
Issue No. 10 | Fall 2018

# Is It a REC? – Emerging Contaminants Part 2

According to the Interstate Technology Research Council (ITRC), Emerging Contaminants, or **Contaminants of Emerging Concern (CECs)** are those chemicals that present known or potentially unacceptable human health effects or environmental risks and currently (1) do not have regulatory cleanup standards, and/or (2) regulatory standards are evolving due to new science, detection capabilities, or pathways.

The last issue of *Is It a REC discussed* PFAS, or per- and polyfluoroalkyl substances, as a class of emerging contaminants that are getting considerable regulatory attention and therefore worthy of evaluation for present and future environmental risk to your subject property when conducting Phase I and II environmental site assessments (ESAs). But PFAS, which number more than 3,000 different chemicals, are not the only CECs to stay on top of. Based on their known and in may cases still unknown effects, several other classes of environmental contaminants are crowding into the CEC spotlight.

## 1,4-Dioxane

1,4 Dioxane is a volatile, flammable, colorless liquid at room temperature and becomes unstable and explosive at elevated temperatures. It is also miscible with water and highly mobile in soils, where it can migrate quickly to groundwater and continue dispersing well beyond release points. It is a by-product that can be found in some consumer items like shampoo, deodorants, and cosmetics, but its main use has been as a chemical stabilizer in chlorinated solvents such as 1,1,1-trichlorethane(TCA) and paint strippers, greases, and waxes. It is often found as a contaminant at sites with solvent releases. Manufactured since the 1950s, 1,4-Dioxane's use has fallen off as TCA use was reduced or outright banned (EPA).

1,4 Dioxane has gained attention as an emerging contaminant partly due to its classification by EPA as a likely carcinogen by all routes of exposure (ingestion of contaminated food and water, inhalation, dermal contact). Its high mobility in the environment and resistance to natural biodegradation also are factors that cause 1,4-Dioxane to occur not only at active and former industrial sites, but also migrating large distances away from them. No federal maximum contaminant level (MCL) has been established, but a multitude of screening levels, health advisory levels, soil and air screening levels, and permissible exposure levels have been set by EPA and OSHA (more information here). It is important also to check with state regulators when dealing with 1,4-Dioxane, as various states have established their own guidelines, at last check ranging from 0.3 to as high as 77 micrograms per Liter (ug/L).

**Not to be confused with Dioxin…**

Among the most toxic group of compounds, polychlorinated dibenzodioxins and polychlorinated dibenzofurans (PCDDs and PCDFs) are usually called "dioxins and furans" or just "dioxins." These are not manufactured chemicals, but rather byproducts often derived from incomplete combustion of PCBs (see *Is It a REC* Issue No.4). Unlike 1,4-Dioxane, with simply an oxygen in the 1,4 positions (para) of its benzene ring, dioxins are complex chains of chlorinated molecules. As such they degrade slowly and are less mobile in the environment than the highly soluble dioxane.

When researching manifests or facility records for evidence of 1,4-Dioxane, also look for its synonyms: p-dioxane (short for *para-*, another descriptor for the 1 and 4 positions of the oxygen molecules on the benzene ring); Diethylene oxide; Diethylene dioxide; 1,4-Dioxacyclohexane; Glycol ethylene ether; Diethylene ether; or simply Dioxane.

## Perchlorates

Perchlorate is a chemical term that refers to what can be both a naturally occurring and manufactured anion that contains a chlorine atom bonded to four oxygens ($ClO_4^-$). Perchlorate has been used by the Department of Defense as an oxidizer in munitions since the 1940s (ITRC), primarily in the form of ammonium perchlorate. Manufactured forms also can be potassium- and sodium perchlorate and perchloric acid. As an environmental contaminant, perchlorate's high solubility causes it to migrate quickly via groundwater to form plumes that can extend miles from its source areas. Not surprisingly, the highest concentrations of perchlorate in the environment often occur at or near active military facilities and Formerly Used Defense Sites (FUDS) where manufacture, testing, storage, decommissioning, etc. of ammunition and rocket fuel took place, as well as past locations of burial, open burning, or detonation. As with other CECs, perchlorates have varying screening levels for soils and groundwater, but EPA is still in the process of developing a federal drinking water standard even though it has been listed on its Contaminant Candidate List (CCL) since 1998.




Perchlorate applications are not just military related or classified, and a thorough environmental site assessment may need to consider a wide range of other uses. The California Department of Toxic Substances Control lists the following uses and occurrence of perchlorates:

- **Rocket and Gun Propellants** – used in virtually every solid-fuel missile in the U.S military inventory but also in NASA space rockets, it is not difficult to imagine that ammonium perchlorate occurrence in and around such facilities can be widespread. Wastewater discharge from these facilities also can be heavily impacted from perchlorates.
- **Munitions, etc. –** in addition to military ammunition, warheads and the like, perchlorate has been used in signal flares, aircraft ejector seats, and fuse (aka fuze), a cord impregnated with black powder used to ignite fireworks and detonate explosives. Other CECs that may occur alongside military perchlorates can include 2,4,6-Trinitrotoluene (TNT), Dinitrotoluene (DNT), and exahydro-1,3,5-trinitro-1,3,5-triazine (RDX), also known as *royal demolition explosive.*
- **Explosives and Blasting** – perchlorate-containing explosives can be found associated with coal and mineral mining, quarrying, construction, demolition, and pyrotechnics industries, including flash powder for cameras up to the 1960s.
- **Oxygen Gas Generators** – given that perchlorates of sodium, lithium and potassium release oxygen when heated, perchlorates are used in devises that generate oxygen for aircraft, submarines, spacecraft, and bomb shelters.
- **Batteries** – Lithium and zinc-magnesium batteries can contain perchlorates in the dry cell material.
- **Manufactured Products** – These can include sodium chlorate herbicide; matches; by-products from use and production of sodium-, calcium, and lithium hypochlorite bleach; nitric acid manufacturing; and pharmaceuticals (i.e., potassium perchlorate was used up to the 1950s to treat hyperthyroidism in humans).
- **Clandestine Drug Labs** – stockpiles and wastes from flares and unburned matches containing red phosphorous, a catalyst in methamphetamine production, can contain perchlorates among other concentrated hazardous wastes.
- **Naturally Occurring** – evaporite minerals such as rock salt, potash, borax and others in arid environments can contain perchlorates. (Sources: EPA, ITRC, Centers for Disease Control, California DTSC)

**Endocrine Disrupting Chemicals (EDCs)**

In many ways EDCs have been emerging for a long time. There has been at least two decades worth of increasing awareness and discussion of chemicals that interfere with the endocrine, or hormone, system, which is found in all mammals, birds and fish and includes glands that secrete chemical messengers to control or regulate many biological processes. When disrupted these processes can interfere with development, reproduction, and immunity to diseases in ways that are not always well understood. Since 1996 EPA has conducted an endocrine disruptor screening program (EDCP) to develop a Universe of Chemicals (more information here) that numbered approximately 10,000 different compounds, and was eventually narrowed down to some 200 chemicals for further screening. This screening list at the moment includes a large number of pesticides, several PFAS, three pharmaceuticals, several phthalates used in plastics, and an array of other industrial chemicals used in pharmaceutical and personal care products.

This methodical approach can be interpreted as a regulatory environment where assessing and managing EDCs is still evolving. This potentially leaves only a hazard-based approach to assess the actual risk of a particular compound to human health and the environment. For example, will your subject property that released a certain compound undergo more scrutiny if that compound is also listed as an EDC? Will risk or remediation decisions be further biased if health effects for that compound are unknown or still debated? Answers to these and many other questions will determine the scope and conclusions of future ESAs. For now it is only certain that this topic is still emerging…