

IEG Technical Briefing Note No. 12

In situ Remediation of Ammonia and Nitrate Impacted Groundwater

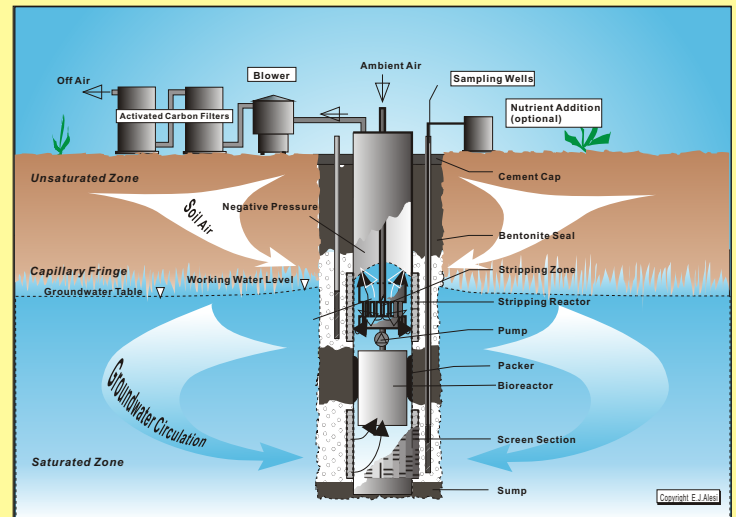
IEG's patented vertical **Groundwater Circulation Well™** (IEG GCW™) technology offers enhanced treatability of conservative contaminants in groundwater, such as ammonia and nitrate, arising as a result of the manufacture of town gas and the agricultural application of nitrogenous fertilisers. The IEG GCW™ provides the ability to effect both the simultaneous containment of groundwater plumes and provide accelerated removal of contaminants through a combination of physical, chemical and biological processes.

This effective and efficient treatment system works in two ways

(a) first of all, the principle of in-ground circulation of groundwater, to bring about hydraulic control of groundwater, the containment of the contamination and hence the minimisation of further contamination movement off-site, and the delivery of contaminated groundwater to the in situ treatment well;

(b) secondly, the in situ treatment itself, for the removal of ammonia, which occurs in two phases:
- bulk removal of gross ammonia contamination using negative pressure air stripping
- final polishing of recirculated groundwater to target concentration using nutrient-enhanced reactive Zero Valent Iron for accelerated bioremediation.

Groundwater circulation can be applied, in principle, to many amenable aquifers, both shallow and deep. Applicability can be confirmed by a hydrogeological assessment of the aquifer. For dual porosity systems, this will include the nature and orientation of fracture and matrix porosity and permeability. For a recently modelled UK chalk aquifer, it was determined using existing site data that the diameter of the capture zone of one IEG GCW™ was in the region of 45m by applying an in-well pumping flow rate of 4m³/hour. Based on the client's estimate of an ammonia plume width of 105 metres, it was estimated that three parallel IEG GCW™ systems would be able to first contain and then provide the groundwater feed for the treatment of the ammonia contamination migrating off-site.

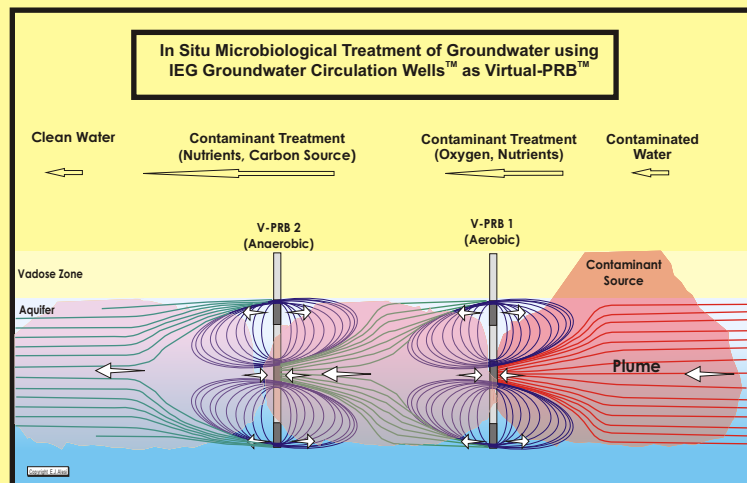


IEG Vertical Groundwater Circulation Well™ System for physical-chemical-biological remediation of groundwater impacted by ammonia and nitrate pollution (IEG GCW™ Process)

ammonia levels were reported to be in the region of 160mg/l and the target concentration 0.5mg/l. On that basis, in situ negative pressure stripping of the gross ammonia contamination using IEG's GCW™ equipped with our patented high efficiency labyrinth stripper was recommended and considered achievable at an operational pH range of 9-10, reflective of site conditions. It was estimated that treatment was feasible to reduce ammonia in groundwater to around 20mg/l with stripped ammonia being recovered into an above-ground wet scrubbing system for onward disposal of a concentrated ammoniacal liquor. In this design, no groundwater would be pumped above ground level, the only above ground wastes being ammonia in the off-gas from the in situ labyrinth stripper.

Notwithstanding the treatability assessment above, a residual level of ammonia of 20mg/l was considered insufficiently low to satisfy the regulator. To overcome this, IEG proposed an in situ polishing system to complete the remediation down to the target level. Levels of ammonia such as these may be further reduced down to acceptable low concentrations using IEG's **Virtual-Permeable Reactive Barrier™** (IEG V-PRB™) comprising specially modified IEG GCW's™ and the injection of a proprietary food grade source of organic nutrients. This involves emplacing two lines of IEG GCW™ systems perpendicular to the direction of groundwater plume flow to create two discrete bioreactive zones. The first, up-gradient aerobic zone serves the purpose of nitrifying the residual ammonia to nitrate. The second, down-gradient anaerobic zone denitrifies the nitrate direct to harmless nitrogen gas. This system is illustrated in the schematic to the left.

The benefits of this system are considerable, given that remediation may be undertaken by the selective removal of ammonia in situ, using naturally occurring micro-organisms, and that the system does not require the removal of groundwater from the aquifer for above ground treatment by expensive methods, followed by the treated effluent's discharge to sewer. Further, once installed, these small footprint low energy systems are capable of performing over an extended period of time with minimal maintenance and for a relatively low cost, with minimum disruption to ongoing (or future) site activities. Should development constraints be an issue, the system may be integrated into the construction design and development activities in order to minimise adverse impacts.



- **Patented design - proven engineering**
- **Quicker, Smaller, Smarter, Greener**

The IEG GCW™ method is a process patented by IEG.



To discuss your in situ soil and groundwater remediation requirements, or for a free remediation concept and quotation, please contact us

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