

THIS POLICY DOES NOT HAVE THE FORCE OF LAW

ADOPTED

SUBJECT: Solid Waste Policy: Ban on Field Filtration of Ground Water Samples from Municipal Solid Waste Landfill Facilities [OAC Rule 3745-27-10(C)(1)]

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PURPOSE: To clarify the position Ohio EPA has adopted, in order to be consistent with U.S. EPA, banning field filtration of ground water samples from Municipal Solid Waste Landfill Facilities (MSWLFs) regulated by Ohio Administrative Code (OAC) Rule 3745-27-10.

BACKGROUND: OAC Rule 3745-27-10(C)(1) requires that ground water monitoring results provide an accurate representation of ground water quality beneath the MSWLF. Federal Rule 40 CFR 258.53(b) specifically disallows the field filtration of ground water samples collected to determine ground water quality at MSWLFs. Ohio EPA has reviewed the research/professional literature references which are summarized below and form the basis for U.S. EPA's decision that field filtration of ground water samples from MSWLFs produce analytical results that do not provide an accurate representation of ground water quality.

One of the most basic premises of ground water monitoring is that the monitoring well must provide a representative hydraulic connection to the monitored unit. Without this hydraulic connection, the ground water chemistry data cannot be interpreted in relation to the flow system dynamics or the transport of chemical constituents in the monitored unit (Puls and Barcelona, 1989). Metal contaminants are transported through fractured and porous media not only as dissolved species, but also as precipitated phases, polymeric species (composed of the same chemical elements in the same proportions by weight, but differing in molecular weight) or absorbed to inorganic or organic particles of colloidal dimensions (State of Wisconsin, 1992). Colloidal particles are particulate matter defined by an upper limit of 10 microns (10^{-6} meters) in size (Stumm and Morgan, 1981).

Lab experiments using natural aquifer material and model inorganic colloids indicate that the transport of colloidal material through sand and gravel-type aquifers may be significant under certain hydrogeologic conditions. Due to the strong reactivity of many inorganic colloids in natural subsurface systems, the potential exists that this form of contaminant transport may be important at certain sites. Its significance depends on a number of chemical and physical variables, including but not limited to ionic strength, ionic composition, flow velocity, quantity, nature and size of suspended colloids, geologic composition and structure, and ground water chemistry. The most significant of these factors, evaluated under conditions investigated in lab experiments, were ionic composition and particle size. Neglecting colloidal mobility may underestimate both the transport rate, maximum transport distance, and possible total mobile contaminant load. As described by Puls (Puls, Eychaner and Powell, 1990), colloidal material may be released from the geologic matrix and transported large distances. Field sampling procedures must account for the possibility of colloidal transport. These concerns must be addressed during site characterization and assessment monitoring if colloid transport is deemed possible for the site (State of Wisconsin, 1992). For the purpose of determining possible total mobile contaminant load, unfiltered samples should be given priority.

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The following definitions are presented for reference to clarify the composition of possible total mobile contaminant loads present in an aquifer:

- a. Mobile species: dissolved and suspended species;
- b. Dissolved species: free ions, inorganic complexes, and low molecular weight organic complexes;
- c. Suspended species: absorbed, precipitated, polymeric, and high molecular weight organic complexes.

Historically, 0.45 μm pore size filters have been used to differentiate between dissolved and suspended species in ground water samples. If the purpose of sampling is to estimate mobile species in solution, including both dissolved and suspended contaminants, significant underestimations may occur, due to removal of colloidal matter by 0.45 μm filtration (Puls and Powell, 1992). In practice, 0.45 μm filters are commonly used to balance between the objectives of isolating dissolved constituents or species and permitting reasonable use in the field (Puls and Eychaner, 1990). Particle sizes do not have a prescribed lower boundary dimension so that the right filter can perfectly separate suspended species from dissolved species.

Use of 0.45 μm filtration may exclude an important component of the possible total mobile contaminant load at some waste sites, particularly where highly toxic metals are involved (Puls and Powell, 1992). Oxidation induced precipitation and sorption processes may cause previously dissolved species to be removed during filtration, resulting in significantly lower metal concentrations than are actually present in situ (Puls and Barcelona, 1992). The conservative approach necessitates that no field filtration be done on samples being estimated for total mobile contaminant load. This places an increased importance on proper well construction, and purging and sampling procedures to eliminate or minimize sources of sampling artifacts. Filtration is not viewed as a method to be used to compensate for poor well construction, development, or sampling procedures (Puls and Powell, 1992).

Puls and Barcelona (1989) also recommend no filtration for the determination of mobile metal ions if extraneous sources of particles are removed by careful well construction and development (Puls, Eychaner and Powell, 1990). The design, drilling, and construction of monitoring wells have been identified as particularly important steps in the collection of representative water chemistry and hydrologic data. The well must allow for sufficient ground water flow for sampling, minimize passage of formation materials into the well, and exhibit sufficient structural integrity to prevent collapse of the intake structure. Well design fundamentals with regard to the selection of a filter pack and screen size are among the most important issues in obtaining representative hydraulic and water quality information. The exclusion of fines (formation sediment which passes a #200 sieve; i.e., silts and clays) can be achieved by selecting the grain size distribution for the filter pack by multiplying the 50-percent retained size of the finest formation sample by a factor of two (Puls, Eychaner and Powell, 1990).

Natural turbidity may exist where conditions are favorable for the production of stable suspensions (e.g., low ionic strength waters, geochemical supersaturation, high clay content), whereas excessively rapid pumping or purging relative to local hydrogeologic conditions is the most common cause of artificial turbidity (Puls, Powell, Clark and Paul, 1991). There is a

strong inverse correlation between turbidity and representativeness of samples (Puls, Powell, Clark and Paul, 1991).

The use of certain sampling devices, particularly bailers and air-lift arrangements, should be discouraged in order to avoid redevelopment of the monitoring well. Redevelopment of the monitoring well can cause additional infiltration of fine grained material into the well. This can occur due to the surging action of the sampling device. Purging the well prior to sampling necessitates that purge rates be kept below development rates also to reduce redevelopment of the well. Pumping rates used during purging should not exceed rates used during development or sampling since further development and well damage may aggravate suspended particulate and turbidity problems even in properly designed monitoring wells (Puls, Eychaner and Powell, 1990). The effects of the chosen pumping rate can induce physical and chemical changes which include excessive turbidity, exposure of fresh sorptive surfaces in suspension capable of adsorbing dissolved metals, dilution or concentration of contaminants due to mixing, changes in pH, carbonate equilibria, metal speciation, and redox and chemical precipitation (Puls, Eychaner and Powell, 1990). The OEPA, DDAGW Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring (TGM), Chapter 10, should be referenced for information on monitoring well purging.

Intensive sampling research at three different metals-contaminated field sites has shown that the method by which samples are collected has a greater impact on sample quality, accuracy, and reproducibility than whether the samples are filtered or not. This same research has shown that 0.45 μm filtration has not removed potentially mobile colloids, when samples have been collected using low pumping flow rates of approximately 0.2-0.3 L/min (Puls, Powell, Clark and Paul, 1991). Low flow sampling entails the use of low flow rate purging and sampling (0.2 to 0.3 L/min), in-line monitoring of pH, temperature, specific conductance, redox, dissolved oxygen, and turbidity, and collection and immediate processing of samples upon indicator equilibration (Puls, Eychaner and Powell, 1990). In general, the monitored zone must be isolated and the sample pumped slowly to minimize sources of sampling artifacts.

The sampling technique must be capable of obtaining representative samples for both dissolved and suspended species of contaminants in evaluating the total mobile contaminant load (Kearl, Korte and Cronk, 1992). Sample collection practices that induce artificially high levels of turbidity have been shown to have the greatest negative impacts on sample quality. These impacts may include redevelopment of the monitoring well, mixing of chemically distinct zones, and aeration of the sample. Contamination of samples can also occur from the following: poor well design or construction; inadequate or improper well development; corrosion, degradation, or leaching of well materials; improper well purging, sampling, or sample processing, and transportation or storage of the sample.

Inconsistent operator usage together with excessive purging generally result in excessive turbidity (> 100 Nephelometric Turbidity Units (NTUs)) and large differences in metals concentrations between filtered and unfiltered samples. The use of low flow rate purging and sampling has produced filtered and unfiltered samples that showed no significant differences in concentrations. Turbidity levels were generally less than 5 NTUs, even in fine-textured glacial till (Puls and Eychaner, 1990).

A field study was performed in 1992 by the Wisconsin Department of Natural Resources (WDNR) on four monitoring wells at a county landfill. All four wells were initially purged with a PVC bailer. Well 1 had very low turbidity, well 2 was described as "medium" turbid, and wells 3 and 4 had extremely high turbidity. The samples from wells 3 and 4 were noted as being way off the turbidity scale and similar to chocolate milk in appearance. At both wells 3 and 4, the water removed the first time the bailer was lowered into the well was clear while all water removed after the first bailer was extremely turbid. Well 3 was then purged again with a centrifugal pump. Problems were initially encountered establishing the flow rate of 0.3-0.45 L/min but once done, the sample was clear to the eye and recorded low turbidity values. This serves to illustrate that a centrifugal pump can produce a "clear" sample from a well that produced extremely turbid water using a bailer. WDNR then used a bladder pump and sampled at the low flow rate of 0.5 L/min. They were able to obtain a "clear" sample using the low flow rate at the well that had produced very turbid samples after the first bailer the previous week. WDNR also was able to obtain samples with very low turbidity using the centrifugal pump at a moderate rate of 0.9-1.0 L/min. at wells 3 and 4.

Following the technical review of the research/professional literature discussed in the background above and in order to be consistent with Federal Rule 40 CFR 258.53(b), the Ohio EPA has adopted the following policy.

POLICY:

Ground water samples collected at MSWLFs must meet the requirements of OAC Rule 3745-27-10(C)(1) which states, in part, "the Ground Water Monitoring Program shall include consistent sampling and analysis procedures... that are designed to ensure monitoring results that provide an accurate representation of ground water quality at the background and downgradient wells." To meet the above requirement, all ground water quality data generated by MSWLFs regulated under OAC Rule 3745-27 must not be obtained from the analysis of field-filtered ground water samples. Any analytical data generated from field-filtered ground water samples shall not be considered an accurate representation of ground water quality at a MSWLF. This ban on the use of field-filtered ground water samples for water quality purposes at MWSLFs shall apply only to facilities regulated under OAC 3745-27.

This policy was developed to be consistent with the U.S. EPA ban on field filtration of ground water samples from MSWLFs. This policy does not preclude the field filtration of ground water samples from entities regulated under different programs not discussed in this policy (e.g. RCRA, CERCLA, UIC). The Ohio EPA maintains the position that field filtration of ground water samples may be necessary in many cases to obtain an accurate representation of ground water quality.

REFERENCED SOURCES

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