



ENVIRONMENTAL MONITORING AT ONE OF THE WORLD'S MAJOR PORTS

Port of Antwerp is undertaking an impressive range of environmental initiatives that go beyond mere regulatory compliance. As a public limited company, with the city of Antwerp as the sole shareholder, the port employs more than 1,600 employees, and aims to be Europe's most sustainable port, reconciling economic, social and ecological interests. In the following article, we will examine the port's challenges and explore the ways in which environmental monitoring is driving a wide variety of improvement projects.

Historical pollution at ports

For a number of reasons, ports represent one of the most challenging environments to protect and improve. Historically, rivers have been treated as convenient recipients of both industrial and municipal waste, and many have transported and deposited this waste in ports. Simultaneously, the environmental impacts of the shipping sector were largely unregulated in the past. The combustion of heavy fuels and degassing caused the release of sulphur dioxide, nitrogen oxides, particulate matter and volatile organic compounds (VOCs), and significant quantities of wastewater were routinely discharged into marine waters. Ports have therefore become a focal point for pollution, and as Europe's second largest port, Antwerp is faced with a number of significant challenges.

Port of Antwerp

Napoleon Bonaparte ordered the construction of Antwerp's first lock and dock in 1811. Since that time, the port has seen considerable development and now operates 24 docks with a total port area of 12,068 ha. Recent development has focused on the creation of fast turnaround tidal berths, both on the Right Bank (Europa Terminal and the North Sea Terminal) and on the Left Bank (Deurganck Dock).

Port of Antwerp received its first barrels of crude oil in 1861, and is now situated next to the largest cluster of petrochemical companies in Europe. The port now handles an annual volume of more than 223 million tonnes of maritime freight, and has become the largest integrated maritime, logistics and industrial platform in Europe.

In February 2021, the City of Antwerp and the City of Bruges reached an agreement to merge their respective ports following a unification process that is expected to take one year. Thereafter, the ports will operate under the name 'Port of Antwerp-Bruges'. In this way, the ports will strengthen their positions in the global logistics chain and perpetuate their sustainable growth.

Sustainability

The sustainability policy and business plan of the Antwerp Port Authority are built around five of the United Nation's core Sustainable Development Goals (SDGs): Good health & wellbeing; Decent work & economic growth; Industry innovation & infrastructure; Sustainable cities & communities, and Climate action. However, in 2019 over 100 employees participated in workshops to define clear objectives and measurable performance indicators for all 17 SDGs, including for example, SDG 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development. The ambitions identified by the workshops are being integrated into the port's strategic plan.

Several initiatives are underway as Antwerp aims to be a climate-neutral port by 2050:

- The Solar Mirror Plant in Kallo on the left bank is generating green heat from concentrated sunlight – a practice that has never been applied in Europe before. Other renewable energy projects are underway, including biomass incineration and there are a growing number of wind turbines in the port area (currently 80). Together, more than 200 mW of energy is being produced from biomass and wind, which is enough to supply power to around 140,000 households per year.
- A 'power-to-methanol' project began in 2020, aiming to produce 8,000 tonnes of sustainable methanol annually by reusing captured CO₂ in combination with sustainably produced hydrogen, which will reduce extra CO₂ emissions by at least 10,000 tons.
- Collaborative efforts are seeking to establish ways in which hydrogen can be generated, imported, stored and transported as an essential component of a low-carbon ecosystem.
- Residual heat is being reused by industry, and by buildings in the port and the city.
- Port of Antwerp is also greening its fleet by reducing energy consumption and commissioning the construction of a hydrogen-powered tug-boat and a methanol-powered tug-boat.

Regulatory environmental monitoring

Monitoring is undertaken jointly by the Port of Antwerp and Vlaamse Milieumaatschappij (VMM) the Flemish Environment Agency. There are no laboratories in the port, but water and sediment samples are collected on a monthly basis and tested in VMM and commercial laboratories. Water testing is conducted for a wide variety of parameters in compliance with the requirements of the EU Water Framework Directive (WFD).

Air quality is monitored at the port, with measurements taken for sulphur dioxide, nitrogen oxides, particulate matter, black carbon, ozone, volatile organic compounds and PCBs. These measurements are compared with both European standards and World Health Organisation recommended values.

Belgium has also ratified the International Convention for the Prevention of Pollution from Ships (MARPOL), so it has a responsibility to enforce these regulations which cover accidental and operational releases of oil, noxious liquids, marine pollutants, sewage and garbage. MARPOL also covers emissions to air for SO_x and NO_x.

Non-regulatory environmental monitoring

Explaining the importance of environmental monitoring and intelligence, Environmental Services Manager Laura Verlaeck



iNose

says: "Our stated goal is to build Europe's most sustainable port in harmony with society and the environment. To achieve this, in conjunction with our SDG ambitions, we need to fully understand current environmental conditions and the factors that affect them, so that we can improve our strategic decision-making and make informed investment decisions, for example.

"This means that we need to be able to continually monitor water, sediment and air quality and synthesise this data to derive actionable insights that improve our business. A number of important monitoring initiatives are therefore underway."

In addition to regulatory monitoring, the VMM network of air quality monitoring stations is also able to help with the investigation of odour complaints. For example, in April 2021, raised levels of benzene were detected at the same time as several reports of odour nuisance. The benzene levels were not found to have breached safety levels, but the monitoring data is helping investigatory work to identify the source.

Air quality in the port and surrounding areas can be affected by degassing, loading or unloading ships, and from industrial process emissions or accidental releases. These emissions are a concern; not just because of health and safety, but also because of unpleasant odours. A network of 'iNoses' has therefore been installed around the port.

iNoses employ multiple sensors to measure up to 30 parameters including volatile organic compounds, particulate matter and NO₂. As low-cost monitors, they can be deployed at multiple locations and the port is currently expanding the network from 50 to 80 stations. "The instruments do not provide absolute measurements, but they are able to detect changes and trends in air quality," Laura explains.

A further advantage of multiple monitoring points is that it provides the port with the ability to identify pollution hot-spots and/or air quality deviations that take place at a specific time or when specific activities take place. It is anticipated, therefore, that the iNose network will be further developed so that it can become an early warning system; helping the port to enforce air quality regulations.

Air Quality

Funding from Port of Antwerp, the municipality of Beveren and VMM has facilitated the creation of a network of twenty air quality monitoring stations that are located around the port. Data from these stations are summarised by VMM in an annual report, the most recent of which made the following conclusions:

- Since 2000, there has been a downward trend for the pollutants sulphur dioxide (SO₂), nitrogen dioxide (NO₂), PM2.5 particulate matter and non-methane volatile organic compounds (NMVOC).
- Since 2009, there has been a downward trend for PM10 particulate matter and black carbon.
- Since 2015, the downward trend has not been continued for SO₂, NO₂, PM2.5 and NMVOC.
- The annual mean ozone (O₃) concentration shows a slightly upward trend. The information threshold for ozone was exceeded 11 times in 2019, but the alert threshold and the European target value were respected.

Summarising, Laura Verlaeckaert says: "Air quality improved significantly between 2000 and 2015, but since then most of the main parameters have remained at approximately the same level.

"Currently the air quality parameter of greatest concern is NO₂ because it is one of the major causes of premature deaths in EU countries (54,000 in 2018). While the concentrations at all measurement locations were below the European limit values and the WHO guideline value, the measured values in the port were 20% higher than the Flemish average.

"Our work has shown that in 2018 35% of the NO₂ was derived from industry, 23% from the energy sector and 34% from traffic. Also, 30% of the traffic NO₂ sources were derived from shipping."

The data on NO₂ sources provides an insight into the port's environmental strategy, in that environmental contaminants rarely originate from a single source, so collaborative efforts are usually required. This desire to work with partners is a common feature

among all of the port's environmental/ sustainability projects, and reflects the port's multifunctional status as a regulator, operator, landlord and community builder. One such initiative with Railport and Infrabel is seeking to double the proportion of goods transported by rail via the port by 2030.

"This will reduce the release of traffic-related pollution whilst also helping in the fight against climate change," Laura explains. "A freight train takes an average of 50 trucks off the road. It also emits 9 times less CO₂, causes 8 times less air pollution, is 6 times more energy efficient and reduces road congestion."

The Port of Antwerp is a participant in the Environmental Ship Index (ESI), which is an environmental initiative designed to incentivise ships to improve air emissions beyond those required by the current International Maritime Organisation standards. The ESI evaluates the amount of nitrogen oxides (NO_x), sulphur oxides (SO_x) and greenhouse gases (GHGs) released by a ship to derive the 'ESI Score'. The Port of Antwerp provides a financial incentive to ships with discounts on the tonnage dues granted for each call that the ship makes. A sliding scale of discounts (up to 15%) is available depending on the ship's ESI score.

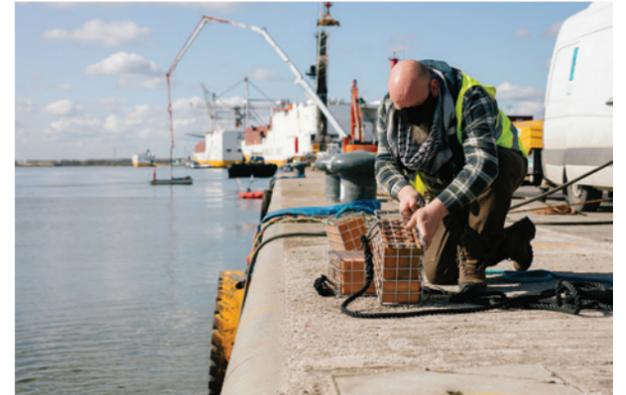
Water Quality

Over the last 20 years, water quality at the Port of Antwerp has improved considerably, with 'good' status achieved in comparison with the Environmental Quality Standards (EQS) for the priority substances listed under the WFD, except for four substances: TBT, dissolved arsenic, dissolved boron and dissolved uranium.

Tributyltin (TBT) was employed for several decades as a biocide in anti-fouling paint, applied to the hulls of ocean going vessels to improve ship performance and durability. However, TBT slowly leaches into the marine environment where it is highly toxic. In 2008 organotin compounds such as TBT were banned under the Rotterdam Convention and by the International Convention on the Control of Harmful Anti-fouling Systems on Ships of the International Maritime Organisation. Nevertheless, TBT remains a common problem in the water and sediments of ports, due partly to its affinity to suspended solids, which results in higher concentrations in sediments.

In 2020, the Flemish government, Port of Antwerp and contractor SeReAnt began dredging and processing the most TBT polluted sludge at the port. "We worked with the University of Antwerp for several years, seeking the best way to remove TBT from the port," explains Jacques Vandermeiren, Port of Antwerp's CEO. "We are proud that we can finally tackle this historical pollution, which made us the first port in the world to not only remove polluted sludge, but also process it in a sustainable manner."

As a port, Antwerp faces a number of historical pollution challenges, but as Agnes Heylen, Technical Manager for Environment, explains: "Our monitoring programmes have helped to highlight the key issues and enabled us to focus on them. For example, we have noticed a gradual increase in water conductivity (dissolved salts) measurements since about 2015.



Targeted placement of cages

"Recent increases in conductivity have been attributed to climate change which is reducing freshwater levels in the canals and rivers, and to increased industrial freshwater demand for cooling. This presents a threat to the ecology of the port so we plan to install continuous water quality monitors to measure conductivity and other important parameters. In addition, modelling is being developed, to better understand the causes and to be able to define the best options for action.

As a regulator, the Port of Antwerp is responsible for:

- Enforcing regulations on underwater cleaning
- The ban on discharges from emission scrubbers
- The ban on ballast water discharge
- Offering advice on discharge conditions
- Port-specific harbourmaster regulation

As the landlord/operator, the Port of Antwerp provides:

- Environmental monitoring
- Dock cleaning and remediation
- Removal of TBT from sediments
- Inland shipping waste parks
- Dock litter removal
- Plastic removal
- Litter collection by volunteers
- Oil spill response plan
- Remediation of historic landfill
- Habitat improvement

Working in conjunction with the University of Antwerp, biologists at the port are looking for ways to improve biodiversity, and a variety of measures have been implemented to create underwater habitats. Alongside these measures, divers installed cages at various locations within the port, so that upon retrieval, it will be possible to assess the populations of macroinvertebrates such as shrimp, worms and snails.

Summary

A study of the environmental performance of the Port of Antwerp reveals four striking features of this forward-looking organisation.

1. **It's big.** The Port of Antwerp obviously recognises the vitally important role that it plays in the Belgian and global economies.
2. **The environmental projects** underway in Antwerp are too numerous to mention in an article of this nature, but it is clear that both the city of Antwerp and its port are determined to fulfil their environmental responsibilities, and to use their sustainability credentials as a competitive advantage.
3. **Innovation and collaboration** are common features of almost all of the port's environmental initiatives.
4. **Testing and monitoring** are driving the port's environmental work; helping to identify problems and measuring the success of solutions.



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