Soil, Sediment, Bedrock and Sludge

Pyrolysis

Introduction:

Chemical decomposition is caused in organic materials via heat in the absence of oxygen. Organic materials are altered to gaseous components and a solid residue called coke that contains carbon and ash.

Description:

In practice, it is not possible to achieve a completely oxygen-free atmosphere; actual pyrolytic systems function with less than stoichiometric quantities of oxygen. Since some oxygen will be present in any pyrolytic system, minimal oxidation will take place. If volatile or semi volatile materials are present in the waste, thermal desorption will additionally occur.

Pyrolysis alters hazardous organic materials into gaseous components, small quantities of liquid, and coke. Pyrolysis of organic materials brings about combustible gases, such as carbon monoxide, hydrogen and methane. When off-gases cool, the liquids condense generating an oil/tar residue and contaminated water. Pyrolysis usually occurs under pressure and at operating temperatures greater than 430 °C (800 °F). The pyrolysis gases necessitate further treatment. The off-gases may be treated in a secondary combustion chamber, flared, and partially condensed. Particulate removal equipment for instance fabric filters or wet scrubbers are also needed.

Standard thermal treatment methods, for example rotary kiln, rotary hearth furnace, or fluidised bed furnace, are utilised for waste pyrolysis.

Rotary Kiln:

A rotary kiln is a refractory-lined, revolving cylinder that operates as a heating chamber.

Fluidised Bed Furnace:

Circulating fluidised beds make use of high-velocity air to circulate and suspend waste particles in a heating loop and operates at temperatures of 430 °C (800 °F).

Molten Salt Destruction:

A molten salt incinerator uses a molten bed of salt, for example sodium carbonate, as a heat transfer and scrubbing method to break down hazardous materials. Shredded solid waste is injected with air under the surface of the molten salt and hot gases (primarily carbon dioxide, stream, and unreacted air components) rise through the molten salt bath, passing via a secondary reaction zone, and an off gas cleanup system ahead of being discharged to the atmosphere. Other by-products react with the alkaline molten salt to generate inorganic products that remain within the melt. Spent molten salt that contains the ash is removed from the reactor, cooled and put to landfill.

While the fundamental theories of the process have been validated, the performance data for the technology has not been evaluated by means of approved methods.

Applicability:

The contaminant groups for pyrolysis are SVOCs and pesticides. The process is valid for separating organics from refinery wastes, coal tar wastes, hydrocarbon-impacted soils, mixed (radioactive and hazardous) wastes and paint waste.

Pyrolysis systems could be relevant to some organic materials that undergo a chemical decomposition in the presence of heat and has shown potential for the treatment of organic contaminants in soils and oily sludge's.

Limitations:

- Specific feed size and material handling requirements that effect applicability or cost at specific sites.
- The technology requires that soil be dried in order to achieve a low soil moisture content (< 1%).
- Highly abrasive feed may damage processor unit.
- High moisture content has potential to increase treatment cost.
- Treated media that contains heavy metals could need stabilisation.

Data Needs:

Once soil contaminants and the concentrations are known, data required for setting up a thermal system to specific applications comprise of soil moisture content and classification and soil fusion temperature.

Performance Data:

Restricted performance data are available for pyrolytic systems for treating hazardous wastes the contain PCBs, dioxins, and other organics. The value of this information has not been established and can be used as a general indication of the performance of pyrolysis equipment. Site treatability studies are crucial in further refining and assessing the pyrolysis process.

Cost:

The complete cost for remediating approximately 10,000 tonnes of contaminated media is thought to be around £ 200 per tonne.