Ground Water, Surface Water, and Leachate

Oxidation

Introduction:

Organic contaminants are broken down in a high temperature 1,000°C combustor. Passing the mixture through a catalyst destroys trace organics in contaminated air streams at lower temperatures.

Description:

Oxidation equipment is employed for destroying contaminants in the exhaust gas from air strippers and SVE systems. Thermal oxidation units usually consist of a single chamber, refractory-lined oxidisers equipped with a propane or natural gas burner and a stack. A lightweight ceramic blanket refractory is often utilised because the units are mounted on skids or trailers. If fuel is the contaminant, heat exchanger efficiencies are restricted to 25 to 35%, and preheat temperatures are maintained below 180 °C to reduce the likelihood of ignition taking place in the heat exchanger. Flame arrestors are always installed between the vapour source and the thermal oxidiser.

Catalytic oxidation is a fairly new alternative for treating VOCs in air streams ensuing from remedial processes. The addition of a catalyst enhances the rate of oxidation by adsorbing the oxygen and the contaminant on the catalyst surface where they react to form carbon dioxide, water, and hydrochloric gas. The catalyst permits the oxidation reaction to take place at lower temperatures than needed by a conventional thermal oxidation. VOCs are thermally destroyed at temperatures usually ranging from 300° to 550° C by means of a solid catalyst. Initially, the contaminated air is preheated (electrically or more commonly by using natural gas or propane) to reach a temperature required to kick off the catalytic oxidation of the VOCs. Subsequently the preheated VOC-impacted air is passed through a bed of solid catalysts where the VOCs are rapidly oxidised.

Catalytic Oxidation:

Catalyst systems employed to oxidise VOCs use metal oxides such as nickel oxide, copper oxide, manganese dioxide, or chromium oxide. Noble metals for instance platinum and palladium can also be used.

Internal Combustion Engine Oxidation:

Organic contaminants in air may be exploited as fuel and burned in an internal combustion engine. When the concentration of organics is too low, secondary fuel is added to improve the oxidation rate.

Thermal Oxidation:

The thermal oxidation process can be improved to lower auxiliary fuel costs by employing an air-to-air heat exchanger to transport heat from the exhaust gases to the inward bound contaminated air. Normally, around 50% of the heat from the exhaust gases is recovered.

UV Oxidation:

Oxidation of organic contaminants in air can be accomplished by means of UV oxidation. UV oxidation is where chemical bonds of the contaminants are broken under the influence of UV light. Products of photo-degradation differ in accordance with to the matrix in which the process takes place, but the complete conversion of an organic contaminant to CO_2 and/or H_2O is not likely.

Applicability:

Contaminants suitable for oxidation are non-halogenated VOCs and SVOCs, and hydrocarbons. Precious metals and base metal catalysts have been developed that are allegedly capable of efficiently destroying halogenated (including chlorinated) hydrocarbons. Specific chlorinated hydrocarbons that have been treated consist of TCE, TCA, methylene chloride and 1,1-DCA.

Limitations:

- If sulphur, halogenated compounds or high particulate loadings are present in the emissions stream, the catalyst may be deactivated/poisoned and need replacing.
- The destruction of halogenated compounds requires specialist catalysts and materials.
- Influent gas concentrations must be < 25% of the lower explosive limit for catalytic and thermal oxidation.
- The presence of some heavy metals (e.g. lead) may poison a particular catalyst.

Data Needs:

It is vital that the contaminated air stream is well characterised.

Performance Data:

Thermal oxidation is an effective process for site remediation and its use is growing. More than 20 firms produce catalytic oxidation systems exclusively for remedial activities. These firms will usually provide the equipment to contractors for integration with specific remedial technologies, such as *in situ* vapour extraction of organics from soil or air stripping of organics from ground water.

Regardless of its relatively new use in remedial activities, catalytic oxidation is a mature technology and its standing as an implementable technology is established. Even so, the technology continues to progress due to improved heat recovery techniques and the development of catalysts that increase the destruction efficiency and/or extend the operating life of the catalyst bed.

Cost:

The main issues that effect the total cost consists of the quantity, concentration, and type of contaminant, the desired destruction efficiencies, management of residuals and utility/fuel expenses.

Catalytic oxidation is more expensive than thermal oxidation at low flow rates, and vice versa for high flow rates. Normally at the start of a project, VOC concentrations are high for a short time and the alternative of leasing a thermal unit ought be considered for this limited duration.