A novel sustainability scoring method for soil remediation technologies assessment

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Abstract

The concept of sustainability is ever more pervasive in all aspects of today's society, and soil remediation should be no exception. Several of the goals set by the United Nations are particularly relevant to soil rehabilitation, such as resilient infrastructure development, safety, resiliency of land management and sustainable consumption.

Unfortunately, the sustainability of a remediation method is too often understood solely as its correspondent greenhouse gases emission. While being a key factor, it is only a limited part of the big picture. Furthermore, several of tools are available for the stakeholders to estimate CO2-equivalent emissions of different technologies but, depending on their scope and assumptions (which are not always disclosed), results can vary significantly.

In order to properly choose the most sustainable technologies depending on project- and pollutant-specific constraints, a sustainability scoring method is proposed. It is based on three main pillars, namely the economic (ECO), environmental (ENV) and socials (SOC) criteria.

The economic criterion is the most straightforward as it relates to the remediation cost. It includes the total cost, degree of uncertainty and change in land value. The social indicator, often the most neglected, relates to the impact of the remediation on society and individuals. It covers safety, education and employment, stakeholder involvement, land use, dust, odours, traffic, and noise generated. Finally, the environmental criterion evaluates the efficiency of remediation, risk of secondary contamination, gas emissions, impact on soil and water characteristics and generated waste.

Each sub-criterion is rated thanks to an evaluation grid, attributing a note ranging from 0 to 10 based on the performance of the given remediation method. When a numbers-based rating is not possible, which is typically the case for some social indicators, a clear description of different scenarios is used to make their objective assessment possible.

After each of the main three pillars have been attributed a score based on the mean score of the topics that they cover, a final scoring method is proposed such that:

Each of the main pillars (ECO, ENV, SOC) is given the same weight.

A poor score in one of the pillars is highly penalizing for the final overall score.

For those reasons, necessary to select truly sustainable technologies, the final sustainability score is the geometrical mean of the three main scores, written as $\sqrt[3]{\overline{ECO} \times \overline{SOC} \times \overline{ENV}}$.

To highlight the method and conclude the paper, a small case study is used, where "remediation" using excavation (dig & dump) is compared against thermal desorption. While studies relying on CO2-equivalent emissions sometimes favour one method or the other based on their respective scopes and assumptions, the weaknesses of the excavation are properly highlighted using a full sustainability scope.

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