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Soil Contamination and Remediation Strategies. Current research and future challenge

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Soil contamination: the heritage of industrial development
Contamination is only a part of a whole set of soil degradation processes, but it is one of paramount importance since soil pollution greatly influences the quality of water, food and human health. Soil contamination has been identified as an important issue for action in the European strategy for soil protection, it has been estimated that 3.5 million of sites are potentially contaminated in Europe. Contaminated soils have been essentially discovered in industrial sites landfills and energy production plants, but accumulation of heavy metals and organic compounds can be found also in agricultural land .

Remediation strategies. from incineration to bioremediation
The assessment of soil contamination is followed by remedial action. The remediation of contaminated soils started using consolidates technologies (incineration inertization etc.) previously employed in waste treatment,. This has contributed to consider a contaminated soil as an hazardous waste. This rough approximation was unfortunately transferred in many legislations and on this basis soil knowledge have been used only marginally in the clean up procedures. For many years soil quality has been identified by a value of concentration of a contaminant and excavation and landfill disposal of soil has been largely used.
In the last years the knowledge of remediation technology has rapidly grown, at present many treatment processes appear to be really feasible at field scale, and soil remediation is now based on risk assessment procedures. Innovative technologies, largely dependent on soil properties, such as in situ chemical oxidation, electroremediation, bioventing, soil vapor extraction etc. have been successfully applied. Hazardous organic compounds are commonly treated by biological technologies, bioremedmdiation and phytoremediation, being the last partially applied also for metals. Technologies selection is no longer exclusively based on eliminating the source of pollution, but also on blocking the pathways from contaminants to receptors or reducing the exposure to contaminants,.

Future challenge :integration of sustainability into remediation decision-making.
Soil is not a waste! There is a growing interest in the clean up approaches that maintain soil quality after remediation treatments. This issue is of great importance in the U.S.A. where the EPA from 2009 is promoting innovative clean-up strategies (Green Remediation). Green remediation is defined as the practice of considering all environmental effects of remedy and incorporating options to maximize environmental benefit of cleanup actions . These remediation strategies restore contaminated sites to productive use with a great attention to the global environmental quality, including the preservation of soil functionality according to the following principles:
[U+F0D8] use minimally invasive technologies
[U+F0D8] use passive energy technologies such as bioremediation and phytoremediation as primary remedies or finishing steps where possible and effective
[U+F0D8] minimize soil and habitat disturbance
[U+F0D8] minimize bioavailability of contaminants trough adequate contaminant source and plume control
If we move from the current definition of remedial targets based on total concentrations, technologies with low impact on the environment can be utilized reducing the wrong choice to disposal soil in landfill destroying quickly a not renewable essential resource.