Intel Chemical of the Month July 2024

Phosgene

Note: This technical material is taken from the website of the National Institutes of Health (NIH), National Library of Medicine. It has been edited slightly to address some typographical errors, link incomplete sentences, and eliminate material not relevant to the topic.

Following the NIH material is a description of events in 2004 when phosgene was discovered in the air near the Intel New Mexico plant. As indicated in the text, Intel NM has always denied using phosgene in its manufacturing processes. Nevertheless, phosgene is one of the hazardous air pollutants listed in the Intel NM air emissions permit with an emissions limit of **5.9 tons** per year. Read this material to learn more about how phosgene is generated by Intel New Mexico.

Description and Uses

Phosgene is a colorless nonflammable gas that has the odor of freshly cut hay. It is a manufactured chemical, but small amounts occur naturally from the break-down of chlorinated compounds. Phosgene is used in the manufacture of other chemicals such as dyestuffs, isocyanates, polycarbonates and acid chlorides; it is also used in the manufacture of pesticides and pharmaceuticals. Phosgene can also be used to separate ores. Phosgene is a gas at room temperature, but is sometimes stored as a liquid under pressure or refrigeration.

Phosgene is a widely used chemical intermediate, primarily manufactured in the preparation of many organic chemicals. Phosgene is used for the synthesis of isocyanate-based polymers, carbonic acid esters, and acid chlorides. It is also used in the manufacture of dyestuffs, some insecticides, and pharmaceuticals and in metallurgy. In the past, phosgene was used as a chemical warfare agent (in WWI and WWII).

It is also produced from thermal decomposition or photo-decomposition of chlorinated hydrocarbons [emphasis added]. The heat or UV light of welding can generate phosgene from degreasing solvents.

The majority of phosgene for industrial applications is made on site by the reaction of carbon monoxide and chlorine gas using an activated carbon catalyst. Phosgene may also be produced as a combustion product of carbon tetrachloride, methylene chloride, trichloroethylene, or butyl chloroformate, although these methods are not utilized industrially.

Health Hazards

Phosgene is a lung toxicant that causes damage to the capillaries, bronchioles and alveoli of the lungs by decomposition to hydrochloric acid. There is little immediate irritant effect upon the respiratory tract, and the warning properties of the gas are therefore very slight. Pulmonary edema, bronchopneumonia and occasionally lung abscesses develop. Degenerative changes in the nerves have been reported as later developments. A concentration of 25 ppm is dangerous for exposures lasting 30-60 minutes and 50 ppm is rapidly fatal after even short exposure. Phosgene is TOXIC and/or CORROSIVE and may be fatal if inhaled, ingested or absorbed through skin. Vapors are extremely irritating and corrosive. Contact with gas or liquefied gas may cause burns, severe injury and/or frostbite. Fire will produce irritating, corrosive and/or toxic gases. Runoff from fire control or dilution water may cause environmental contamination.

After exposure to phosgene levels between 120 and 1200 mg/cu m-min, three distinct clinical clinicopathological phases have been reported. The initial phase consists of pain in the eyes and throat and tightness in the chest, often with shortness of breath, wheezing, and coughing; hypotension, bradycardia and rarely sinus arrhythmias can occur. The second or latent phase, which is often asymptomatic, can last as long as 24 hours depending upon the level and duration of exposure. In the third phase, pulmonary edema may develop, leading to death in some cases. Populations exposed to phosgene after industrial accidents have reported a wide variety of symptoms, including headache, nausea, cough, dyspnea, fatigue, pharyngeal pain, chest tightness and pain, intense pain in the eye and severe lacrimation.

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Community-Based FTIR Results
Corrales Residents for Clean Air and Water—2004

In July 2004, Corrales Residents for Clean Air and Water (CRCAW), after raising almost $100,000, celebrated the purchase of its very own Fourier Transform Infrared Spectrometer (FTIR). At that time, the FTIR was (and perhaps remains) the most sophisticated and capable piece of equipment for measuring chemicals in the air. It was also extremely complex, both to operate and to translate the data it collected into understandable findings.

The FTIR would monitor the air 36 times per minute and compile each measurement into a "reading" every minute or 1,440 readings per 24 hours. It had an integrated weather station for confirming wind speed and direction and was capable of running non-stop for a full year with only a weekly reflector adjustment.

CRCAW immediately deployed its FTIR as part of the Corrales Air Toxics Study. Intel New Mexico and the New Mexico Environment Department (NMED) also had FTIRs, and the plan called for all three FTIRs to begin operating in July 2004. However, the NMED and Intel deployments were delayed until August, coinciding with a period when Intel's production was at its lowest.

During this monitoring period, all three FTIRs detected low concentrations of ammonia, hydrogen chloride, acetone, carbon tetrachloride, hydrogen fluoride, phosgene, hydrogen cyanide, isopropanol, carbon monoxide, and methane. While NMED and Intel ceased their FTIR monitoring at the end of August, CRCAW continued its efforts until near the end of September.

In September, one of the scientists checking on CRCAW's FTIR, which was located near the top of the escarpment just below the Intel factory, started to smell an odor. As she was sniffing the air to try to identify the odor, she became ill—constriction of her throat, difficulty swallowing, and nausea, all of which took "a couple of days" to subside. The FTIR had detected concentrations of acetone and 1,2,dichloro-ethylene in hundreds of parts per billion. On further follow-up, other scientists determined that hexafluoro-ethane and tetrafluoromethane were present, both of which were used by Intel and were known to cause the kind of symptoms that area residents had been reporting for years.

As the September monitoring continued, the community-owned FTIR detected spikes of hexa-fluoroethane and tetrafluoromethane on 36 separate occasions ranging from 34 ppb* to 7,650 ppb and 20 ppb to 4,500 ppb respectively. One huge spike reached 12,150 ppb. In the last half of September, acetone, o-xlene, phosphine, toluene, phosgene, carbon tetrachloride, methane, isopropanol alcohol and ammonia were also identified.

Phosgene had been detected by all three FTIRs every day during the August monitoring period. Phosgene is a chemical intermediate, used in the manufacture of many other organic chemicals. During World War I, phosgene was the most lethal chemical warfare agent. It causes severe respiratory effects in humans including pulmonary edema, pulmonary emphysema, and death.

Intel staff have long held that phosgene is not used in the production of their microprocessors. That is consistent with information available online which says that phosgene is only used in the production of other chemicals. **Nevertheless, it is listed in Intel's air emissions permit as one of their hazardous air pollutants, and they are allowed to emit up to 5.9 tons per year.**

Emission of phosgene into the ambient air can originate from chemical manufacturing plants, which is not applicable in this situation. Rather, phosgene can be formed from the thermal decomposition of chlorinated hydrocarbons which are used in the production of Intel's microprocessors. Intel constantly routes some of its waste streams through thermal oxidizers, burning the materials with natural gas in the range of 1400 to 1500 degrees Fahrenheit, which may well explain how phosgene enters the air near the plant. Phosgene is also produced by photooxi-dation of chloroethylenes which are used by Intel, emitted, and exposed to New Mexico's intense sunlight. Despite the FTIR findings, one of the Intel contractors working on the Air Toxics Task Force declared that the phosgene readings were "false positive" and NMED agreed.

At some point, the community FTIR stopped functioning and was transferred to the Southwest Organizing Project which had been the fiscal agent for its purchase. From there, it was sent to Hillsboro Air and Water in Washington County Oregon which is where Intel Oregon facilities are located. Unfortunately, key parts of this equipment are missing and it is no longer functional; it was being sold for parts.

*ppb = parts per billion