

Recycling of river sediments to produce raw materials for construction sector – Upscaling of mineral processing techniques to supply a large batch of sediment

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Introduction: Sediment accumulation in waterways constitutes a serious problem for navigation. In EU, dredged sludge is considered as a waste and is usually landfilled. However, sediments could be a source of raw materials for construction if the right pretreatment is applied.

Many sediment beneficial uses are known and studied; the most cited are: as embankment (dykes, anti-noise wall, landscaped mound), by incorporation into concrete or road sub-layers, by incorporation into bricks or lightweight aggregates and by producing SCMs. Introduction of sediment in concrete is studied in this Interreg V VALSE project by building of a large demonstrator (bicycle path).

Most of these beneficial uses require adequate pretreatment, as dredged sediments are reputed for their heterogeneity, high water content and can be highly polluted. Mineral processing techniques are well dedicated for these treatments allowing end users producing suitable material.

Mineral processing is a vast field and therefore suitable techniques have to be chosen for suitable beneficial use. Reduction of the size of lagooned sediment agglomerates or blocks is the main objective of this work; this process is called "deagglomeration" in the following text. The second objective is the treatment of a large batch of sediment (approximately 16 tons). Upscaling is therefore necessary, even for pilot scale demonstrator, as small scale trials may turn out to be time-consuming or unachievable at larger scale.

Methods: Lagooned sediments from three different locations (two Walloon sediments and one French sediment) were treated.

Dry mineral processing techniques are privileged, as sediment will be introduced in the concrete mixer as solid material.

Preliminary trials were done on different techniques, like screw feeder, shredding or roller crusher technologies. Different roller crusher technologies were applied:

- Single roller crusher, equipped with one toothed crushing cylinder. A push-piece allows the contact between the material and the cylinder.
- Toothed roller crusher, equipped with two parallel toothed cylinders.
- Fluted roller crusher, equipped with two parallel cylinders demonstrating waves on their external surfaces.

Vibrating screens were used for sieving and to assess the size reduction of agglomerates.

Results: Preliminary trials with a few kilograms in screw, shredder or roller crushers confirm that roller crusher technologies are the most suitable to deagglomerate large block of sediments. Main advantage is the acceptance of large or hard exogenous pieces in the sediment (e.g. stones, glass). First used roller crusher was the single roller crusher. A first attempt at treating one cubic meter of sediment (approximately 800 kg) with the single roller crusher permitted to conclude that the moisture content of the lagooned sediment has to be decreased from 30% to a value between 15 and 20%.

Single roller crusher allowed us to prepare a big bag of material for each sediment, using passive drying before crushing to reduce the moisture content, and sieving on vibrating screen to recover deagglomerated sediment. Nevertheless, several steps of crushing were necessary (at least three) and the flow rate of the single crusher is low. This forced us to reconsider the use of single roller crusher to treat more than one ton of material.

Roller crushers with two parallel cylinders were used, equipped either with teeth or with waves. These crushers allow flow rates of several tons per hour. A larger drum screen was also used to allow the treatment of large sediment blocks.

Toothed roller crusher has the advantage to reduce the size of the large agglomerates. Nevertheless it is difficult to reduce below 10 mm with this equipment. But wetter sediment can be treated using this equipment, allowing moving the passive drying between the two roller crusher steps, instead before, and saving therefore spaces for passive drying. Fluted roller crusher is well suited for the final size reduction on the passively dried sediment.

Discussion: Selection of suitable techniques to prepare sediment is essential, if for no other reason than producing a large amount for pilot demonstrator. The selected process for deagglomeration of 16 tons of lagooned sediment was as follow: sieving at 10 mm with a large drum, followed by a grinding of the refusal with toothed roller crusher and further sieving at 10 mm on vibrating screen. The final refusal was further dried passively and treated with a fluted roller crusher with a final sieving at 10 mm to be sure that all material are deagglomerated.