TECHNOLOGY

Functioning principle

In Paris, an area that is emblematic of environmental issues in urban areas, the storm overflow crosses the Bois de Boulogne. It discharges rainwater from a section of the ring road directly into the Seine, and on rare occasions wastewater. To improve the management of urban discharges during rainy weather, the City of Paris has planned to upgrade the spillway by equipping it with a storage system and filtering water before it is discharged into the Seine.

It seemed particularly opportune to use the infrastructure that is to be built to install a run-off water treatment prototype designed to demonstrate the possibility of treating particulate and dissolved pollution. The list of pollutants considered is relatively broad, including macropollutants (suspended solids) as well as micropollutants: metals, hydrocarbons and other environmentally toxic substances (phthalates, alkylphenols, perfluorinated compounds, etc). Dissolved pollution is insufficiently retained by conventional stormwater treatment systems.

General principles

Based on ecological engineering (EE), the Life Adsorb prototype combines 'grey techniques' and 'green techniques'. It involves storing the water to be treated in existing sewage infrastructure. The water is treated using a natural solution based on a natural retention/pollution structure: a semi-saturated vertical-flow reed filter. The mechanical action of filtering particulate pollutants is coupled with the adsorption of dissolved micropollutants by a layer of adsorbent materials (hence the name 'Life Adsorb'), combined with the natural biodegradation of these substances. The purified water is drained at the bottom of the filter and then discharged into the artificial river adjacent to the filter before returning to the natural aquatic environment, in this case the Seine.

The key role of vegetation

On the one hand, vegetation helps to improve the efficiency and extend the life of the filter (limiting clogging, supporting the development of microbial biomass), and on the other, it helps to restore biodiversity and improve the living environment. In Anglo-Saxon countries, where this type of structure is already widely used, research has focused on their effectiveness against metals and nutrients. However, the behaviour of organic micropollutants in these structures remains relatively undocumented. The long-term fate of contaminants (accumulation, degradation, possible release), and the role of microbial flora, present real challenges for managers. Retention of the dissolved phase of micropollutants is generally less effective than that of the particulate phase, with some micropollutants such as bisphenol-A, alkylphenols and phthalates reaching high concentrations at the end of the structure. In addition, the transport of dissolved trace metals seems to be facilitated by their association with dissolved organic carbon, exposing them to the risk of leaching.

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Reed bed filter
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Leucanthemum vulgare

The reed bed filter : a technological innonvation

How does it work ?

The reed bed filter is a purification process initially designed to treat domestic wastewater, but now increasingly used to treat rainwater. It involves infiltrating water through a mass of sand and gravel in which bacteria develop. The solids are separated from the water by filtration. Dissolved pollutants are treated biologically by bacteria and absorbed by the specific material (a geotextile) in the F2 filter.

The role of reeds

The reeds, 'Phragmites australis', are aquatic plants that help to clean up pollution by creating an environment conducive to water treatment. Their root system :

- plays a physical role, preventing the filter from clogging up due to the effect of the wind on the stems
- plays a biological role by creating a zone for bacteria to develop in the soil

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Pumping principle

The two filters operate in what is known as saturated mode, with the filters being loaded by regulating the leakage flow. The feed strategy consists of two phases:

- The first phase involves 'filling the freely drained zone', rapidly saturating the filter to leave 5 cm of water above the surface.
- The second phase, 'flooding during rainy weather', in which the filter is fed at a lower flow rate.

The filter is divided into two filters, which are used alternately to allow for rest periods. However, in the event of heavy rain, the adjacent filter may be used to limit saturation times. This is why there are several management and pumping modes:

- Management modes: dry weather and rainy weather
- Pumping modes:

- Dry weather pumping: If the tank level does not exceed the maximum dry weather level before the end of the time delay, then dry weather mode is activated.
- Rainy weather pumping: If the tank level exceeds the maximum dry weather level before the end of the time delay, then rainy weather mode is triggered and dry weather mode is stopped.
- Pumping during heavy rain: If the storage level continues to rise despite the pumping sequences following the ‘pumping during rain’ mode until it reaches the ‘heavy rain’ level, then this mode is triggered.

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Hydraulic operating diagram


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Water entering the filter

Measuring water quality

In order to monitor water quality, several samplers have been installed at different stages of the water flow. As a reminder, rainwater from the Boulevard Périphérique passes through the storm overflow to a storage station. It is then pumped to the reed filter, where it passes through and is treated. The treated water then flows into the river, which feeds the Saint James pond. The overflow from the pond is channelled into the storm overflow, while the treated water flows back into the Seine.

Samplers are used to obtain water samples, which are collected by our teams. These are then transported to our partners' laboratories for analysis.