Air pollutants measured in Cattewater Harbour,

Summary on their WHO suggested limits and main impacts on health

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This summary lists all main air pollutants measured at the Cattewater harbor, the WHO limits where they are known to start to be harmful and their impacts on health and the environment. As no harmful values were observed in the data sample, this report aims to support the interpretation of the air pollutants potential impacts when measured in the Cattewater harbor. The World Health Organization data have been used as a main reference.

1. Tropospheric ozone

Tropospheric ozone is formed by the interaction of UV sunlight with precursors, which are gases present in lower layers of the atmosphere. It is not measured itself but the following precursors gases are. Ozone is a powerful oxidant and tropospheric ozone can have adverse effects on human health and ecosystems. It is a problem mainly during the summer months where the high concentrations of ground-level ozone adversely affect the human respiratory system. There is evidence that long-term exposure accelerates the decline in lung functions with age and that it may impair the development of lung function in children and babies. Some people are more vulnerable to high concentrations than others, with the worst effects generally being seen in children, asthmatics and the elderly. High concentrations in the environment are harmful to crops and forests, decreasing yields, causing leaf damage and reducing disease resistance. The Department for Environment, Food & Rural Affairs recommends that the limit of 100 $\mu g/m^3$ should not be exceeded more than 10 times a year [DEFRA limits].

Tropospheric Ozone presence is caused by emissions of non-methane volatile organic compounds (NMVOCs), nitrogen oxides, carbon monoxide and methane, mostly from industry and transport [EEA ozone]. Those gases and their impacts are listed below.

1.2. Methane

Methane (CH_4) is non-harmful itself but it is a known ozone precursor, with a limit fixed at 10 mg/m^3 daily to meet ambient air quality EU/DEFRA requirement [EEA ozone].

Another group of air pollutants is known as a main precursor for tropospheric ozone and is known as NMVOCs for Non-Methane Volatile Organic compounds [UK NMVOCs].
Below are listed the main NMVOCs measured by Cattewater harbor's sensors:

1.3. Carbon monoxide

Carbon monoxide is a colorless, non-irritant, odorless and tasteless toxic gas. It is produced by the incomplete combustion of carbonaceous fuels such as wood, petrol, coal, natural gas and kerosene. Breathing the high concentrations of CO typical of a polluted environment leads to reduced oxygen (O_2) transport by hemoglobin and has health effects that include headaches, increased risk of chest pain for persons with heart disease, and impaired

reaction timing. The daily limit fixed by [DEFRA] is of 10 mg/m^3 and has not been exceeded in the considered data.

1.4. Propane

Propane itself is not harmful. A high concentration can displace oxygen in the air and if less oxygen is available to breathe, symptoms such as rapid breathing, rapid heart rate, clumsiness, emotional upsets and fatigue can result. No high concentration has been seen in the data sample.

1.5. Butane:

The inhalation of butane at high concentration can cause euphoria, drowsiness, unconsciousness, asphyxia, cardiac arrhythmia, fluctuations in blood pressure and temporary memory loss. No high concentration has been seen in the data sample.

1.6. Formaldehyde

The WHO guidelines fixe a daily limit of 0.1 mg/m^3 [WHO CH2O] for formaldehyde. Many adverse effects result from exposure to formaldehyde, such as irritation and burns. They are observed primarily in those tissues or organs with which formaldehyde first comes into contact. At concentrations higher than those 0.1 mg/m^3, formaldehyde may also contribute to the induction of generally small, reversible effects on lung function. The airborne concentrations of formaldehyde in the sample data are less than those associated with sensory irritation.

2. Nitrogen dioxide

Nitrogen dioxide is an air pollutant which can be harmful to humans. At short-term and at concentrations exceeding 200 µg/m^3, it is a toxic gas which causes significant inflammation of the airways. NO_2 is the main source of nitrate aerosols, which form an important fraction of particulate matter, $PM_{2.5,}$ and, in the presence of ultraviolet light, of ozone. The major sources of anthropogenic emissions of NO_2 are combustion processes: heating, power generation, and engine combustion in vehicles and ships. Studies have shown that symptoms of bronchitis in asthmatic children increase in association with long-term exposure to NO_2 [WHO]. Reduced lung function growth is also linked to NO_2 at concentrations currently measured in cities of Europe. The current WHO guideline values of 40 µg/m^3 as an annual mean limit and 200 µg/m^3 as an hourly mean were set to protect the public from the health effects of NO_2. In the data provided, those limits were not exceeded.

3. Ammonia

Ammonia in the air is released by various industries and will mostly be degraded into nitrogen in the water and soil. Excess nitrogen can cause eutrophication and acidification effects on semi-natural ecosystems, which in turn can lead to species composition changes and other deleterious effects [Bobbink et al., 2010]. Exposure to high concentrations of ammonia in air causes immediate burning of the nose, throat and respiratory tract. This can cause bronchiolar and alveolar edema, and airway destruction resulting in respiratory distress or failure. Inhalation of lower concentrations can cause coughing, and nose and throat irritation. No high concentration of ammonia was found in your data sample.

4. Particulate matter

Particulate matter (PM) is one of the main indicators used to assess air quality [WHO PM]. It consists of a complex mixture of solid and liquid particles of organic and inorganic substances suspended in the air mostly sulfate, nitrates, ammonia, sodium chloride, black carbon, mineral dust and water [WHO PM]. While particles with a diameter of 10 microns or less, ($\leq PM_{10}$) can penetrate and lodge deep inside the lungs, the even more health-damaging particles are those with a diameter of 2.5 microns or less, ($\leq PM_{2.5}$). $PM_{2.5}$ can penetrate the lung barrier and enter the blood system. Chronic exposure to particles contributes to the risk of developing cardiovascular and respiratory diseases, as well as of lung cancer.
Air quality measurements are typically reported in terms of daily or annual mean concentrations of PM_{10} particles per cubic meter of air volume (m^3). There is a close, quantitative relationship between exposure to high concentrations of small particulates (PM_{10} and $PM_{2.5}$) and increased mortality or morbidity, both daily and over time. Small particulate pollution has health impacts even at very low concentrations. No threshold has been identified below which no damage to health is observed. Therefore, the WHO 2005 guideline limits aimed to achieve the lowest concentrations of PM possible. For fine particulate matter ($PM_{2.5}$) those limits reach 10 $\mu g/m^3$ and 25 $\mu g/m^3$, respectively for the annual and 24-hour mean [WHO PM]. For coarse particulate matter (PM_{10}) 20 $\mu g/m^3$ and 50 $\mu g/m^3$, respectively for the annual and 24-hour mean [WHO PM]. Those limits were not reached in the considered data.

References:

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