

## MULTIFUNCTIONAL WELL IMPLEMENTED FOR IN SITU REMEDIATION OF HYDROCARBON CONTAMINATIONS IN SOIL AND GROUNDWATER

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### INTRODUCTION

The Multifunctional Well is a new in-situ system for the remediation of hydrocarbon contaminations. It consists of an inner well with three screened sections and an outer well casing (Figures 1 - 4). Several air injection wells are arranged in the vicinity.

### OPERATION OF THE MULTIFUNCTIONAL WELL

Four remediation processes can be operated within the same well. At optimal efficiency of each remediation process, successive treatment of the capillary fringes, the vadose zone, and the aquifer can be accomplished.

- I. Free Product Recovery (FPR). Free product is removed by applying a vacuum without having to pump groundwater. An adjustable inner tube is arranged inside the well in such a way that the middle screening section is nearly covered by groundwater and free product floating on top. Within a double-cased screen containing hydrophobic material (DMF) the free product is pumped to the surface.
- II. Soil Vapor Extraction and Bioventing. In this treatment step the volatile hydrocarbons are removed from the unsaturated zone. Using an adjustable inner tube, the length of the screen can be varied to regulate the airflow depending on the vertical contaminant distribution in the unsaturated zone. The remediation progress can be improved by inducing a vertical soil circulation flow (BLK).
- III. Soil Circular Flushing Well (SZB). The saturation of the vadose zone is increased by a vertical flow of flushing water. The hydrocarbons remaining in the soil are removed primarily by in-situ stripping in the well. The oxygen supplied through the stripping process and additional air injection wells further enhance biodegradation of the contaminants.
- IV. Vacuum Vaporizer Well (UVB). To operate in the UVB mode the stripping reactor simply has to be arranged lower in the well. Contaminated groundwater is pumped from the middle section and after treatment in the stripping reactor reinjected into the lower section, thereby inducing a vertical groundwater flow.

FPR<sup>1</sup>, DMF<sup>2</sup>, BLK<sup>3</sup>, SZB<sup>4</sup> and UVB<sup>5</sup> are remediation processes patented by IEG mbH, Reutlingen, Germany.

### REFERENCES

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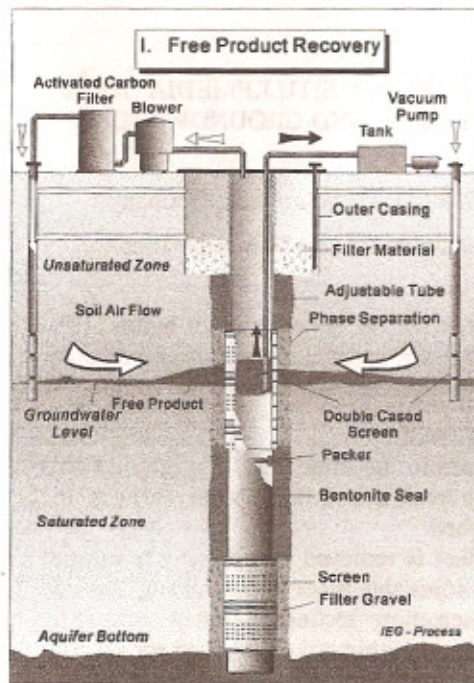


Figure 1.

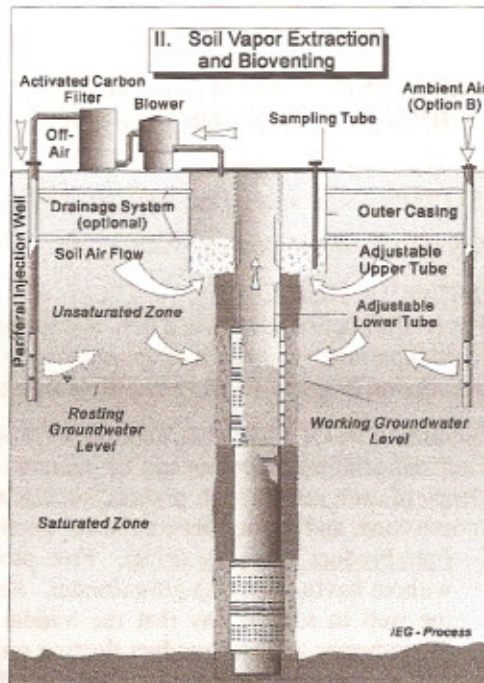


Figure 2.

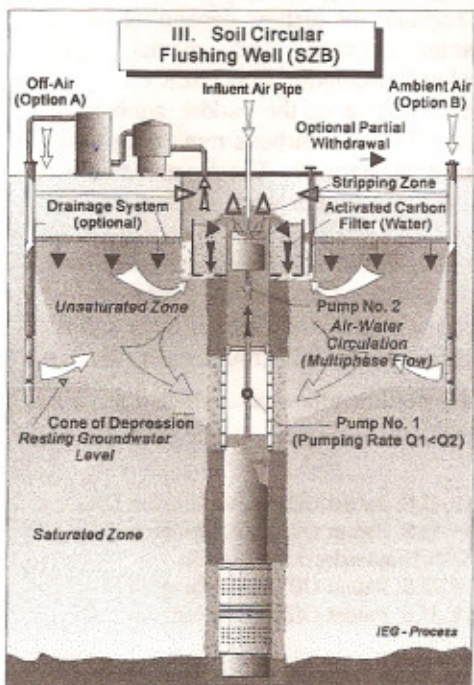


Figure 3.

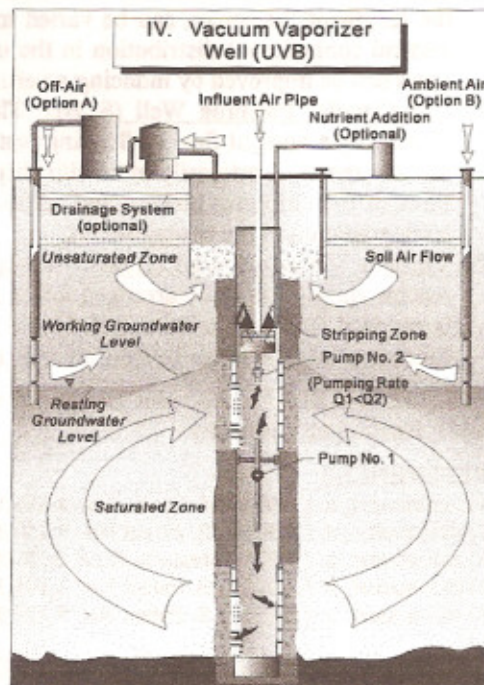


Figure 4.