In-Situ Groundwater Nitrification and De-Nitrification Remediation Processes

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ABSTRACT:

These processes are in-situ remediation for the reduction of elevated ammonia or nitrate concentrations in groundwater such as at fertilizer manufacturing facilities, sewage treatment facilities, agricultural areas, airports, etc.

Elevated concentrations of ammonia and nitrate in water can present a freshwater aquatic environment health concern. Discharges of ammonia and nitrate contaminated groundwater to aquatic environments is a growing public concern and elevated concentrations of nitrate in drinking water can present a human health concern. One aspect of these processes provides in-situ remediation of ammonia or nitrate contaminated groundwater in a cost effective manner.

To reduce concentrations of ammonia the process provides a method of in-situ groundwater nitrification, by: extracting groundwater from the ground; adding oxygen and nutrients to the extracted groundwater; and the injection of the oxygen and nutrient amended groundwater in order to encourage nitrifying bacteria to convert ammonia to nitrate.

The conversion of ammonia to nitrate occurs through the following reactions:

$$NH_4^+ + 2/3\ O_2 \rightarrow NO_2^- + 2H^+ + H_2O$$

$$NO_2^- + ½\ O_2 \rightarrow NO_3^-$$

As a result, the following overall reaction occurs:

$$NH_4^+ + 7/6\ O_2 \rightarrow NO_3^- + 2H^+ + H_2O$$

During in-situ pilot scale testing in an alluvial aquifer ammonia concentrations were reduced from 58 mg-N/L to 6.0 mg-N/L in approximately 120 days.

To reduce concentrations of nitrate the process provides a method of in-situ groundwater de-nitrification, by: extracting groundwater from the ground; adding carbon and nutrients to the

extracted groundwater; and the injection of the carbon and nutrient amended groundwater in order to encourage de-nitrifying bacteria to convert nitrate to nitrogen gas.

De-nitrifying bacteria are attached growth biofilms, and the conversion of nitrate to nitrogen gas occurs through the following reaction:

$$2NO_3^- + 1.5(CH_3COOH) \rightarrow N_2 + 3CO_2 + 3H_2O$$

(Acetic acid or another carbon source)

During in-situ pilot scale testing in an alluvial aquifer nitrate concentrations were reduced from 66 mg-N/L to 0.2 mg-N/L in approximately 14 days.