Optimizing the Environmental Performance of In Situ Thermal Remediation Technologies Using Life Cycle Assessment - DTU Orbit (09/11/2017)

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In situ thermal remediation technologies provide efficient and reliable cleanup of contaminated soil and groundwater, but at a high cost of environmental impacts and resource depletion due to the large amounts of energy and materials consumed. This study provides a detailed investigation of four in situ thermal remediation technologies (steam enhanced extraction, thermal conduction heating, electrical resistance heating, and radio frequency heating) in order to (1) compare the life-cycle environmental impacts and resource consumption associated with each thermal technology, and (2) identify options to reduce these adverse effects. The study identifies a number of options for environmental optimization of in situ thermal remediation. In general, environmental optimization can be achieved by increasing the percentage of heating supplied in off peak electricity demand periods as this reduces the pressure on coal-based electricity and thereby reduces the environmental impacts due to electricity production by up to 10%. Furthermore, reducing the amount of concrete in the vapor cap by using a concrete sandwich construction can potentially reduce the environmental impacts due to the vapor cap by up to 75%. Moreover, a number of technology-specific improvements were identified, for instance by the substitution of stainless steel types in wells, heaters, and liners used in thermal conduction heating, thus reducing the nickel consumption by 45%. The combined effect of introducing all the suggested improvements is a 10 to 21% decrease in environmental impacts and an 8 to 20% decrease in resource depletion depending on the thermal remediation technology considered. The energy consumption was found to be the main contributor to most types of environmental impacts; this will, however, depend on the electricity production mix in the studied region. The combined improvement potential is therefore to a large extent controlled by the reduction/improvement of energy consumption.

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