Microbial Activity Analysis (TIC)

PAES has developed a method for analyzing microbial activity using Total Inorganic Carbon and methane that takes the guess work out of calculating TIC across a site.

There are three forms of inorganic carbon that exist in groundwater: carbon dioxide, carbonate and biocarbonate. They exist in groundwater in a pH dependent equilibrium.

If carbonate from soluble carbonate minerals in the soil matrix dissolves into the groundwater, there will be concentrations of all three forms of inorganic carbon at equilibrium. Since soluble carbonate minerals are common, there is almost always some background level of TIC, even in uncontaminated aquifers. In contaminated aquifers, there is almost always oxidation of organic material. Aerobic or anaerobic oxidation leads to the generation of inorganic carbon in the form of carbon dioxide in contaminant plumes. Therefore, when analyzing methane and TIC across a plume, one would find background concentrations over uncontaminated portions of the aquifer and anomalous concentrations of methane and TIC over contaminated portions.

Why Measure TIC?

- TIC is the final product of fuel oxidation.
- TIC analysis provides the most comprehensive look at inorganic carbon across a site.
- Mapping TIC across a site reveals the back-ground TIC that results from aquifer sediments.
- Mapping TIC reveals the elevated TIC resulting from bioxidation of contamination.
- TIC combines bicarbonate, carbonate, carbonic acid and dissolved carbon dioxide into one analysis.

Reporting Limit for TIC:

1 mg $CaCO_3$/L

TIC can be determined from a groundwater sample if the sample is acidified before determining the dissolved carbon dioxide. Acidification causes the equilibrium to shift such that most of the inorganic carbon is in the form of carbon dioxide. The dissolved carbon dioxide measurement of an acidified water sample gives an excellent measure of TIC.

Some may feel that measuring alkalinity is sufficient and TIC is unnecessary. That's not true because inorganic carbon is present as both alkalinity and as carbon dioxide, and the ratio between the two can vary widely across a site depending on pH and dissolved solids. The crucial pH is near neutral, and the dissolved solids will increase dramatically as biological activity causes mineral dissolution. Thus, there can be wide swings across a site that alkalinity alone or carbon dioxide alone will not point out. Granted, by doing both tests, accounting for pH and TDS, and making many assumptions, TIC could be calculated. However, the method utilized by PAES provides TIC in one measurement and eliminates assumptions, multiple analyses and arduous interpretation.

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