Beneficial reuse of sediments as secondary raw materials for construction sector

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Introduction: The materials resulting from the erosion of rocks and soils are transported under the effect of climatic actions (wind, tides) or human actions (development works) and are deposited in harbors and waterways. The main problems linked to this accumulation of sediments concern economic activities, the risk of flooding and the impact on the physical and chemical balance of aquatic environments. Therefore, dredging operations are a necessary practice to ensure acceptable navigation thresholds of the waterways. The reuse and recycling of industrial waste and by-products are nowadays major priorities in order to preserve natural resources. Moreover, this is also part of a sustainable development and circular economy approach for the territories. As a consequence of dredging operations, large volumes are produced and need to be managed every year, which represents economic, environmental and technical issues. Therefore, it is essential to find alternative eco-responsible solutions, in particular through the recovery of dredged sediments in viable sectors such as civil engineering where 400 million tons of granular materials are consumed annually in France. In the Suricates European project framework launched in France in 2019, several innovative ways for recycling Rance sediments (France) have been studied: materials for Dike construction, as well as the use sediments in the concrete manufacturing.

Methods: The materials studied were collected in 2019 from Rance sediment storage areas located in Brittany (France). Physicochemical and geotechnical characterization tests were carried out on two separate sediment samples, according to French standards. The both sediments were classified in class A, according to the GTR classification, which represent the fine material.

Following this characterization study, it turned out that the sediments studied were of a very fine nature for the first (SBF) and more sandy for the second (SBS). As a result, fine sediments have been prepared for use in concrete formulations as mineral additions to cement for concrete application and sandy sediments have been prepared for use in dike materials.

Results: for concrete application: There are several technical requirements for raw materials that can be used in concrete application and especially as cementitious addition. Using the chemical composition, the sum of the SiO_2-CaO-Al_2O_3 oxides had to be sufficient to be used as an addition to the cements. According to the characterization tests of mineral additions according to the NF EN 196-1 standard, fine sediments can be used as an addition to cements with a mass replacement rate of 10% [1].

For dike application: From the obtained results and according to the triangle of texture SBS and SBF are classified as silty sand and silty (fine silty) respectively. Referring to the different characteristics, and based on the technical requirements for the materials constituting the dyke (Fig. 1), it can be concluded that:

- SBS sediment can be applied as core material without treatment;
- SBF sediment can be applied as core material after treatment (granular correction).

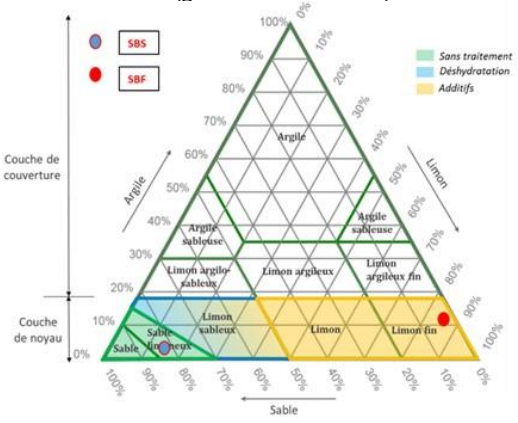

Fig1. *Conditions of use of sediments in dyke materials according to their physical characteristics*

References: [1] Sadok et al. (2021) *Buildings*