mGCW Technology

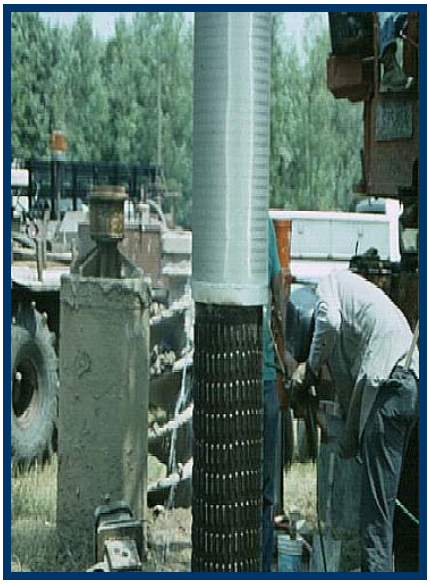
Introduction

Adventus Americas Inc. specializes in the design, improvement, construction, installation, field validation, operation and monitoring of various groundwater circulation well (GCW) systems, including the Unterdruck Verdampfer Brunnen (UVB), Coaxial Groundwater Circulation (CGC), Density-Driven Convection (DDC), K-Sparge, and NoVOCs technologies. As of September 2004, our staff designed and/or installed over 170 full-scale GCW systems throughout the United States and Europe. The knowledge accrued through these efforts is reflected, in part, by over 60 scientific and technical publications.

Vaulted system for BTEX/MTBE

Overview of mGCW Technology

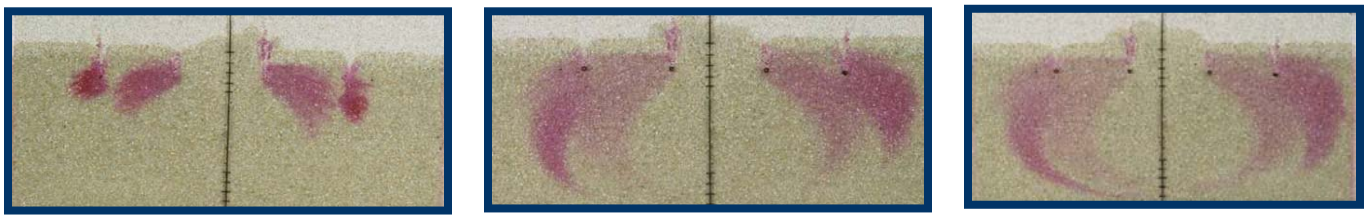
Microbiologically enhanced vertical groundwater circulation well (mGCW) technology significantly modifies conventional GCW systems to effect the removal of inorganic constituents (*e.g.*, heavy metals and nitrate) and/or accelerate the biodegradation of persistent organic compounds under aerobic (*e.g.*, high-molecular-weight PAHs) or anaerobic (*e.g.*, organic explosives, perchlorate, chlorinated hydrocarbons) conditions. The mGCW systems are specifically designed and uniquely configured to provide accelerated aerobic, enhanced anaerobic or sequential anaerobic/aerobic reactions. These reactions facilitate terminal destruction of persistent organics, appropriately coupled with the removal of inorganic constituents (COI) where needed.



Upper screens for mGCW system

mGCW Mode of Action

The mGCW system treats soil and groundwater simultaneously. By drawing groundwater from an aquifer formation through one screen section of a multi-screened well and discharging it through another, the mGCW creates an in situ vertical groundwater circulation cell. Under “standard-flow” conditions, groundwater is pumped upward inside the remediation well. Groundwater flow upward through the mGCW can be achieved via an air-lift effect, or it can be induced via a submersible, in-well groundwater circulation pump. The circulation cell flow path thus encompasses groundwater flowing from the lower part of the treatment zone into the lower part of the mGCW. In a reverse circulation mode, the flow of groundwater within the mGCW well is downward via the aid of an in-well groundwater pump (*i.e.*, water flows from the bottom of the aquifer formation in a torroidal upward pattern, or from the top of the mGCW to the bottom). In both the standard and reverse flow modes of operation, groundwater is circulated around the central mGCW. In most cases, no water is removed from the aquifer.



Tank model demonstration of a standard—flow mGCW

In combination with in situ soil flushing, the mGCW combines a series of biotic and abiotic processes to effect COI removal or destruction.

Accelerated Aerobic Biodegradation: In-well aeration/oxygenation results in the addition of oxygen to the groundwater that is returned to the aquifer and circulated throughout the formation. Combined with the overall mixing effect, this serves to enhance the rate and extent of in situ, aerobic biodegradation of susceptible organic COI. The catabolic activity of the resident microflora can be further stimulated through the addition of rate-limiting inorganic nutrients (e.g., nitrogen and phosphorus) to the circulating groundwater. In rare cases, the in situ bioreactors can be inoculated with specially selected biomass to initiate desired biocatalytic reactions.

Enhanced Anaerobic Biotransformation: mGCW systems can be designed to greatly enhance the kinetics of anaerobic biotransformations of many COI, including organic explosives and halogenated aliphatics. As with the accelerated aerobic bioreactor, these systems can rely on the activity of resident biomass colonizing the reactor or the reactors can be inoculated with specially selected strains. The means of stimulating the catalytic action of resident anaerobic microflora can entail the introduction of various electron donors such as acetate, hydrogen, methane, ethanol or methanol.

Immobilization: The removal of inorganic COI (*i.e.*, dissolved heavy metals) is accomplished through the integration of an in-well bioreactor or some other form of metal recovery. For example, ligand-specific ion exchange resins have been employed to remove cadmium and chromium from groundwater. Field variations for immobilization include the design of the reactor chambers and the location or sequence of the in situ immobilization/recovery steps.

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