

# Towards an integrated and circular management of dredged sediments: HAROPA PORT | Rouen as a transforming force in the territory

**Benjamin Constant<sup>1</sup>, Maurane Vermander<sup>2</sup>, Maude Soubeiran<sup>3</sup>, Sandrine Samson<sup>4</sup>**

<sup>1</sup>Neo-Eco, 1 Rue de la Source, 59320 Hallennes lez Haubourdin, France

Phone: +33-(0)-3 20 10 31 18

<sup>2</sup>*Ibid*

E-mail: bconstant@neo-eco.fr

<sup>3</sup>*Ibid*

<sup>4</sup>HAROPA PORT | Rouen, 34 Boulevard de Boisguilbert BP4075, 76022 Rouen Cedex 3, France

## Conference theme number(s):

**2-Circular economy - sediment as a resource;**

**8. Zero pollution in the soil-sediment-water nexus.**

---

**Introduction:** HAROPA PORT | Rouen is strategically positioned within the French port system. Within the limits of its district, this institution ensures that sustainable development issues are integrated into its current operating strategy and future developments, particularly in the context of maintenance dredging activities. In collaboration with Neo-Eco, a territorial framework has been developed to recycle part of the dredged sediments according to the circular economy models. In addition to the deployment of recovery synergies, an experimental research project on bio-dredging, on another site of the port, which is unique in Europe. This pilot should make it possible to reduce pollution in sediments, to optimise their management while controlling upstream risks. The overall approach aims to explore the feasibility of new dredged sediment “recovery loops” and built a case for local authorities and economic actors.

In a more prospective manner, this paper aims to present two complementary methods, on two different types of sediments, but managed together allows an integrated approach where bio-dredging and the creation of recovery channels would go hand in hand. By presenting this unique feedback in Europe, HAROPA PORT | Rouen and Neo-Eco wish to prove that this “territorial approach”, based on sorting waste at its source and risk management represents an unprecedented opportunity to take the turn towards sustainable development.

## Methods:

Two methods will be presented, highlighting in a third step their complementarity.

### 1. SEDINNOVE

The SEDINNOVE project concerns the building of new sustainable economic sectors, based on marine sediments valuation from HAROPA PORT | Rouen stocks. The study consisted in characterising the sediments to define their technical and environmental properties, to then underline territorial needs and

demand. This modelling of the value chain made it possible to highlight the most relevant applications in line with local economic dynamics. On another hand, by correlating those characterisations to process and local infrastructure analysis, it was possible to validate two different *eco-material applications*: a new concrete and a geo-sourced roadbed. After the formulation phase, the research team could assess the percentage of sand that could be substituted by sediment, while maintaining technical and environmental performances of a standard product (without sediment). To finalise the research, an economic evaluation of the sector was carried out. This comprehensive approach aims to provide technical, environmental, and economic elements to define the interest of setting up a recovery system and its sustainability.

### 2. Neo-Bio

HAROPA PORT | Rouen has a harbour basin containing polluted sediments. The dredging of these sediments was necessary for the maintenance of the basin and in the context of the replacement of its floating dock. The Neo-Bio project consisted in a bio-dredging process based on micro-organisms capable of reducing the organic pollution present in sediments. This process is using category 1 bacteria integrated into mineral substrates (aggregates of all sizes -  $\mu\text{m}$  to mm), allowed not only the decontamination of sediments, but also the reduction of their volume. Its implementation was done directly in the basin by surface spreading, but also underwater with the help of divers to allow the penetration of substrates within the sedimentary matrix. The biotreatment was monitored following a scientific protocol, defined beforehand with local authorities and carried out by an independent organization. This monitoring made it possible to verify the harmlessness of the micro-organisms on the environment and to observe the evolution of the pollution levels throughout the treatment.

## Results:

The SEDINNOVE study demonstrated the opportunity of creating a robust economic sector based on sediments valuation, in line with local needs and demands of raw materials. By confirming the environmental safety of the different formulas as well as their long-term performance, it was possible to substitute up to 30% and 100% of natural material. The next step is to implement full-scale experimental worksites.

The Neo-Bio study made it possible to cut down on pollution rates *in-situ*, reaching the recovery thresholds that had been set after 3 months of treatment. This bio-dredging was an opportunity for HAROPA PORT | Rouen as the volume of sediment to be dredged was reduced and the final outlet could be re-evaluated. Thanks to this project, HAROPA PORT | Rouen was able to highlight an innovative and economically competitive de-pollution technique, which allowed the valuation of its sediments and meet the project schedule initially set.

## Discussion: Controlling its sediments

Thanks to these complementary steps, HAROPA PORT | Rouen has implemented a complete approach to the exploitation of sediments: on site treatment to manage risk and pave the way to circular valuation. Characterization of used materials, understanding of value chains and modelling of sustainable economic balances are the key steps to enable a “closed loop valuation process”. This feedback allows us to reveal the incentives and obstacles in the establishment of a circular approach. HAROPA PORT | Rouen has positioned itself as a virtuous institution by considering its sediments as resource (and not waste). This radical change in waste management allowed to change its position from a waste producer to a producer of secondary raw materials. From a desire to offer new sustainable solutions, the port institution structured a new sector for resource exploitation in the region.

## References:

- For SEDINNOVE:

Cerema (2015) – *Acceptabilité environnementale de matériaux alternatifs en technique routière – Annexe 3 : Prescriptions pour les prélèvements et la préparation des échantillons*. French national guidelines for resource valuation (road engineering)

Cerema (2008) - *Guide d'utilisation du béton en site maritime*. French national guidelines for resource valuation (underwater concrete)

IMT Lille-Douai & ASIMS (International Symposium on Sediment Management) (2019), *Wikised database for sediment valuation*

<https://www.sedilab.com/programmes-dinnovation/wikised-la-base-de-donnees-des-sediments/>

Maherzi, W., Benzerzour, M., Mamindy-Pajany, Y., van Veen, E., Boutouil, M., & Abriak, N. E. (2018). Beneficial reuse of Brest-Harbor (France)-dredged sediment as alternative material in road building: laboratory investigations *Technology*, 39(5), 566-580.

French standard used in SEDINNOV:

AFNOR (2008). NF EN 12920 + A1 « *Caractérisation des déchets, méthodologie pour la détermination du comportement à la lixiviation d'un déchet dans des conditions spécifiées* ». [Norme NF EN 12920+A1 \(afnor.org\)](#)

- For Neo-Bio:

Drakides, C. (1980). La microfaune des boues activées. Etude d'une méthode d'observation et application au suivi d'un pilote en phase de démarrage. *Water Research*, 14(9), 1199-1207.

Lay-Son, M., & Drakides, C. (2008). New approach to optimize operational conditions for the biological treatment of a high-strength thiocyanate and ammonium waste: pH as key factor. *Water research*, 42(3), 774-780.

Regional institution « Département du Nord » (2015), Développement et amélioration du biotraitement des sédiments, *COP21 position paper*. Web edition: <https://www.plateformesolutionsclimat.org/wp-content/uploads/2015/11/BIOTRAITEMENT-COP-21-2015-11-19.pdf>