Cumulative Risk from Airborne Chemicals

Background

Normally, people are exposed to many chemicals from many sources every day—both human-made and naturally occurring—in food, water, soil, and air. For example:

- naturally occurring chemicals and food additives
- emissions from cars, dry cleaners, and industrial sources
- natural minerals such as arsenic and by-products from disinfection in drinking water
- chemicals from soil that volatilize (become vapors)
- emissions from vegetation and wildfires

Exposure to chemicals is associated with some level of risk of adverse effects on health. The body can generally remove harmful chemicals, but sometimes it may not be able to get rid of a chemical before it can cause harm. As the amount of chemical a person is exposed to increases, so does the likelihood of harm.

Exposure of a person to one chemical from multiple sources is called *aggregate exposure*. Exposure from multiple sources is called *cumulative exposure*.

TERMS TO KNOW

Adverse health effect—damage to normal functions of the body, which can include such problems as irritation and lung disease, as well as cancer

Aggregate exposure—exposure to one chemical from multiple sources

Cumulative exposure—exposure to multiple chemicals from multiple sources

Cumulative risk—combined risk from exposures to multiple chemicals from multiple sources

What is cumulative risk assessment?

Cumulative risk assessment aims to evaluate adverse health effects from all chemicals from all possible sources to determine the overall risk to human health.

In the environment, chemicals can interact with each other, which can increase or decrease their toxicity or have no effect. Therefore, besides identifying chemicals and their individual concentrations, cumulative risk assessment also attempts to characterize chemical interactions, especially when they may increase toxicity.

What is the TCEQ doing to address cumulative exposure?

Although chemicals are emitted from a variety of sources, the TCEQ only has statutory authority to regulate emissions from stationary facilities such as power plants and refineries. The federal government has regulatory authority over most mobile sources. According to the most recent National-Scale Air Toxics Assessment (NATA) conducted by the U.S. EPA, emissions of chemicals from industrial sources pose approximately 3 percent of the total cancer risk from all sources (automobiles, gas stations, natural sources, etc.) of chemicals in the air in Texas. The TCEQ currently addresses aggregate and cumulative exposures from air primarily through air permitting and through its extensive monitoring of outdoor air.

The TCEQ's Toxicology Division calculates safe concentrations of chemicals in air, which are used in the permitting process to establish maximum emission rates. Maximum emission rates are then written into enforceable air permits. The 2006 guidelines for developing these levels, called *Effects Screening Levels* (ESLs), were peer-reviewed outside of the agency by world-renowned experts in inhalation toxicology and risk assessment. The guidelines—and the ESLs calculated from them—are scientifically-sound assessments of a chemical's potential for adverse health effects.

The method for deriving these ESLs (described in detail online at <www.tceq.state.tx.us/goto/esl-guidelines>) addresses both cumulative and aggregate exposures. The

risk-management goal for cancer-causing chemicals is 1 in 100,000, the theoretical added cancer risk (above the background cancer risk of about 1 in 3) that a chemical may cause over a lifetime of exposure in the most sensitive portions of the population. In other words, lifetime exposure to a permitted chemical carcinogen at the 1-in-100,000 risk level would increase the chances of such persons developing cancer from 33 percent to 33.001 percent in a worst-case estimate of risk. This 1-in-100,000 risk level is ten times more stringent than the highest level that EPA deems acceptable.

For all other chemicals, the TCEQ derives a scientifically sound, safe level, then tightens that number by 70 percent for evaluating air permit applications.

In addition to this large buffer in acceptable levels of pollutants, the TCEQ also models concentrations based on a proposed facility's worst-case operating scenario before granting a permit. In other words, the model used to evaluate the appropriateness of proposed emissions assumes the facility is operating at full capacity at all times, which rarely happens.

Does the TCEQ have confidence that the air permitting process works?

The TCEQ's extensive air monitoring network helps verify that its permitting process has been effective for multiple emission sources even in the most industrialized areas of Texas.

The TCEQ benefits from the largest stationary monitoring network in the country (Table 1). Many of these monitors are placed in areas with densely packed sources, such as industrial areas, which represent a worst-case scenario of aggregate exposure—giving the agency high confidence that policies and practices that work in those areas will work equally well in less industrial areas.

Table 1. Ambient Air Monitoring Sites Measuring Volatile Organic Compounds, 2010

Rank	State	Number of Monitoring Sites
1	Texas	74
2	Louisiana	18
3	Minnesota	18
4	Pennsylvania	18
5	California	17
6	New York	13
7	Florida	10
8	Indiana	9
9	Kentucky	8
10	Delaware	7

Monitors provide reliable data on aggregate and cumulative exposure as they measure the air concentrations due to emissions from all sources (such as industrial sites, mobile sources such as cars, and area sources such as gas stations). The vast majority of the monitors in the state showed annual average concentrations under the 1-in-100,000 screening level for carcinogenic chemicals like benzene. Because actual monitoring data verify acceptable exposure levels and the ESLs are inherently conservative and health-protective, the TCEQ is confident that the potential of additional impacts from individual sources in an area are minimal.

The TCEQ also uses cumulative risk assessments from other organizations, such as EPA's NATA, to identify areas with computer-modeled concentrations above a level of concern. Although NATA is based on a theoretical model of reported emissions rather than actual monitored concentrations, the assessment helps the TCEQ identify other potential issues.

Finally, in the limited areas (about 0.08 percent of the state) where actual monitored concentrations of chemicals indicate a potential concern, the TCEQ uses the Air Pollutant Watch List to reduce ambient (outdoor air) levels. The list considers all the possible sources of the chemical of concern. More information can be found online at <www.tceq.state.tx.us/goto/apwl>.

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