PM10 peak concentration is reduced around 79% (from 350µg/m3 to 75µg/m3), PM2.5 peak concentration is reduced around 95% (from 280µg/m3 to 15µg/m3) and NO2 peak concentration is reduced around 79% (From 140µg/m3 to 30µg/m3),

PM2.5 Concentration Trend between February and March 2020

Concentration Range [µg/m3]	PM2.5 – February [%]	March 1st Week [%]	March 3rd Week [%]	March 4th Week [%]
<50	5	22.5	72	100
50 - 100	42	60	18	0
100 – 150	30	10	10	0
<150	23	7.5	0	0

Comparison between February & March on PM2.5 concentrations are well reduced due to lockdown in Delhi and the vehicular emissions are drastically reduced. During February 50 – 150µg/m3 is around 72% and the same trend is on March 1st week but from 2nd week onwards this was reduced from 72% to 10%. Whereas less than 50µg/m3 is around 72% and 100%.

BEST QUALITY ASSURANCE SYSTEM

Good Sampling

Good Analysis

Coordination

Dr.S.Suresh Kumar
Chief Technical Director
Mobile No: 9940157123, 9884836199
Email: suresh@glenslabs.com