

## GOT VAPORS?

Chemical vapors seeping into indoor air is not a new concept. In fact, "chemical vapor intrusion" as it is technically known, has been addressed by government officials, the construction industry, developers and other parties for many years. However, recent studies have shown that chemical vapor intrusion can be as much, if not more, of a threat to public health than contaminated groundwater or other contamination pathways (i.e. soil). That is why it is becoming more common for Department of Natural Resources (DNR) and Department of Commerce staff to raise concerns about chemical vapor intrusion to indoor air. As a result of this concern and the need for more investigation, some case closures are being deferred until the vapor intrusion pathway has been adequately addressed.

The roles of DNR and Commerce staff have not changed – they continue to be responsible for the same reviews and approvals as well as all decisions about case closures. However, you may find that staff with the Department of Health and Family Services (DHFS) are now consulted more frequently on vapor intrusion-related issues because of their expertise related to indoor air quality issues, radon mitigation and risk assessment communication.

### **A Complex Pathway**

The vapor intrusion pathway is complex to evaluate because, not only is it dependent on fate and transport properties in multiple media, but it is also dependent on site- and building-specific factors. For instance, indoor air vapors may come from attached garages as well as cleaning agents used in homes (please see Figure 1 on the next page). The variability over time and seasons adds another layer of complexity. Also, in some cases (e.g. TCE and xylene) the dissolved contaminant levels below which vapor intrusion may be screened out as a potential pathway of concern are less than the enforcement standards for groundwater protection.

Some simple field procedures can be implemented to begin to assess the presence of vapors at contaminated sites. For example, environmental consultants can sample the air (i.e. headspace) in groundwater monitoring wells before initiating any other field work at a well (as called for in U.S. EPA's standard operating procedure on water-level measurements, which is available at [www.ertresponse.com/sops/2043.pdf](http://www.ertresponse.com/sops/2043.pdf)).

In addition to being a technically complex pathway to investigate, there are important considerations specific to the needs of state grant and loan programs, and to the use of tools available for brownfield redevelopment, that must be included. State health staff work closely with DNR and Commerce officials on these site-specific and policy issues related to vapor intrusion.

### **Sources of Information**

In order to increase the number of cases where the vapor intrusion pathway is properly evaluated, DHFS has issued a guidance document on the topic, directed towards environmental consultants and contractors. This guidance is not prescriptive, but provides a general framework for approaching the evaluation of pathway. Entitled *Chemical Vapor Intrusion and Residential Indoor Air: Guidance for Environmental Consultants and Contractors* document is available on the DHFS web site at [www.dhfs.state.wi.us/eh/](http://www.dhfs.state.wi.us/eh/)



air.

EPA has also released draft guidance on the topic specific to chlorinated solvents. Their guidance provides a more detailed and prescriptive approach. Although the EPA document is quite long (178 pages), it can be a valuable decisionmaking tool. A worksheet is provided in the guidance that is particularly helpful in identifying sites that should be investigated for a vapor intrusion problem. The EPA document, *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance, ains caev)* available at the following web site: [www.epa.gov/correctiveaction/eis/vapro.htm](http://www.epa.gov/correctiveaction/eis/vapro.htm).

Other guidance tools that are particularly useful for addressing the vapor intrusion pathway include the *Guidance for Documenting the Investigation of Utility Corridors*, *Understanding Chlorinated Hydrocarbon Behavior in Groundwater Investigation, Assessment and Limitations of Monitored Natural Attenuation*, available on the RR Program web site at [www.dnr.state.wi.us/org/aw/rr/archives/pub\\_index.html](http://www.dnr.state.wi.us/org/aw/rr/archives/pub_index.html).

## **PERMANGANATE INJECTIONS INTO GROUNDWATER - QUESTIONS & ANSWERS**

Recently, there have been requests to RR project managers and other DNR staff to inject permanganate – MnO<sub>4</sub> in either the potassium or sodium form – into groundwater to treat contaminants in-situ. Some issues have come up which staff are now addressing with our customers.

### **What Is MnO<sub>4</sub> Used For?**

Permanganate is primarily used to oxidize & destroy chlorinated ethenes. While it does not oxidize petroleum compounds, MnO<sub>4</sub> does provide oxygen to the subsurface and will support biological activity that can degrade petroleum. Please note, though, that this is a very costly method for adding oxygen.

### **What Kinds of Trace Metals Are Present With MnO<sub>4</sub>?**

Permanganate is created from manganese ores, which contain a variety of trace metals. Trace metals that may be present include: antimony, arsenic, chromium, mercury, beryllium, cadmium, lead, and thallium. The metal of most concern is chromium (Cr), which will be in the Cr (VI) form, the most oxidized and mobile form.

In general, concentrations of the trace metals injected with the MnO<sub>4</sub> should not exceed Enforcement Standards (ES). However, there are various grades of MnO<sub>4</sub> containing different concentrations of trace metals. The manufacturer should be able to provide an analysis of the MnO<sub>4</sub> proposed for injection at a remediation site, including the amounts of trace metals to be expected.

Permanganate (and other strong oxidizers) can oxidize and mobilize chromium that is native to soils and bedrock. Other metals may also be mobilized through oxidation. The background concentration of the trace metals, the availability of the trace metals to the oxidant, the soil type and other factors will determine the final concentrations in groundwater. It is possible to exceed ES levels for chromium (and perhaps other metals) through mobilization of native trace metals.

### **What Needs To Occur Before An MnO<sub>4</sub> Injection?**

We recommend that the following issues be addressed when requesting approval of an MnO<sub>4</sub> injection:

- provide the chemical analysis of the MnO<sub>4</sub> proposed for injection;
- provide a mass balance of the MnO<sub>4</sub> versus the natural oxidant demand and contaminant demand (i.e., to avoid excess MnO<sub>4</sub>);
- provide rationale for the proposed concentrations of MnO<sub>4</sub> in groundwater necessary to oxidize the contaminant;
- provide rationale for the expected persistence of MnO<sub>4</sub> in the groundwater (i.e., how long it will be effective);
- propose a monitoring system that can determine the extent of the area affected by the MnO<sub>4</sub> injection;
- propose groundwater analysis for:
  - \* total Cr before treatment, and then periodically during treatment and after treatment until Cr has declined to background levels;
  - \* other trace metals that could exceed PALs; this includes an assessment of metals contained in the MnO<sub>4</sub> as well as native trace metals; and
  - \* MnO<sub>4</sub> concentrations;
- propose sentinel wells as part of the monitoring program; use these wells to determine that MnO<sub>4</sub> doesn't extend beyond the area intended to be treated; and
- propose monitoring MnO<sub>4</sub> and trace metals until those compounds have returned to background levels.

Please note, all injection requests require approval under NR 812, Wis. Adm. Code, before injection. Depending on levels, an exemption from NR 140, Wis. Adm. Code, may also be necessary. For questions or more information on permanganate injection for remediation, please contact Terry Evanson at 608-266-0941, or [theresa.evanson@dnr.state.wi.us](mailto:theresa.evanson@dnr.state.wi.us). For more information on temporary exemptions to NR 140 groundwater standards, please contact Bill Phelps at 608-267-7619, or [william.phelps@dnr.state.wi.us](mailto:william.phelps@dnr.state.wi.us).