Operational Sediment Management System

Mahfoud Benzerzour [1], Nor-Edine Abriak [1], Raid Mansi[2],

[1]IMT Lille Douai, 764 Bd Lahure, BP 10838, 59508, Douai, France
[2]OVALE, 6 b rue du chateau d'eau, france

Phone: +00-(33)-327712419
E-mail: mahfoud.benzerzour@imt-lille-douai.fr

Introduction: Several years ago, global consumption of materials used in the field of Civil Engineering and especially materials for public works, has strongly growth. The reuse of marine and/or river dredged sediments presents a promising alternative to deal with the problematic of sustainable development. In this paper, we study a management problem of existing treatments for these sediments. Looking to the economical and legislative obligations associated with the treatment process, these operations present one of the main encountered problems during the valorization process of sediments. The solution for this problem is to find an optimal set of treatments respecting these economical and legislative constraints. This optimal solution is obtained by solving a non-linear mathematical model with binaries variables. The proposed resolution algorithm for this model is based on a linearization of the nonlinear constraints in order to solve a simple problem using a solver. In this study we present a validation of our approach by experimental study. This modeling work allowed us to create software dedicated to the management of sediment recovery. This work is carried out within the framework of a European project named USAR (Using Sediment As a Resource).

Methods: The objective of our research is to find a solution that provides an acceptable material for civil engineering used. This solution is in the form of a mixture of sediment with one or more noble materials (ex: sand) which is subjected to a set of physical and chemical treatments in order to respond to requirements and normative constraints with minimum cost. The objective function developed can be written as:

$$Min\left(\sum_{i=1}^{n} C_i x_i + \sum_{j=1}^{m} C_j S_j + \sum_{i=1}^{n}\sum_{t=1}^{|T|} C_{ti} T_{ti}\right)$$

Eq. 1: Objectif fonction

Results: The figure below presents a comparison of the numerical and experimental results of the development of an optimal mixture for a road application respecting the environmental and mechanical constraints.

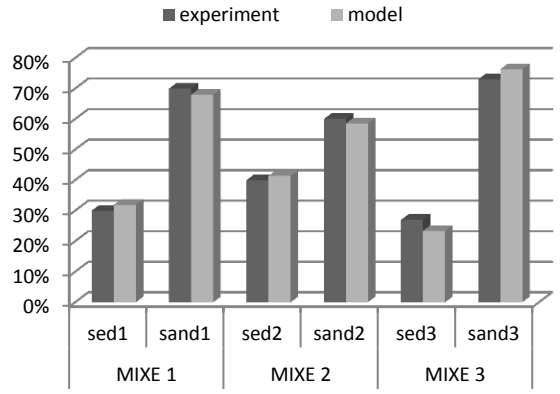

Fig. 2: Comparison between the model developed and the laboratory experiment

Discussion: In this paper, we proposed a mathematical model that optimizes the management and the choice of used treatments for a reuse of marine and/or river sediments. This problem has been modelled as a nonlinear mathematical model with mixed variables. Our solving approach is mainly based on a linearization of this model. This linearization is based on the enumeration of all non-linear combinations. Finally, the simplified mathematical model is solved using a numerical solver. This mathematical model can be widened to other parameters, in particular, physical and mechanical parameters, in order to use sediments as alternative materials.

References:

[1] George, B, Dantzig and Philip, Wolfe Decomposition Principle for Linear Programs. Operations Research, 8(3): 101–111, (1960)

[2] Zentar, R., Dubois, V., Abriak, N Mechanical behavior and environmental impacts of a test road built with marine dredged sediments. Resources, Conservation and Recycling, 52: 947–954, (2008).

[13] Satone, H., Mamiya, T., Harunari, A., Mori, T., Tsubaki, T. Solidification Mechanism of the Sediment Formed by Particle Settling — Analysis of the Final State of the Sediment. Original Research Article Advanced Powder Technology, 19(3): 293-306, (2008).