Thermal Conductive Heating (TCH) is effective for cleaning emerging contaminants. Is it energy efficient ?

H. SAADAOUI, J. HAEMERS - HAEMERS Technologies

Thermal desorption is an environmental remediation technology that uses heat to increase the volatility of contaminants (organic and/or inorganic) as such that they can be removed from solid matrix (typically soil) to be recycled or destroyed. The subject will focus on two existing in situ TCH techniques: electrical and thermal heating.

The designs and calculations are made considering the injection of power per linear meter of heating element. The method of heat injection with electrical power directly injects 1 kW/m, when the method of heat injection by thermal conduction has a 50-55% efficiency, therefore needs to produce 1.8-2 kW/m to inject 1 kW/m. The question here is how is electricity produced?

Current data shows that the needed power in terms of natural gas to produce 1 kW of electricity can vary from 1.6 kW to 2.85 kW depending on the type of thermal plant (conventional or with cogeneration for example). If we take these two extremes of yields, we get to an electrical power consumption in terms of combustion of natural gas between 320 – 640 kWh/m³ of soil for the best case and 570 – 1140 kWh/m³ of soil for the worst case (when the direct natural gas consumption to heat the soil with thermal conduction can vary from 619 to 894 kWh/m³).

The difference between the two techniques in terms of power efficiency and consumption will depend on the type of thermal electricity production. Whether the electricity production is advanced or not, the advantage given to one technique can easily become the advantage of the other depending on the electricity production rates of the countries in which thermal remediation projects will take place. As of now, very few thermal plants can reach a yield of 60% with natural gas. We can globally admit that with the current sources of electricity production, the two techniques are very close to each other in terms of consumption and efficiency. Another important factor to consider is the location of remediations sites because of both the electrical power and gas supply availability.

The second part of the article will cover the energy loss related to the interdistance between heating elements. Indeed, energy efficiency in heat injection is only a part of total remediation energy efficiency. Interdistance between heating wells drives remediation time and energy losses.

