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Residual sludge from dimensional stones: characterisation for their exploitation in civil and environmental applications

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Residual sludge coming from dimensional stones working plants (diamond framesaw and ganguesaw with abrasive shots processes) represents a problem for Stone Industries. In fact the cost connected to their landfilling amounts to more than 3% of operating costs of dimensional stone working plants. Furthermore their strict feature as waste to dump (CER code 010413) contrasts the EU principles of “resource preservation” and “waste recovery”.
The main problems related to their management are: size distribution (fine materials, potentially asphyxial), presence of heavy metals (due to the working processes) and TPH content (due to oil machines losses).
Residual sludge, considered according to Italian Legislative Decree n.152/06, can be used, as waste, for environmental restoration of derelict land or in cement plants. It is also possible to think about their systematic treatment in consortium plats for the production of Secondary Raw Materials (SRM) or "New Products" (NP, eg. artificial loam, waterproofing materials, ...).
The research evidences that, on the basis of a correct sludge management, treatment and characterization, economic and environmental benefits are possible (NP or SRM in spite of waste to dump).
To individuate different applications of residual sludge in civil and environmental contexts, a geotechnical (size distribution, permeability, Atterberg limits, cohesion and friction angle evaluation, Proctor soil test) characterization was foreseen.
The geotechnical tests were conducted on sludge as such and on three different mixes:
- Mix 1 - Bentonite clay (5-10%) added to sludge a.s (90-95%);
- Mix 2 - Sludge a.s. (90-80-70%) added to coarse materials coming from crushed dimensional stones (10-20-30%);
- Mix 3 - Sludge a.s. (50-70%) mixed with sand, compost, natural loam (50-30% mixture of sand, compost, natural loam).
The results obtained from the four sets of tests were fundamental to evaluate:
- the characteristics of the original materials;
- the chance to obtain new products for dumps waterproofing (Mix 1). In this case the permeability has to be at least 10-9 m/s;
- the opportunity to use them for land rehabilitation and reclamation (fine and coarse materials to fill quarry or civil works pits - Mix2; artificial loam to use for quarry and civil works revegetation – Mix 3). In Mix 3 phytotoxicity tests have been performed in cooperation with Agricultural Dept. – University of Turin. In this case the “cradle to grave principle” would be applied: “waste” coming from dimensional stone working plants could return to quarries.
The results coming from geotechnical tests are promising, but to exploit sludge mixtures in civil and environmental applications it is necessary to guarantee, by means of appropriate chemical analysis, that there are no problems connected to soil, water and air pollution (connected to heavy metals and TPH contents). Magnetic or hydrogravimetric separation can be performed to reduce heavy metal content, instead TPH decrement can be reached by mean of specific agronomic treatments (eg. Bioremediation).
Several in situ tests will be performed to compare the laboratory results to the “pre-industrial” ones: the obtained results will be potentially useful to propose some integration to the present Italian legislation.