The Environmental Corner

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Can Perc Releases Be Age Dated And Fingerprinted?

For years parties responsible for the costs associated with environmental investigations and cleanups of Perc contamination have been trying to determine when Perc releases have occurred. This topic has important ramifications when sites have had a series of dry cleaning operations over time, when different insurance carriers insured dry cleaners and property owners, and when several dry cleaning releases have comingled together from different dry cleaning locations.

So, for the past 15 to 20 years, scientists like Dr. Konrad Banaszak with EnviroForensics, have been trying to figure out how to age date PERC releases. So, can Perc releases be accurately age dated? The answer is yes, no and maybe.

One of the ways to determine a relative age of a release is by evaluating the breakdown products of Perc (trichloroethene, dichloroethene, and vinyl chloride). Generally speaking, groundwater that contains higher concentrations of vinyl chloride is typically associated with an older release of Perc. However, there are limitations in that the ambient water quality has a direct effect on the breakdown time. For example, Perc generally breaks down more rapidly in an anerobic groundwater environment, one that is starved for oxygen. Conversely, Perc released into an aerobic groundwater environment would generally break down very slowly. Therefore, using the ratio of breakdown products to Perc is not singularly a reliable method for estimating the age of the Perc release.

Another approach is to determine the horizontal extent of the contaminated groundwater plume. In general, the groundwater velocity multiplied by time equals the distance traveled (R*T=D). Hydrogeologists can determine the groundwater velocity and

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As Seen In...

Cleaner & Launderer

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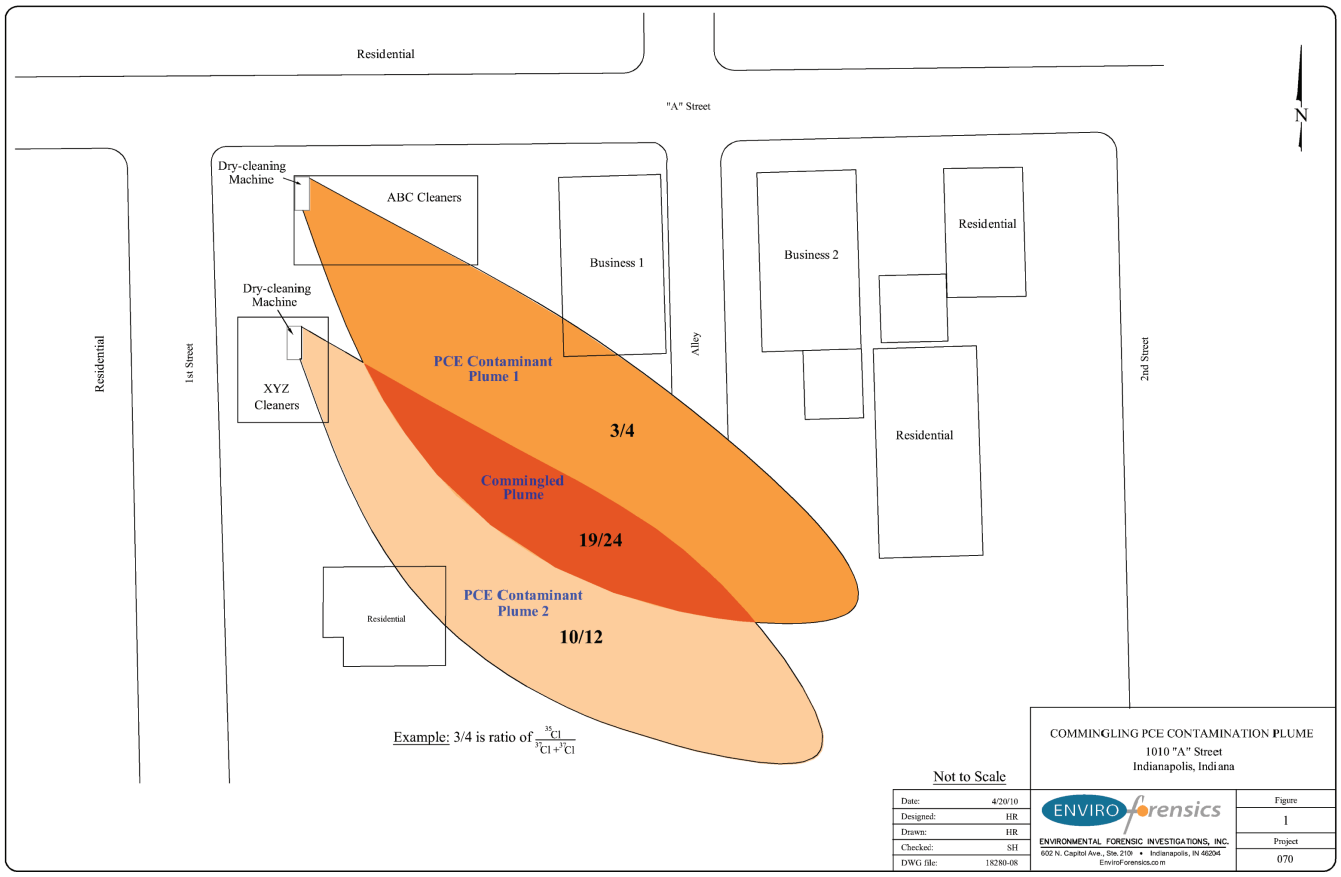

the distance the impacted groundwater has migrated from the source area and may be able to provide a release time. Additional information is required to more accurately determine the time of travel in that the higher the organic content of the aquifer, the more the volatile organics like Perc are retarded or slowed from migration.

The above scenarios can be difficult to provide accurate estimates, although hydrogeologists and scientists can develop reasonable estimates. A more complicated scenario is when one is trying to determine the age of a Perc release when it has comingled with another release. Scenarios include different releases at the same location over different times periods or different releases from different dry cleaning establishments. The later is common in large regional contamination studies.

In situations where comingled plumes exist, scientists more likely than not would rely on evaluating different isotopes of Perc. To understand this approach, the scientist must have information on the original product that the dry cleaner used over specific time periods. Different manufacturers of Perc had unique product formulas from their competitors and recycled Perc would have a very different formula from virgin Perc. Therefore, different isotopes become the focus of the study.

Isotopes may be an idea that you have long forgotten. The idea of isotopes is simple enough in that different atoms of the same element can have different masses. For example, ancient temperatures on earth can be determined from the isotopic signature of the oxygen in core samples collected from glacial ice.

To illustrate this in age dating a perc release the following is assumed; a Perc molecule has two carbon atoms and four chlorine atoms. There are 5 different molecules of perc by mass. The two carbons have a mass of 24. Carbon practically speaking

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has only one isotope, but chlorine has two common isotopes (35 and 37). The resulting Perc molecule may weigh 164 (all four chlorines being 35), 166, 168, 170, or 172 (all four chlorines being 37) units.

By quantifying the various molecules of Perc in groundwater samples, we can in some cases distinguish Perc by its source. This may be useful in establishing which sources contributed how much contamination to a plume that is composed of several sources. It may also be useful in age dating a Perc release.

In the case of a commingled plume, the isotopic "fingerprint" of each source needs to be established. In theory this is not too difficult and would require just a couple of samples in the source area and at the leading edge of the plume. However, age dating a plume is more complex. A precondition is that we know the isotopic fingerprint of the Perc product that was used at a given time and location versus the isotopic fingerprint of the Perc product used at a later time and location. If one is trying to establish the age of a release at the same site, we need to know the date when the Perc products that were used switched from one to another. If that information can be substantiated, we may be able to differentiate the isotopic fingerprint near the source area from that at the leading edge of the plume. Further work would then be required to discover where the change occurs within the plume. By coupling an understanding of groundwater flow velocity and of the change in the isotopic signature in the plume, one could probably determine the age of the release.

The cost to evaluate the isotopic signature of the Perc in groundwater samples is relatively inexpensive, approximately $350 per sample. Obtaining the soil or groundwater samples, conducting the investigative research to determine what Perc products were used would be additional.