STARx: *Ex Situ* Smoldering Combustion for the Treatment of Contaminated Soils and Organic Wastes

Hottpad™ Systems and Capabilities

Overview

STARx systems use smoldering combustion for the treatment of contaminated soils and organic wastes. Modular engineered base systems have been developed to apply STARx via soil piles. These bases, called Hottpads, are low profile modules with trafficable surfaces containing the heat and air distribution systems for ignition and propagation of the smoldering reaction. The Hottpad modules can be networked together to build a customized system to meet the throughput demands of the project.

STARx Hottpad systems can be used to treat contaminated soils, liquid organic wastes, or both soils and liquid organic wastes in a co-treatment process. Soils impacted with heavy hydrocarbons, PFAS compounds, and other low-volatility compounds are ideal, as are liquid organic wastes such as oily sludge, tank bottom residuals, waste water treatment plant biosolids, and agricultural wastes. STARx Hottpad system have been deployed all over the world, with many applications associated with the oil and gas industry.

Evaluation Systems

Three scales of STARx Hottpad systems can be used to evaluate the technology for site-specific applications:

1. **Laboratory Smoldering Column Studies** – best suited to demonstrate treatment effectiveness for impacted soils, and to identify compounds in the emissions stream.
2. **Rapid Screening Systems** – Field-deployed 1 cubic meter (m^3) Hottpad systems designed to facilitate the rapid screening of materials with respect to smoldering treatability.
3. **Pilot Hottpad Systems** – 10 m^3 field pilot systems designed to evaluate treatment efficiency, processing rate, and emissions treatment requirements (IMAGE 1).

IMAGE 1: 10 m^3 pilot Hottpad system designed to evaluate treatment efficiency, processing rate, and emissions treatment requirements

Conclusions

STARx Hottpad systems are:

- Effective and robust, providing rapid on-site treatment and complete destruction of contaminants.
- Cost effective versus other technologies.
- Safe and sustainable (self-sustaining combustion = less energy used).
- Flexible, as the modular design allows for easy shipping and scalability to meet target throughputs.

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Full-scale Hottpad Systems

STARx Hottpad systems are composed of a series of shippable Hottpad modules which can be pieced together to allow for the creation of the Hottpad base of any dimension (IMAGE 2). The size of the base can be scaled to match the processing rate of the material to be treated and the schedule requirements of the project. Multiple Hottpad bases can be networked into a treatment plant that uses common ancillary equipment (e.g., blowers, vapor treatment system, etc.) which are operated sequentially in a semi-continuous batch process for maximum material processing efficiency.

IMAGE 2: Full-scale Hottpad system. Processing rate is a function of the base size which can be increased by adding Hottpad modules.

Costs

STARx Hottpad Systems are available for sale or lease for operation by local contractors/partners; or they can be provided and operated as a service from Savron. Costs vary as a function of combustion reaction propagation rate, project duration, and emissions treatment requirements. In general, costs are a function of scale with the lowest unit cost possible for smaller systems operated over a long time period.

As an example, a treatment plant, constructed and operated in North America, can treat 135 tonnes of soil per day for as low as $50 USD/tonne. This is just one example and site-/project- specific cost estimates can be provided upon request.

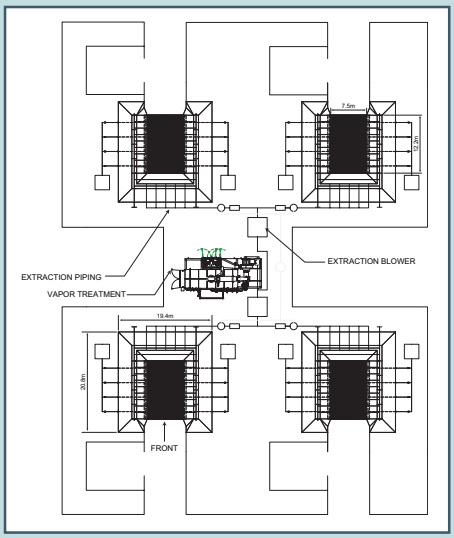

IMAGE 3: Treatment plant consisting of four (4) Savron HP-200 base units (200 m^3 volume each) can treat approximately 135 tonnes of soil per day.