

# **Air Quality Measurement**

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## **Introduction**

The Department for Environment Food and Rural Affairs (DEFRA) informs that the causes of air pollution are petrol and diesel motor vehicles, which emit the following pollutants: Carbon Monoxide, Nitrogen Dioxide, Volatile Organic Compounds (VOC), Ozone, Particulate Matter (including PM10 and PM2.5). This report focuses on the methods for the measurement of these pollutants.

## **Measuring Nitrogen Dioxide Pollutant**

For measuring Nitrogen Dioxide (NO<sub>2</sub>) the most popular method is Diffusion Tube. The diffusion tubes are 71 mm length and 11 mm in diameter, made of plastic. On top end it has a metal mesh disc and placed inside the tube, coated with Triethanolamine (TEA) is an absorbing substance hence able to absorb NO<sub>2</sub>. This tube is then fixed to a street light post or drain pipe at a height of 2-4 metre and with mesh side at the top. The bottom end cap is removed to let the air to go inside for a period of one month. After one month the cap will be replaced and the tube is taken to a laboratory, where the mesh is removed and washed with water. The next step is to shine ultraviolet (UV) light through the water in a container. The amount of UV light that is absorbed by the water is measured and is called the total concentration of NO<sub>2</sub>. This means of measuring NO<sub>2</sub> is not very accurate and the readings need to be revised based on a calibration process that uses a more accurate means, at least in one location, for comparison purposes. The UK Government has instigated a means to artificially reduce emission readings from diffusion tubes arguing that the location of these tubes is generally 2 to 4 metres away from the road supplemented by other illogical arguments. The truth of the matter is that these readings should be increased as the concentration of pollutants at roadside is much higher. The strategy to reduce the values of the actual readings is scientifically and morally wrong as it

gives a mother pushing a pram in a busy road an understating that the NO<sub>2</sub> readings are much lower hence safer, whereas they are actually much higher.

In some cities the local residents exercise their right to be involved to position and change the diffusion tubes on a monthly basis. The information collected is shown on some local Airmap website.

Plum Labs Flow 2 sensors is a low cost transducer costs about £136 for a portable type. It can detect the levels of 3 pollutants: NO<sub>2</sub>, Particulate Matter and Volatile Organic Compounds (VOC). The VOC are released from burning fuel such as gasoline, coal, natural gas and wood.

## **Ozone pollutant**

It can be produced from Nitrogen Oxides (NO<sub>x</sub>). Atoms of Oxygen can be freed from Nitrogen Dioxide under the action of visible hot sunshine during the Summer (June-August) time and react with oxygen molecules to produce Ozone (O<sub>3</sub>). NO<sub>x</sub> can react with Ozone and produce NO<sub>2</sub> and the cycle can continue.

In different environment Ozone can be found in the lowest layer of the atmosphere known "Tropospheric Ozone". The ozone found in this layer is bad Ozone. Tropospheric Ozone is a result of air pollution from vehicle exhaust and industrial emissions mainly NO<sub>x</sub> and VOC. The troposphere starts at the Earth's surface and extends 8 to 14.5 kilometres high (5 to 9 miles). This part of the atmosphere is the densest. Almost all weather is in this region.

Ozone pollution on a sunny calm day can be the major cause of summer smog. It can also damage crops, such as wheat, spinach, peas and beans. The cost is 5 billion pounds to the agriculture and farming industry around the world. The study for the United States indicates that human exposure to high concentration of O<sub>3</sub> for a long period leads to damage to the lower levels of lung which results in death. At this present time, Smog in some main cities around the world is causing respiratory diseases in unprecedented numbers in the population (Reference: Care4Air Organisation).

For Ozone pollutant, there are detectors and meters which are hand held with rechargeable batteries and other sensors available for NO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub>, with cost under £200 from Amazon online.

Sensors such as AQMesh small type (Bird size unit) are available for different air quality measurement. It can measure NO<sub>2</sub>, O<sub>3</sub>, Carbon Monoxide (CO), Sulphur Dioxide, PM10 and PM2.5. It can be attached to a lamp post by an engineer for monitoring. It can also be powered by various power options, including battery and solar pack. It is chosen for the following reasons: quality, accuracy, multiple power choice, easy installation and managed from online dashboard. The manufacturer provides ongoing support to users (info@sqmesh.com).

The monitoring takes place in various environment, for example, outdoor air monitoring, such as roadside (at hot spots), or inside a vehicle such as in taxis and inside buses. The concentration of pollutants in these types of vehicles has been well above the permitted levels. Reputable public transport companies have taken measures to reduce the level of pollutants to acceptable levels. Until recently, indoor the residential building was not the focus of clean air priorities, but it is now.

## **Particulate Matter Pollutant**

These are very fine solid particles. Dust and soot are fine particles. The size of particles determines where they affect our health. Particles smaller than 10 micron, PM10, can penetrate into our lungs and cause damage. There are instruments that can be used to measure fine particles such as PM2.5 and PM10. The human hair width is 90 microns. Our life expectancy depends on the length of time we have been exposed to breathing polluted air with fine particles throughout our life (reference.care4Air).

For monitoring dust and other fine particles various types of instruments are used; the choice of instrument depends on the application and environment. For example, the one of the instrument for monitoring to measure dust and particulate matter PM10 and PM 2.5 is called Aeroqual Dust Pro. It measures and reports on data measure on a real-time basis and in one minute intervals. It is in a robust weatherproof lockable container made in New Zealand. It can be carried by one person to different sites and set up for measurement. It looks similar to portable building surveying instrument from the size point of view. There are smaller low cost portable air sensors monitoring PM 10 and PM2.5 under ISO 900:2008. As these devices become more available, people becoming

more interested to know what is in the air that they are breathing in (Reference: US EPA and Aequal).

About 2 years ago, the Guardian reported “thousands of people are using home air quality monitoring kits due to fears official figures are not capturing dangerous particle levels, as claimed by the Friends of Earth”.

A number of councils in the UK seem to miss deadlines to submit plans required by Ministerial direction. DEFRA warns consequences for missing government deadlines. For example, Bristol City Council has missed another Government deadlines for progressing its plan to tackle illegal air pollution. Bristol has been under pressure for its work to bring levels of NO<sub>2</sub> within legal limits.

Environmental lawyers fire warning to councils on legal risk of air pollution inaction. Greenpeace said ministers were in no position to “shake their fists” at cash-trapped councils. It adds “while it is right that local authorities are being reminded to play their part in tackling air pollution, the government’s message would carry more weight if ministers had practised what they were preaching”. Instead, they failed to rein in illegal air pollution for years and are still delaying the measures we need to clean up our air” (Reference: Guardian News 2019).

## **Conclusion**

In accordance with DEFRA, UK is in compliance with the limits of pollutant concentration and respects what is set out in the legislation, with the exception of Nitrogen Dioxide, which is the very toxic pollutant damaging human health. There is an air quality plan for NO<sub>2</sub> to ensure compliance limit as soon as possible. Reduction required by 2030 is 73%; therefore the ceiling for 2030 is 463 (Kt). DEFRA states that the emission projections are by Ricardo Energy and Environment on behalf of DEFRA. Random measurement carried out by local residents has clearly proven that in many hot spots there are not Particulate Matters measurement and that in many cities and towns the level of NO<sub>2</sub> is well above the government own targets. Sample hospital admission figure for example in Coventry has shown the numbers admitted for respiratory problems have steadily increased in line with the sample measurements of NO<sub>2</sub> levels in the City. There is therefore a proven correlation between air quality and admissions for respiratory difficulties to local hospitals.

It is at present the start of a cold winter for 2020 and the difficulties continue. In UK uncertainties about the BREXIT certainly has not help the economy. It is hoped that in the near future, when storms of bad politics has passed, hopefully not only in the UK but the rest of the world too, the people in power would make the right decisions to bring about means to comply with UN Environment targets. All pollutions particularly GHGs gases into atmosphere are still increasing so the governments, including ours, have failed in their basic and declared policy of safeguarding our well-being.

With reference to the theme “Protecting the planet for future generations”, the author would like to close this report with a message in the Guardian by John Bird – House of Lords. It reads “For those in power, the questions are straightforward. Are they prepared to jeopardise their careers - or their profits - for our children’s children? Are they ready to put short-term politicking aside and help deliver a sustainable plan for the future? Are they willing to take difficult decisions on behalf of voters they will never meet? These questions have guided my future generations’ bill. It is a direct response to the challenge posed by those striking for the greener climate: at a national level, it will ensure that future generations are counted for at every level; of politicking. As a father and grandfather, the author knows what kind of ancestor I want to be. The question is how many parliamentarians feel the same?”

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