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Research Review of GenX

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In June 2017, GenX, a man-made chemical which is used in manufacturing nonstick coatings, was found in the Cape Fear River, the drinking water source for more than 200,000 people in Wilmington and surrounding areas. The Chemours facility in Fayetteville, which produces GenX and discharged wastewater containing GenX into the river, was the source of the contamination. This situation has attracted attention across the state since municipal water treatment centers are unable to remove GenX from the drinking water. The North Carolina Department of Environmental Quality (DEQ) and Department of Health and Human Services (DHHS) has been investigating and drafting regulations since the initial finding [1].

In response, the North Carolina Department of Health and Human Services (DHHS) developed a provisional drinking water health goal for GenX at 140 ng/L [2]. Water samples from the Cape Fear River have been tested by DEQ since July 2017 to ensure safe drinking water. Chemours is providing bottled water for residents whose wells exceed the provisional health goal and proposing granular activated carbon as a treatment technology [1].

Under the Chemours air quality permit, DEQ has been monitoring air quality emissions in the area and reported an air emission leak on November 14, 2017 [3]. DEQ also found GenX in rainwater samples, which indicates that air emissions may have contributed to the contamination of private wells and nearby lakes [1].

What is GenX?

GenX is the commercial name of perfluoro-2-propoxypropanoic acid (CAS No. 62037-80-3). The chemical structure of GenX is shown in Figure 1. GenX is a type of per-and polyfluoroalkyl substances (PFAS), which are used in products ranging from food packaging such as popcorn bags and pizza boxes to household products like Teflon and electronic components [4]. It is a relatively new chemical replacing some of the legacy PFAS, including perfluorooctanoic acid (PFOA), which has been phased out and is no longer manufactured in the U.S. due to the PFOA Stewardship Program [5]. GenX

has been found to show negative effects on the liver and blood of laboratory animals [6]. However, there is currently no regulation of GenX on the federal level [7]. GenX is just one of the PFAS chemicals that have been found in the Cape Fear River and in the Wilmington area drinking water [1].

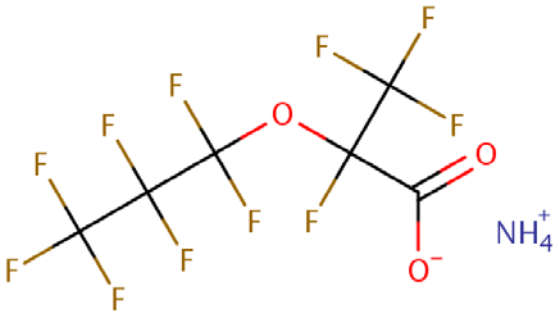

Figure 1. Chemical Structure of GenX

Is GenX in the air?

Because of GenX's chemical structure, it does not stay in the air for long periods of time but GenX emissions are still a serious human health concern for two reasons. DEQ has tested for GenX 20 miles from the plant and it was detected in rainwater approximately 5 miles from the plant [8]. When GenX is emitted into the air it can contaminate groundwater and drinking water wells via dry and wet deposition. Consuming GenX contaminated water could cause negative health impacts because of its toxicity, persistence, and bioaccumulation potential. There is also concern for the workers who are exposed to GenX, but few if any occupational studies have been done on the health effects.

What are the potential health effects of GenX?

Since GenX is a novel chemical and research remains limited, its effects on human health through air emissions are unknown. Because GenX is a PFAS member and shares similarities with other substances, this review includes available studies focusing on airborne PFAS, their distribution and their health effects.

Perfluorooctanesulfonate (PFOS), a type of PFAS, was found in multiple non-industrially exposed human and wildlife species tissues, including polar bears and seals in remote areas such as the Arctic [9,10]. As there was no manufacturer in the remote areas, the findings indicated that PFOS has the ability of global distribution and bioaccumulation to higher trophic levels [10]. Based on smog chamber studies, one theory about long-distance distribution is that fluorotelomer alcohols can degrade in the atmosphere and yield perfluorinated carboxylic acids, which have been found in human and animal

tissues in remote locations (Dinglasan, Ye, Edwards, & Mabury, 2004; Ellis et al., 2003, 2004).

The health advisory levels of PFOA and PFOS from drinking water are 70 ng/L, updated by EPA in November 2016 [11]. The GenX provisional health goal of 140 ng/L set by NC DHHS was generated from a risk assessment using benchmark dose modeling [12]. Seven repeat oral dose studies longer than 28 days were included in the model and different endpoints, such as hepatic, hematology, and developmental endpoints were collected [12]. The study is designed to approximate exposure of the most vulnerable population, bottle-fed infants. There could be an increased risk of adverse health effects over a lifetime when consuming water with a level of GenX exceeding this goal [12]. Among them, effects on liver and blood such as increased liver beta-oxidation activity have been seen [12]. GenX was believed to be less toxic than its precursor PFOA in terms of reproduction effects, but there is also a sub-chronic oral toxicity study finding that GenX is more toxic than other PFAS, including PFOA and perfluorobutanoic acid (PFBA), in male rats [6,13].

What are the next steps?

From the available studies, we can conclude that GenX could be more than a local issue. Even though contamination of local rivers and private wells raise significant concern due to its persistence, bioaccumulation, and toxicity potentials, long-distance distribution through the atmosphere due to air emissions should also be investigated and controlled. We recommend that more research on GenX be conducted to understand its acute and chronic health effects both in the air and water. Also, residents living close to the Chemours facility and in the surrounding areas should reduce their exposure to GenX by ensuring their drinking water meets the provisional state health goal. Finally, we recommend a local air action alert be put in place to make the communities near the Chemours plant aware of their potential exposure.

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