National Clean Air Program (NCAP)

The National Clean Air Programme (NCAP) in India was launched by the Ministry of Environment, Forest and Climate Change (MoEF & CC) in January 2019. The program aims to improve air quality in cities across the country. Non-attainment cities were identified based on historical ambient air quality. The CAP aims to:

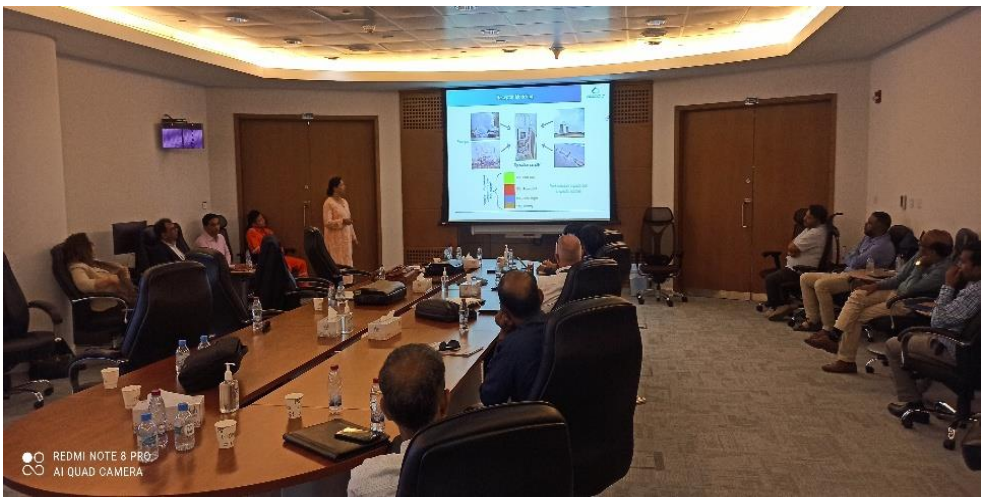
- Reduce particulate matter (PM) concentrations by 20-30% by 2024
- Reduce PM10 levels by 40% or achieve national standards by 2025-26

The program involves a collaborative approach between central ministries, state governments, and Urban Local Bodies (ULB). Under this program, CSIR-NEERI were entrusted with the responsibility of carrying out emission inventory and source apportionment studies in eighteen cities of Maharashtra and several other cities of states like West Bengal, Odisha, Meghalaya, and Andhra Pradesh. Studies were carried out for these cities spread across India by different zonal centres of NEERI at Mumbai, Kolkata and Hyderabad.

The study includes development of gridded emission inventory, sampling of PM_{10} and $PM_{2.5}$ on quartz and PTFE filter for chemical speciation using ED-XRF, Ion Chromatography and EC-OC analyser.

Some of the cities of Maharashtra are Mumbai, Navi Mumbai, Pune, Nashik, Nagpur, Solapur, Kolhapur, Amrawati, Aurangabad, Chandrapur, Thane, Jalgaon, Akola, Ulhasnagar, Jalna, Badlapur, Latur, Sangli. Twin Cities of Kolkata and Howrah, in West Bengal were studied.

While these studies were in progress, other agencies also approached CSIR-NEERI to get these studies much beyond the limited scope of non-attainment cities. Northen coalfields Limited (NCL), Singrauli sponsored a source apportionment (SA) study in their coal mining area spanning 25 km x 15 km, which is very large area and is a challenging problem considering spatially and temporally varying emission rate.



SA Study presentation by CSIR-NEERI at Ras Laffan Industrial City, Doha, Qatar.

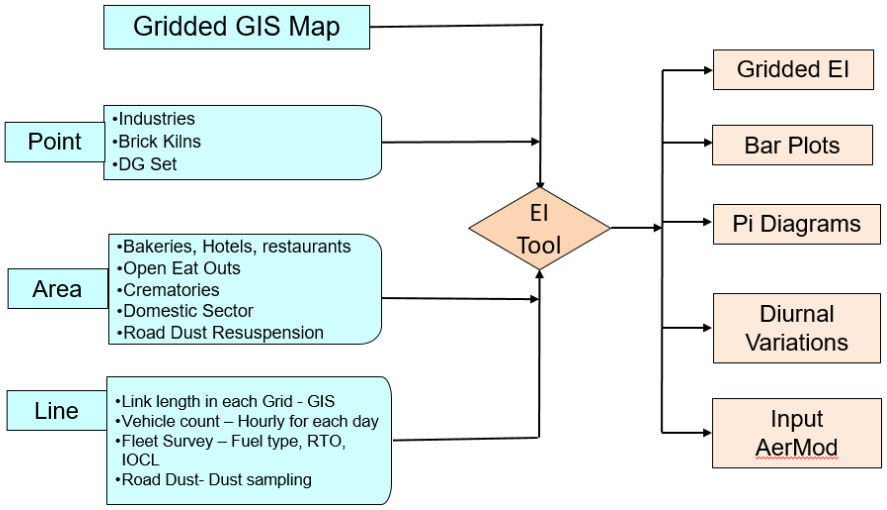
Switzerland Development Corporation (SDC) funded a project for advanced source apportionment study in four Indian cities namely Nashik, Pune, Lucknow and Kanpur in collaboration with Paul Scherre Institute (PSI).

Another major SA study was sponsored by Qatar Design Consortium (QDC) for Ras-Laffan Industrial City (RLIC), Doha, Qatar. These studies included sampling of PM_{10} and $PM_{2.5}$ from stacks of gas refineries, ambient air sampling of PM on PTFE and Quartz filter its chemical speciation using sophisticated analysers. The filters were conditioned at CSIR-NEERI, weighed it on micro-balance

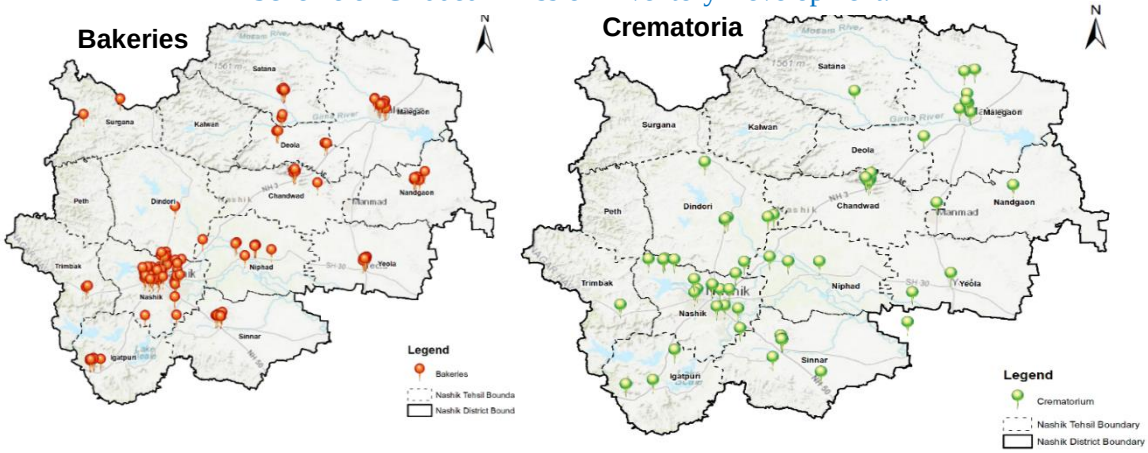
sending it to Qatar for field exposure followed by its return to lab for further analysis. The project is successfully presented before the authorities of RLIC, Qatar.

Gridded Emission Inventory Development

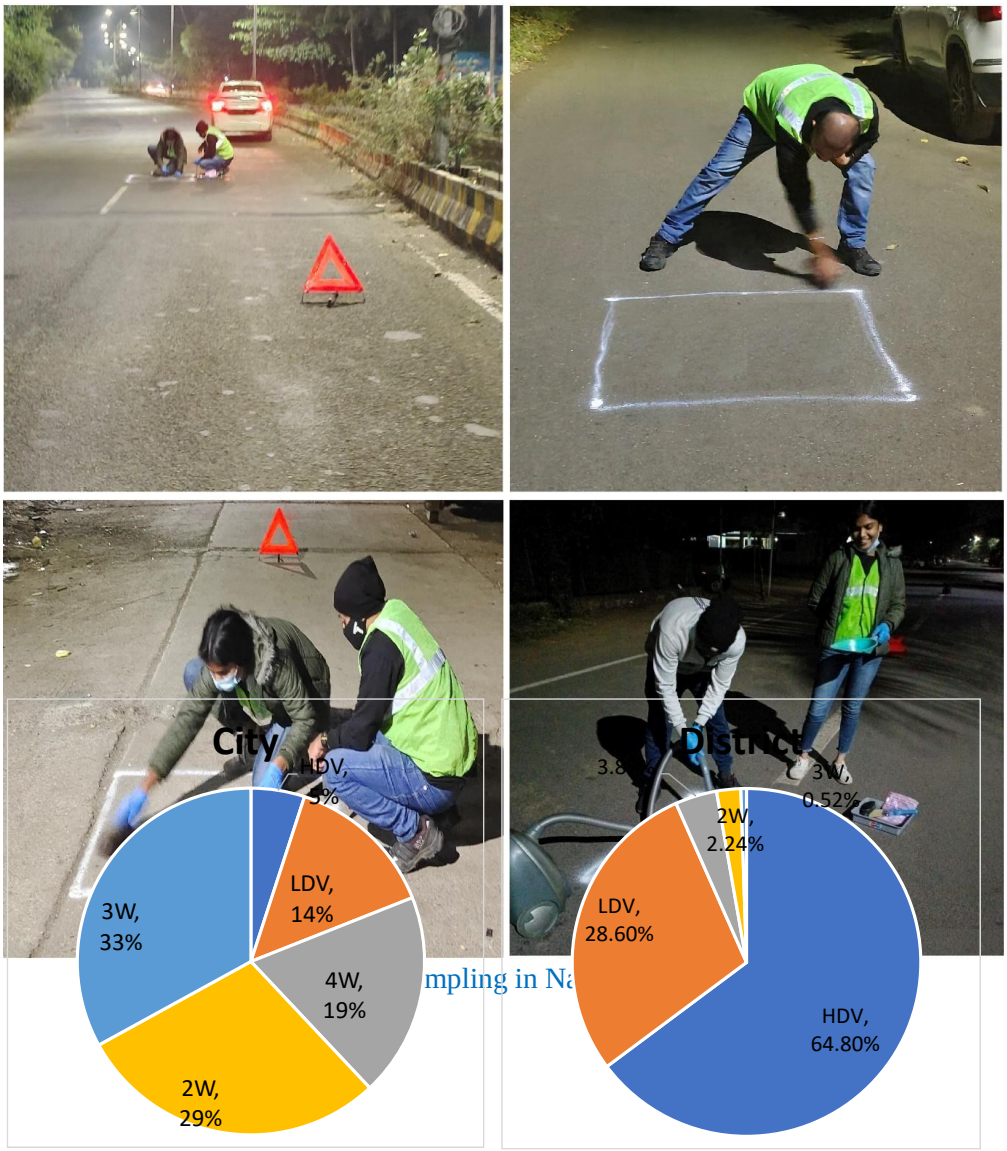
Computerized gridded emission inventory for urban area is developed, which makes the generation of graphical and tabular very fast if the activity data is available. The computerized tool is developed such that the input data sheet can be shared with each activity in-charge for updating it online. This helps in real-time gridded emission inventory generation. Different department / units of urban local bodies (ULB) like those dealing with fuel consumption record of hotels and restaurants, open eateries, bakery, crematoria, DG Sets, households; vehicle registration of traffic department can be given the soft copy of data sheet, which if uploaded can yield the online emission inventory. The activity of Nashik city and district is gathered in similar manner and the output generated.



Scheme of Gridded Emission Inventory Development.



Location of Bakeris and Crematoria in Nashik District.



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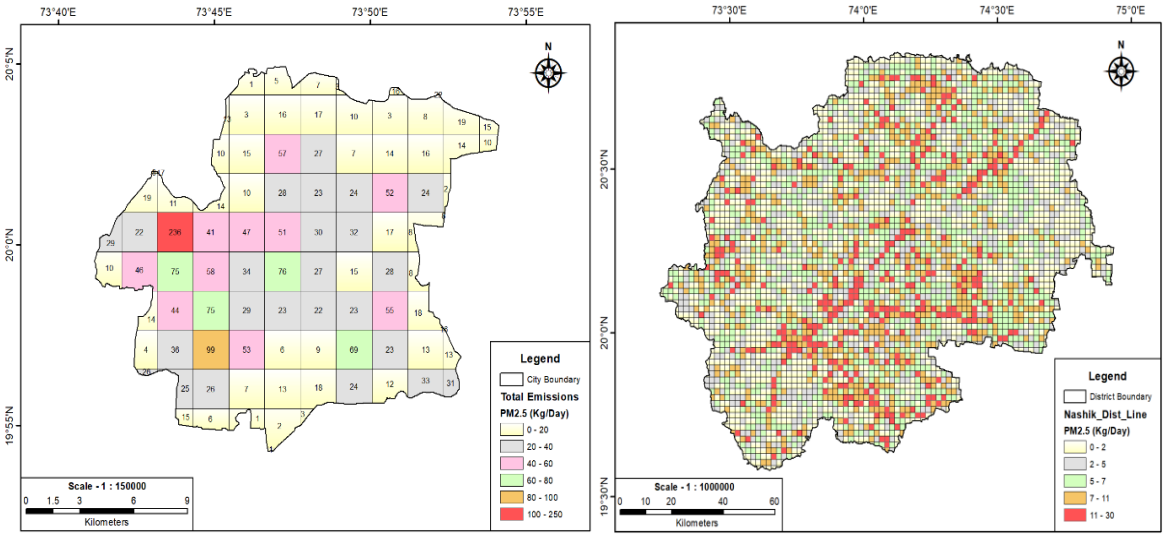
Particulate Emission Load from Line Source in Nashik City & District.

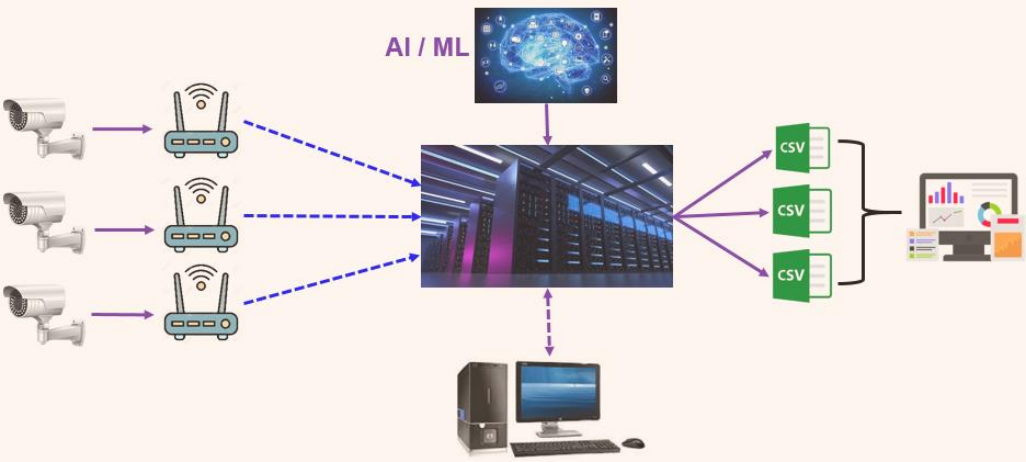


Gridded $PM_{2.5}$ emission load for Nashik City and District (Kg/d).

Artificial Intelligence based Machine Learning (AI/ML) Tool for Vehicle Identification and Counting

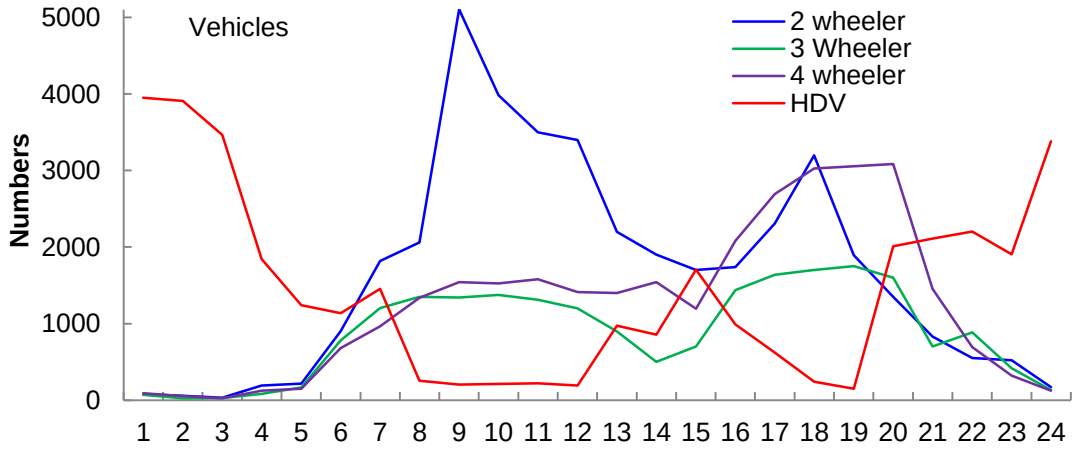
Currently the line source emission inventory consist of manually counting the vehicle for a short duration of few yours on any road cross-section by deploying half a dozen skilled workers. They identify and count the number of vehicles passing through like a cricket score board. Subsequently, the tabulated vehicle category is gathered for each road section and extrapolated for full day. This is further extended for the whole city roads. In the process of extrapolating for 24 hours from few hours data, the diurnal variation is not covered exactly and this introduces error.

Such error involved in short term counting is reduced by using CCTV Camera, which captures one full day data. The video of one full day is played on a big screen and a few skilled workers can count it leisurely, whenever they have time in a conducive environment. However, this has large manpower resource requirement

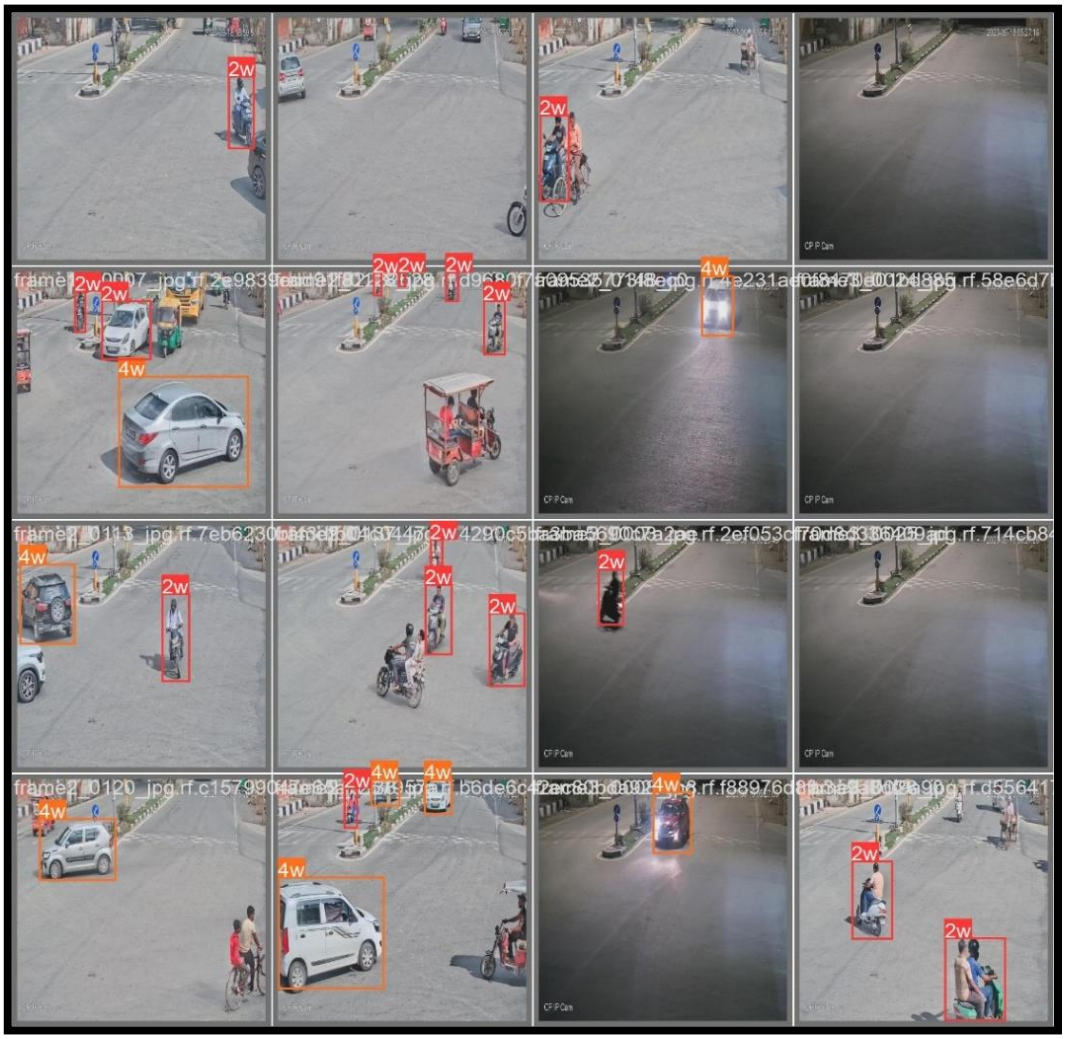


Real-time Vehicle Category Identification and Counting.

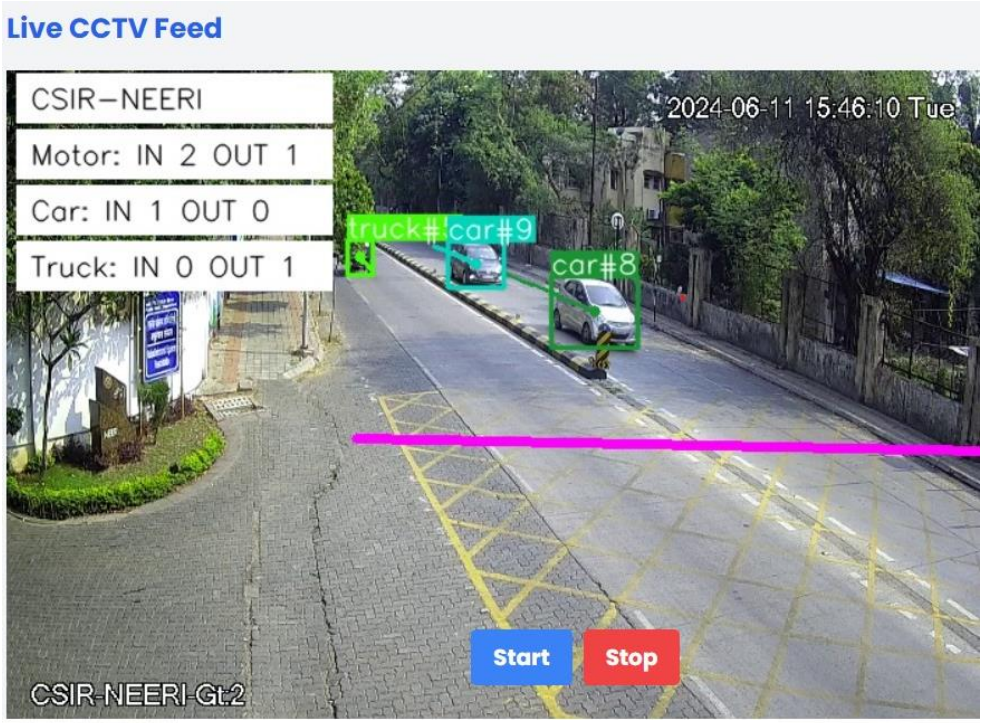
Air Resource vertical at CSIR-NEERI, Nagpur has developed an AI/ML tool, which can identify the vehicle and count it, thereby saving the man-hour spent on counting. This automation helps in quick output, which can be used subsequently for line source emission inventory generation. The additional benefit of such AI/ML based counting is traffic management, wherever a traffic flow direction is to be planned based on a particular type of vehicle, cross road traffic volume, provision of public service for last mile connectivity etc.



Diurnal Variation of Different Types of Vehicles.



Training of AI/ML for identification of different type of Vehicles.



Real-time Vehicle identification and counting.

Flue Gas Desulphurization

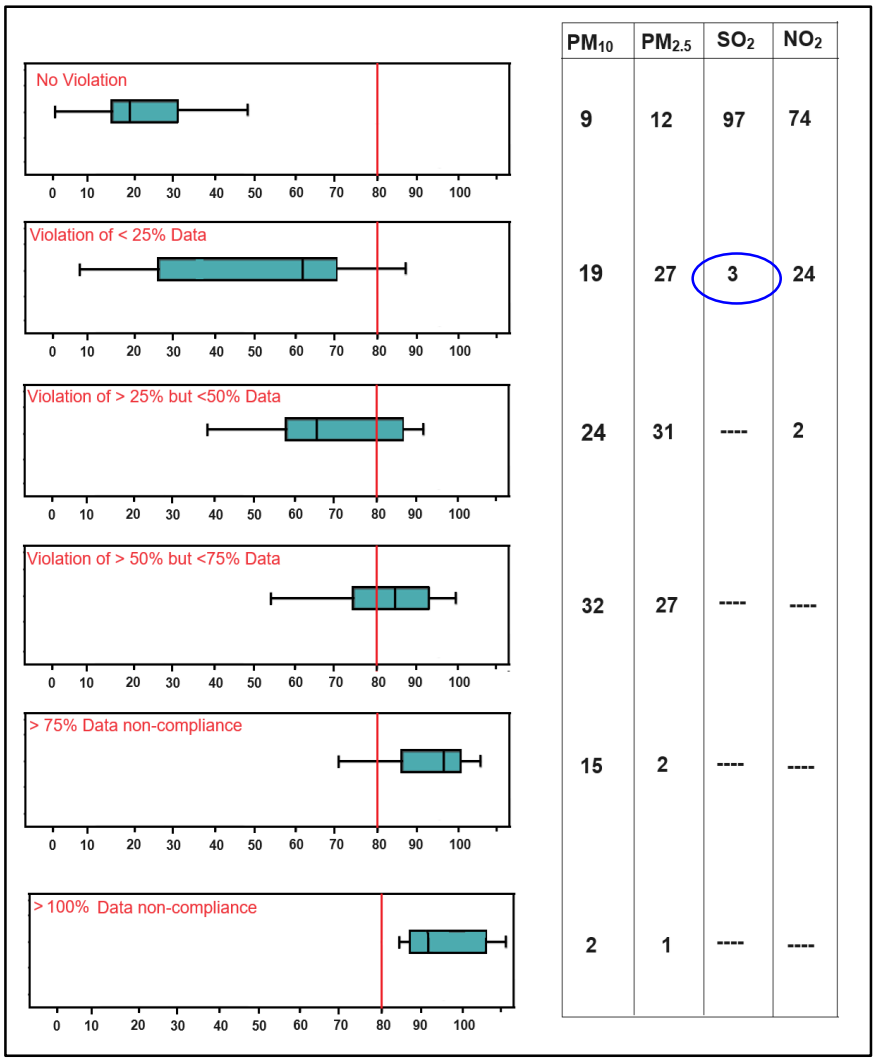
To reduce emission of SO_2 from coal based thermal power plant from its current 600 mg/Nm^3 to 100 mg/Nm^3, MoEF & CC issued relevant notification in December 2015. SO_2 emission from TPP can be reduced by installing flue gas de-sulphurisation (FGD) technology in the path of flue gas of TPP. Due to limited capacity of Indian industries, the TPP were compelled to procure it from other countries to be compliant on the time frame. This not only increase the cost of power, but also leads to outflow of foreign currency. Such notification for compliance in short duration can be compared to a jerk policy, that compels TPP to procure FGD from other countries thereby violating the Make-in-India policy.

It was felt very strongly by academic and research community that there was no prior study carried out to arrive at the need of lowering the SO_2 emission from 600 to 100 mg/Nm^3 for Indian coal based TPP. NITI Aayog, Delhi approached CSIR-NEERI, Nagpur to carry out a study by analysing air quality data generated by CAAQMS and other sources to understand the urgent need of lowering the SO_2 emission rate from Indian coal based TPP. CAAQMS data generated for four years at 464 stations were retrieved from CPCB server were analysed. It was found that among these many stations, only 3% of the stations were not in compliance that too for less than 25% of the observation among the four years data period.

Other studies with the objective of analysing SO_2 by monitoring and modelling were also carried out at Lalitpur Thermal Power Plant of Bajaj Energy Limited, Lalitpur U.P.; and Vedanta Aluminium Ltd. Jharsuguda, Odisha. The dispersion modelling results of SO_2 from TPP on mass balance and conservation leads to relatively high ground level concentration of SO_2. However, the ambient air monitoring does not reveal similar results. One of the major reasons of dissimilarity is mathematical model used in dispersion model, which does not consider the chemical transformation of SO_2 in the atmosphere leading to very conservative results.

Another study at coal field of NCL, Singrauli reveals similar findings. At this site, PM and SO_2 were monitored at the top of overburden dump, which coincides with the stack top height. Due to low level of SO_2, the sulphate content of collected PM was also analysed. Overall, it is found that due to lower emission load of SO_2 from Indian coal based TPP, the ground level is not impacted by the presence of high SO_2 levels.

After the notification, a few studies were carried out by reputed Institutes like IIT Delhi and National Institute of Advanced Studies (NIAS), Bengaluru on the necessity of reducing SO_2 emission and concluded similar outcomes. The report is available on NITI Aayog Web Site.



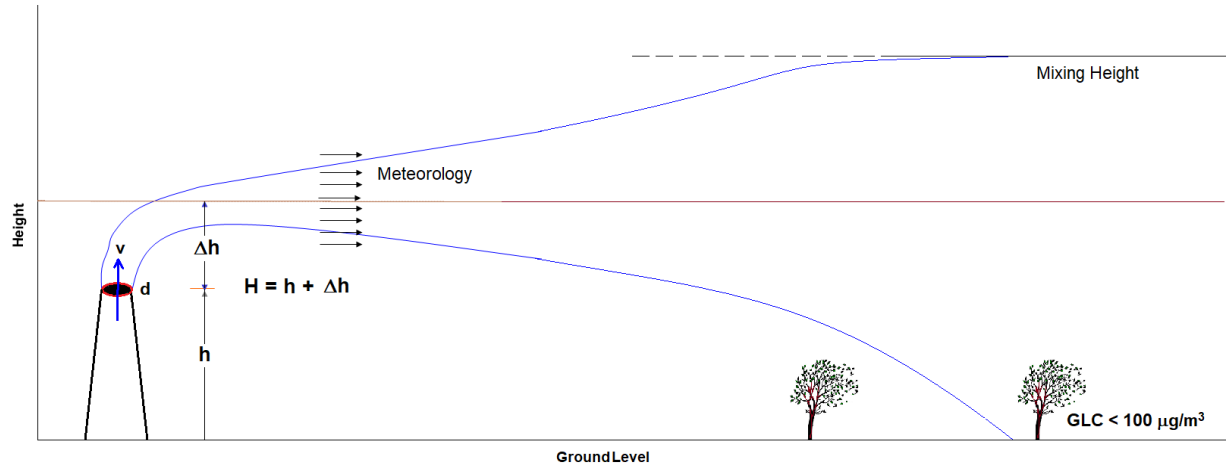
PM_{10}	$PM_{2.5}$	SO_2	NO_2
9	12	97	74
19	27	3	24
24	31	----	2
32	27	----	----
15	2	----	----
2	1	----	----

Pictorial presentation of compliance (%) status of air pollutants based on CAAQMS data.

Stack Height Determination for Viscose Filament Yarn Plant

Production of Viscose Filament Yarn (VFY) emits Carbon Di-Sulphide (CS_2) and Hydrogen Sulfide (H_2S). These extracted gases are diluted with ambient air and released high into the atmosphere so that the ground level concentration remains below 100 $\mu g/m^3$. As per the regulatory norms, only two stacks are permitted in the production facility with minimum distance between them as three times the taller stack for releasing the foul gases. The emitting gases are of lower temperature due to addition of ambient air at ground level for dilution before pushing the foul gases into the stacks. Low temperature lowers thermal buoyancy leading to relatively low plume rise. In order to achieve GLC as per the regulatory norms, the height of stack, top diameter, exit gas velocity all needs to be designed with due consideration of the assimilative capacity of the atmosphere.

M/s. Grasim Industries Limited (Unit- Indian Rayon), Veraval, Gujarat proposed to expand its VFY production capacity, requiring change in their old stacks, which were very short. The assimilative capacity of coastal region of Veraval, Gujarat measured as mixing height, ventilation is used in designing the stack height and emission properties to comply the regulatory requirements.



Visualization of dispersion of CS_2 from VFY plant.

Damage Cost Assessment

Monetary valuation of environmental damage by the industries or cluster of industries has been realized for the environmental restoration, welfare of receptor population, and preservation of environment and ecosystems. The principle of polluter's pay ensures to enforce the environmental laws as well as precautionary measures to be adopted by the polluters. The environmental compensation needs to be scientifically computed such that it ensures the liability on the polluter keeping in view the reasonability of the imposed cost for sustainable growth. A few recent environmental damage cost estimates are;

- Damage Cost Assessment due to Pollution Caused on Account of Fire incident at PHIN-2 Plant North side of Pharma Intermediate plant on April 20, 2020 at M/s. Atul Limited, Valsad, Gujarat

- Damage Cost Assessment due to the Pollution Caused on Account of Fire incident on November 29, 2023 at M/s. Aether Industries Ltd., Sachin, Dist.-Surat, Gujarat.

- Assessment of Damage to Environment and Suggestion for Restoration Plan in Morbi-Wankaner, with reference to Ceramic Industrial Cluster, Morbi, Gujarat.

Analytical Facilities for Air Quality Management

Conditioning of Poly Tetra Floro Ethylene (PTFE) is carried out in desiccator. Quartz Filter is backed in furnace at 400 ^{o}C followed by its desiccation and weighing in Micro-Analytical Balance of 1 □g least count.

Pre-weighed filters are exposed for sampling ambient air particulate matter (PM_{10} and $PM_{2.5}$) on PTFE and Quartz filter using federal reference method (FRM) sampler or four-channel speciation sampler.

Furnace for baking Quartz Filter

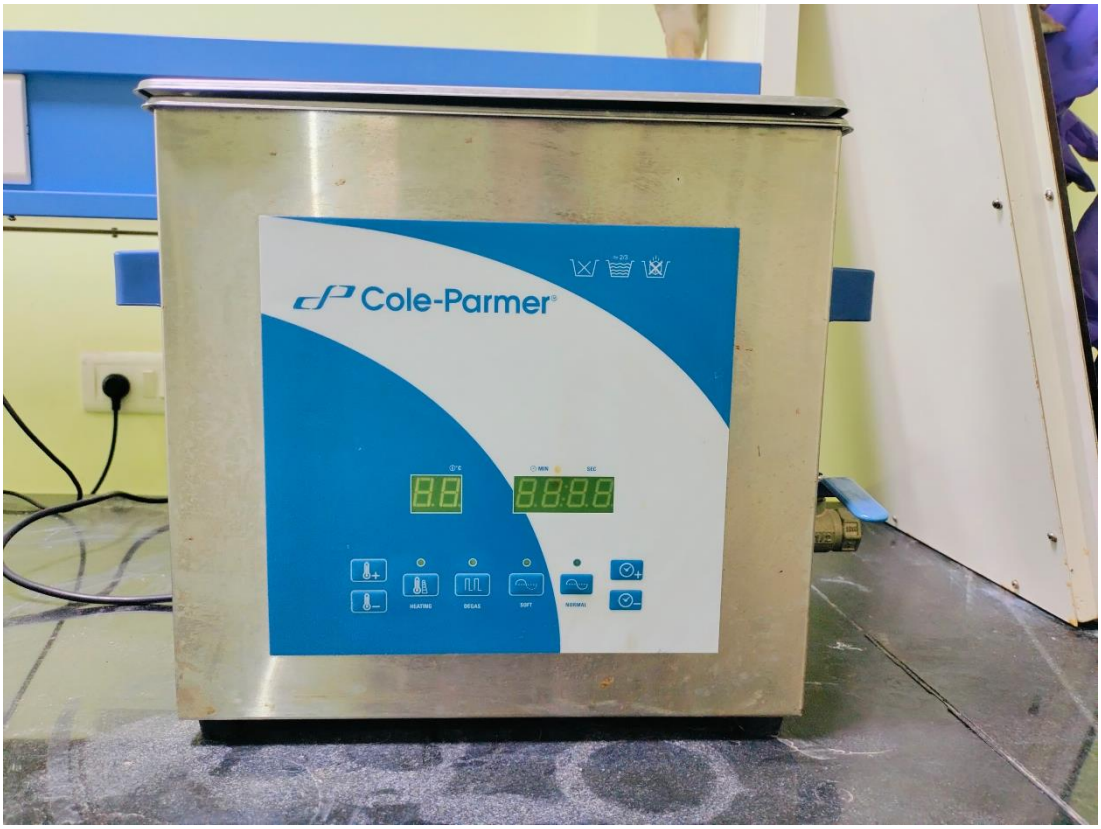
Micro-Analytical Balance
(Least Count 1 µg).

4 – Channel Speciation Sampler.

FRM Sampler

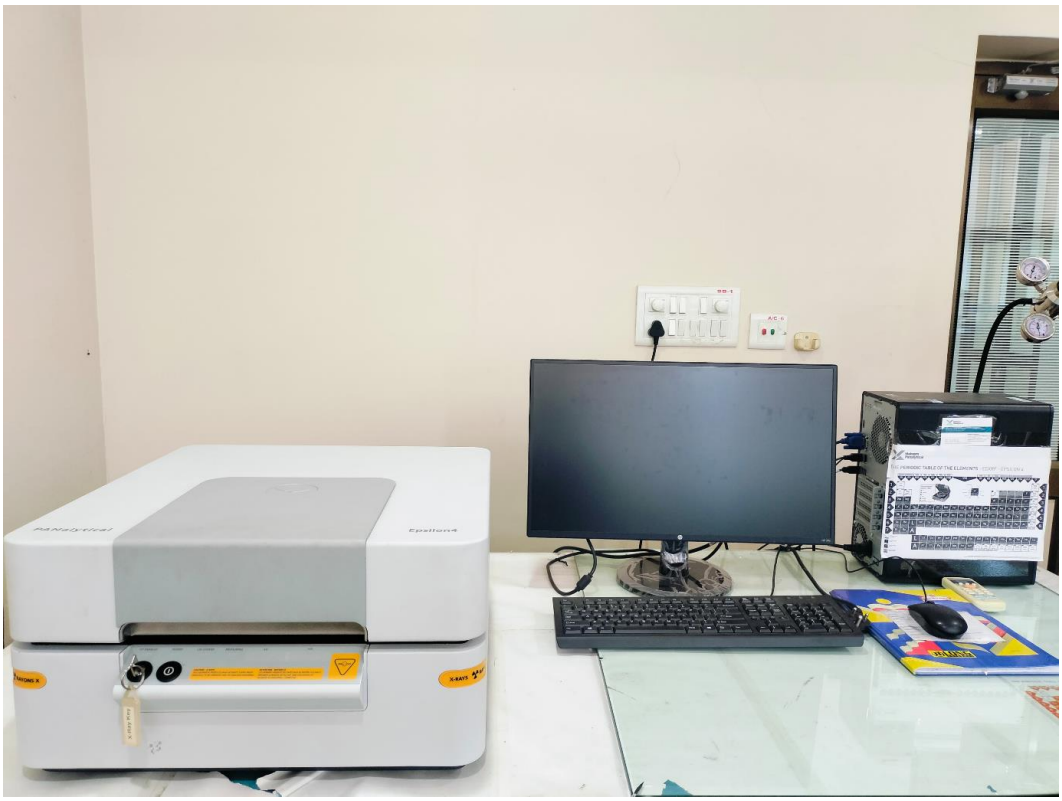
Particulate Matter collected on PTFE filter is analysed for its elements using Energy Dispersive – X-Ray Fluorescence (ED-XRF) analyser.

After the elemental analysis of PM collected on PTFE filter using Non-Destructive Technique (NDT) ED-XRF, the same filter is used for Cation and Anion analysis using Ion-Chromatograph (IC). The PM collected on Quartz filter is analysed for its organic and elemental carbon (OC, EC) using DRI Analyser. All collected chemical speciation data is further used in receptor modelling Positive Matrix Factorization (PMF) and Chemical Mass Balance (CMB).



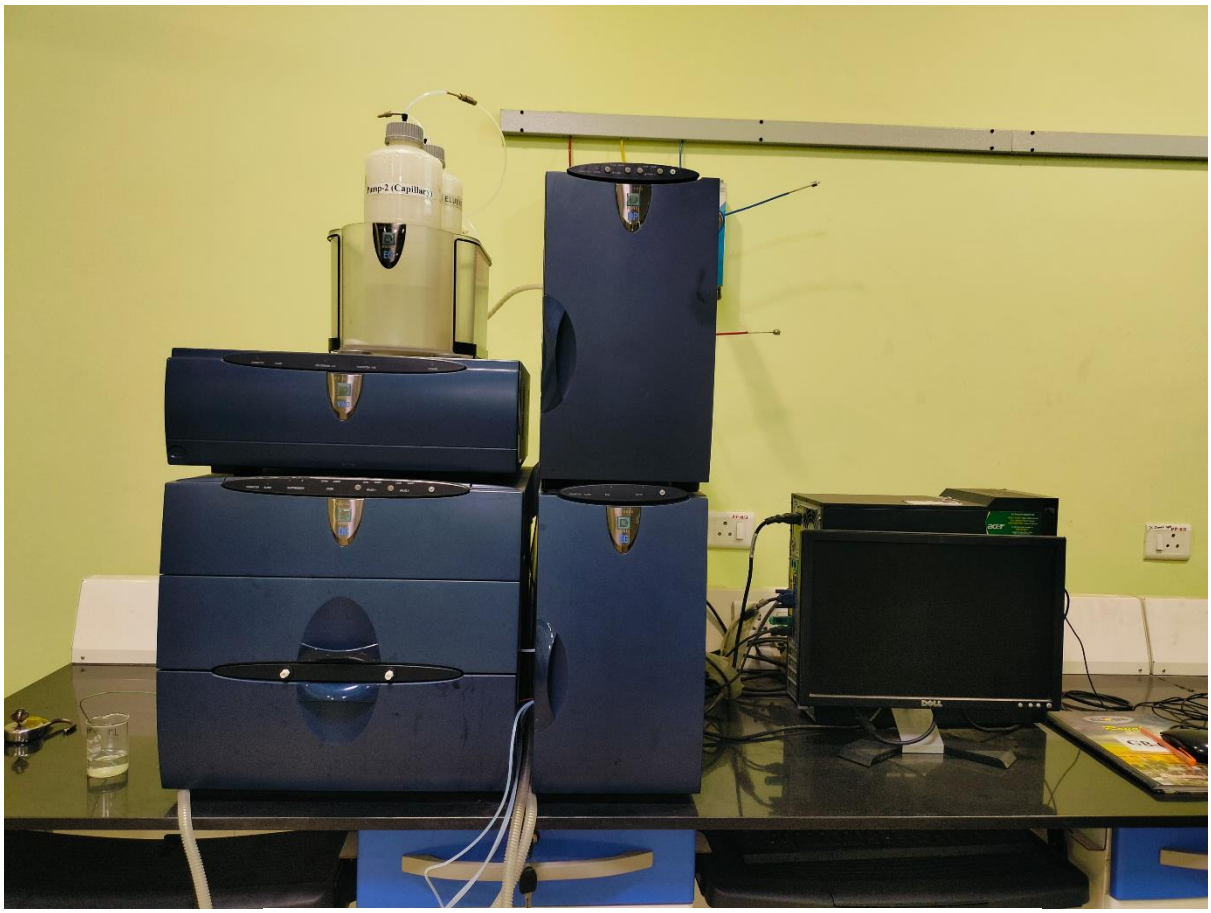
Sonicator.

UV Spectrophotometer.



ED-XRF Spectrophotometer Epsilon4 for elemental analysis.

Microwave Digestor.



Ion Chromatograph.

EC/OC DRI Analyzer.