Compound Specific Isotope Analysis to Identify the Source of Ammonia and Nitrate in Surface Water Adjacent to a Fertlilizer Plant

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Background/Objectives. Ammonia and nitrates are produced for use as fertilizers in agriculture, however they are both also produced and consumed by natural processes. Ammonia and nitrate are present in a creek that runs near a fertilizer plan. Ammonia and nitrate are also present in groundwater under the plant and these impacts are associated with the ammonia and urea production at the facility. An Outfall is located offsite near the eastern fenceline of the facility. Nitrate and ammonia concentrations have been detected in standing water located at and downstream of the Outfall.

The creek is intermittently dry upstream of the Site Studies were performed to determine whether groundwater at the Site is connected to the creek and to determine whether Site groundwater contributes to the ammonia and nitrate present in the creek.

Compound specific isotope analysis was used to determine whether the site has contributed nitrates to the surface water through groundwater and to better understand isotope differences between the groundwater and surface water

Approach/Activities. Groundwater samples from 10 monitoring wells with known high nitrate and ammonia concentrations, a sample from the Outfall, and six samples from surface water in the creek were collected for the study. The surface water samples were collected from close to and downstream of the Site. CSIA for $\delta\ ^{15}N$ for ammonia and nitrate, $\delta^{18}O$ for nitrate, and $\delta\ ^{18}O$ and $\delta\ ^{2}H$ for water were analyzed for these samples. Ammonia concentration versus the $\delta\ N^{15}$ values; $\delta^{15}N$ is vs $\delta^{18}O$ for nitrate and $\delta\ ^{18}O$ vs $\delta\ ^{2}H$ for water were plotted to understand the relationships between the chemicals and provide information about the source of the ammonia and nitrate in the samples.

Results/Lessons Learned. The isotope data collected during this study demonstrated that the plant appears to have little effect on surface water in the creek. The $\delta^{15}N$ values for ammonia and nitrate suggest that the ammonia is biologically derived and that the nitrate is from oxidation of the biologically derived ammonia. The groundwater samples from the furthest downgradient wells also show this pattern suggesting that the ammonia and nitrate from the plant do not migrate very far downgradient and closer to the creek these species are not associated with the plant.

The Outfall sample does appear to contain impacts from the plant, as expected.

The isotopic signature of the water in the creek does appear to be different from the isotopic signature of the groundwater, however it cannot be conclusively proven that groundwater does not exfiltrate into the creek as this difference could be due to evaporation as the water moves along the creek. However, if groundwater were constantly exfiltrating into the creek, the creek would be expected to have a more similar isotopic signature to groundwater; therefore, these data suggest that there is not a large amount of groundwater exfiltrating into the creek.

These data taken together suggest that the plant does not have a large amount of impact on the creek.