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Using Air Stripping and Electro Kinetic Soil Flushing to Remove Lindane

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Abstract

In order to clarify the primary processes taking place in the soil when electric fields of 0.75 V cm and 1.50 V cm are applied, this research assesses the remediation of soil spiked with lindane utilizing a combination treatment consisting of Electro Kinetic Soil Flushing (EKSF) and air stripping. The outcomes show that lindane is delivered to the cathodic and anodic wells effectively when flushing solutions containing Sodium Dodecyl Sulphate (SDS) are used. The air injection also causes a significant proportion to be volatilized and stripped. Because of the very alkaline media in the cathodic well, lindane is rapidly converted into other species. These additional species are also present in the soil areas close to the well, supporting the effectiveness of SDS in the transfer of chlorinated organics.

Keywords:* *Electrochemistry; Cathode; Reservoirs

Introduction

Nearly 50% of the spiked lindane may be extracted from the soil after 14 days of operation. Despite the fact that the soil matrix contains water, operation with large electric fields does not improve the performance of the treatment technology and leads to lower current intensities, electro-osmotic fluxes, and higher evaporated water, indicating the coexistence of multiple inputs in these processes.

In several nations throughout the world, lindane (γ-hexachlorocyclohexane, $C_6H_6C_{l6}$), a very dangerous contaminant that was once widely employed as a highly effective synthetic pesticide, has been outlawed. There are currently many heavily polluted soil locations associated with its production and agricultural use. The problem is becoming more relevant due to the spread of this species and its derivatives from the soil to water reservoirs and effective removal technologies are currently being researched. It is vital to explore for alternatives for their immediate elimination at the sources of origin due to the issue of lindane accumulation in the environment and their various modes of propagation.

These locations' air/soil partition coefficient promotes both regional and global long-range atmospheric transport phenomena. It has been shown that these types of technologies can be promising for the removal of nonpolar organic compounds like lindane, for which the use of flushing fluids with a suitable formulation (primarily containing surfactants) is required. Transportation of organics with the help of electric fields is one of the soil remediation processes that have attracted the attention of many scientists in recent years. Due to this, it is now possible to combine Electro Kinetic Soil Flushing (EKSF) with many other technologies. Using permeable reactive barriers or traps where the pollution that EKSF mobilized can collect, is particularly crucial.

These traps may be made of a variety of materials, such as biological, granular activated carbon, and zero-valent iron beds. Recently, it was made clear that lindane volatilization could be significant during remediation procedures and should be taken into

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consideration when planning the cleanup of polluted sites. In fact, it has been noted that the formation of gaseous fluxes during the use of electrochemical soil remediation technologies is a crucial input to take into account in the design of the majority of electro kinetic remediation technologies. However, electrochemically supported methods for lindane-contaminated soil remediation are not just electro kinetic-based methods; they also include other intriguing technology.

As a result, additional studies from the past and present have concentrated on combining electrochemical technologies with traditional soil-washing processes and have shown that the surfactant sodium dodecyl sulphate is effective at removing lindane from soil and is compatible with electrochemical technology.

In order to apply the technique on a wide scale, it is essential to understand how lindane is transported between electrodes and from the soil to the gas phase. This effort aims to learn more about this process. To achieve this, 14-days tests were conducted in bench-scale, completely sealed plants, where the function of the electric fields was examined and frequent air injections were used to remove volatile contaminants. There was thorough monitoring of the gas, liquid, and soil phases, followed by a thorough postmortem investigation. Full characterization of the dehalogenation intermediates formed by the interaction of the basic front created on the cathode with lindane is a crucial finding since it shows that the electrochemical treatment also encourages a significant unanticipated benefit: a decrease in how harmful the contaminants in the soil are.

The gas chromatography data actually showed that the amounts of lindane and its derivatives in the electrolyte wells was very low, indicating that electro kinetic transport was slow and that volatilization made the biggest contribution to the removal of this dangerous species. This indicates that volatilization and further drag to the air became more significant than EKSF in the process. These findings demonstrate the importance of this research as well as the vast array of variables that need to be taken into account in order to fully understand the potential performance of the combined EKSF air stripping remediation technique.

Using flushing fluids containing SDS and electric fields, lindane was successfully delivered to the anodic and cathodic wells. A substantial proportion was also volatilized and removed by the injected air. The cathodic well's lindane quickly changed into other species due to the very alkaline media. These additional species were also discovered in the soil areas close to the well, supporting the effectiveness of SDS in the transportation of chlorinated organics. Nearly 50% of the spiking lindane had been extracted from the soil after 14 days of operation. Contrary to early expectations, operation with a strong electric field did not enhance the effectiveness of the treatment technique and led to lower current intensities, lower electro-osmotic fluxes, and higher electro-osmotic pressure.