Smouldering combustion is a low-cost / low-energy thermal technique for the treatment of contaminated soils. This approach is commercially available as the STAR (in situ) and STARx (ex situ) technologies and is ideally suited to the treatment of heavy hydrocarbons. Recent advances have demonstrated the flexibility and robustness of smouldering-based remediation techniques, expanding the applicability of STAR/STARx to the management of a wide range of challenging environmental issues.

PFAS and other contaminants of emerging concern (CECs) present a unique remediation challenge due to their chemical and thermal stability. Smouldering combustion is a promising technique for PFAS treatment, as the temperatures required to both destroy PFAS and minimize the production of short-chained volatile organic fluorines (VOFs) and fluorinated dioxins and furans (PFDD/F) are possible with smouldering, depending on the conditions of the system and the fuel being combusted. Recent work has demonstrated that granular activated carbon (GAC) can be used to support smoldering combustion to achieve temperatures that destroy PFAS when added to soils at ~40 to 60 g/kg. Non-detect concentrations of PFAS in soils and hydrogen fluoride (HF) presence in the emissions suggest that complete decomposition of PFAS via smoldering combustion is possible.

Smouldering combustion can also be used to treat inorganic compounds if a supplement fuel is used (similar to the use of GAC to facilitate PFAS remediation in soil). This adaptation has utility in the mining industry, as recent work has demonstrated that combusting a smoulderable material mixed with mine tailings can result significant mineralogical, compositional, and pH changes within the tailings that have the potential to mitigate acid mine drainage (AMD). The high temperatures attainable with smouldering combustion (i.e., >1000°C) facilitate the removal of sulfur and other acid-generating compounds.

Ex situ applications of smouldering combustion have been extended for the disposal of liquid organic wastes such as oily sludge and waste water treatment plant (WWTP) biosolids. These materials will not readily combust in a flaming combustion reaction but when mixed with a porous matrix can be made to smolder in a self-sustaining manner. Ideally, the porous matrix used in the mixture is also a waste product. In the oil and gas industry, the porous matrix is often a hydrocarbon-impacted soil requiring remediation while solid organic waste materials such as wood chips can be used to support the smouldering of WWTP biosolids. This co-treatment approach, involving a robust, low-energy combustion process, has obvious economic benefits.

This presentation will provide an overview of smouldering combustion and present case studies demonstrating the effectiveness of the technology for mitigating both organic and inorganic environmental liabilities.

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Dr. Grant has 15 years of experience in the field of environmental remediation and the development and implementation of the STAR and STARx technologies. He completed his Ph.D. studies at the University of Edinburgh, Scotland, under the direction of Dr. Jason Gerhard, co-inventor of the STAR technology. Dr. Grant is the Operations lead for Savron and has been the project director or technical lead for STAR-related projects with top-tier clients in the chemical manufacturing, oil and gas, and utility industries. Dr. Grant is also an Adjunct Professor at Western University, supervising numerous graduate students studying smouldering combustion for environmental applications.