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Pilot scale testing of microwave heating for in-situ decontamination of unsaturated zone

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Thermally assisted in-situ decontamination represent innovative technology that will significantly accelerate the process of desorption of contaminants from soil and compared with a conventional venting increase the efficiency of the remediation. In various stages of development are methods of radiofrequency heating, whose advantage is good penetration of radio frequency waves geological environment, which leads to dissipation of energy into heat. Main disadvantage may be big radius of radio frequency waves from the application well with low thermal conversion efficiency.

This article is focused on a microwave heating unsaturated zone performed by microwave generator (magnetron) of 6 kW and a frequency of 2 450 MHz. Application well was constructed from ceramic casing pipe, which is transparent for the penetrating microwave radiation, to inside was placed a waveguide for guiding microwave radiation. They were tested waveguides square (49 x 99 mm) and round (\varnothing 105 mm) consist of 4 segments with a total length of 4 m. Construction waveguides allow microwave radiation conduit and simultaneously drainage of desorbed vapors contaminants, which were then drawn off conventional pump.

Monitoring wells equipped with thermocouples for temperature sensing geological environment were installed around the application well. After ten days of continuous running of the microwave generator of 5.5 kW was reached average temperature of geological environment 65° C in ring around the application well at a distance of 0.75 m. This is the average temperature value throughout the vertical profile of 2.5 - 4 m. The temperature geological environment with the distance from the application of microwave well declined, as seems that most effective distance application wells is 1 m (at power 6 kW). The waveguide length and composition of soil (geological environment) have not a significant role in terms of the efficiency of microwave heating. Microwave heating may be useful for promoting desorption especially lower boiling non-polar substances and aliphatic chlorinated hydrocarbons (trichloroethylene, tetrachloroethylene etc.).