SIERRA CLUB
MAINE CHAPTER

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Sierra Club comments on hazards with incineration of PFAS containing biosolids

Sierra Club applauds the State of Maine's efforts to study and manage PFAS contaminated wastewater and biosolids. As the State is learning, there will be an ongoing challenge to biosolids management, as many of the wastewater treatment plants have concerning concentrations of PFAS chemicals.

Among the many issues related to PFAS in wastewater and biosolids, we would like to focus our comments on the lack of data on the safety of PFAS incineration. The strength of the carbon-fluorine bond is the basis for PFAS helpful industrial qualities, its usefulness in fire fighting, and its extreme persistence in the environment. We share Maine's concern about sending the chemicals to landfills where managers must actively collect and treat leachate waters over dozens, or even hundreds, of years. However incineration is a poorly studied and potentially hazardous alternative.

EPA national rules for biosolids incinerators were implemented in 2016 and set the first national regulations for biosolids incinerators. While they require pilot testing and monitoring for a handful of toxic contaminants, they were not designed to address PFAS and biosolids incinerator protocols are not optimized to ensure complete breakdown of fluorochemicals.

Our review of the scientific and technical literature finds very little information to document whether PFAS chemicals can be broken down in the real world conditions of biosolids and hazardous waste incinerators. There is some indication that poorly controlled incineration could release unreacted PFAS chemicals into surrounding communities, or form other harmful byproducts. These hydrogen fluoride gas, shorter chain PFAS, including C1 and C2 fluorochemicals, which are potent greenhouse gases. Studies have not examined the possible formation of fluorinated dioxins and furans during incineration of a complex material like biosolids. Because these chemicals are highly toxic, and biosolids incineration could potentially be required in the long-term for massive volumes of wastes, the formation of even trace amounts of harmful byproducts could result in problems for the communities and ecosystems surrounding incinerators.

Here is a brief summary of the article we are submitting for your consideration which demonstrate the potentially hazards of PFAS incineration:

1. Incineration of PFAS chemicals can form harmful byproducts:
L. Lundin, S. Jannson. 2017. Destruction of Persistent Organic Compounds in Combustion Systems. Norway Umea University https://www.diva-portal.org/smash/get/diva2:1155115/FULLTEXT01.pdf

"Complete combustion of PFOS/PFAS would result in CO2, H2O and HF, however as with all other combustion processes this puts quite high demands on the process conditions. The strong C-F bonds in the molecules requires high energy input to break the bonds. The knowledge on

how PFAS behaves in combustion processes is scarce, but consensus in the limited scientific literature is that degradation of PFOS occurs at temperatures above 500C. However fluorinated by-products are formed, which in themselves may have undesired properties. A study conducted by the United States Environmental Protection Agency and 3M states that degradation of PFOS occurs at temperatures above 600°C, and the main degradation products are the potent greenhouse gases Cf4 and C2F6 (Taylor 2003)[1]

It has however been shown that thermally treated PFOS-contaminated sludge with an addition of Ca(OH)2[2] has reduced the emissions of CF4 and C2F6 in favor of Cf3H but, above all, formation of solid CaF2 and Ca5(PO4)3F.

[M]unicipal waste incineration is carried out at about 850°C, and to our best knowledge, any emissions of fluoro-polymer degradation products from household waste incineration have not been monitored yet. On the laboratory scale the degradation of fluoropolymers, primarily PTFE, has been investigated in the temperature range 700-1050°C, yielding CF4, CHF3, C2H6, tetrafluoroethene and hexafluropropene as major products. The kind of compounds formed is strongly dependent on the incineration conditions like temperature, moisture, oxygen content, use of catalysts etc. Few studies have been published on the incineration degradation products of other fluoropolymers than PTFE."

2. Short chain fluorochemicals have long atmospheric residency times, making them potent greenhouse gases
J. Mühle, et al. 2010. Perfluorocarbons in the global atmosphere: tetrafluoromethane, hexafluoroethane, and octafluoropropane. Atmos. Chem. Phys., 10, 5145–5164, 2010

Fluorocarbon	Atmospheric residence time
CF4	50,000 years
C2F6	10,000 years
C3F8	2600 years

3. The Air Force research office revealed similar concerns with the safety of high temperature incineration of AFFF foams and is actively funding research into safer destruction technologies.
SBIR 2017 https://www.sbir.gov/sbirsearch/detail/1254657

In 2017, the Air Force Small Business Innovation Research fund posted a solicitation for safer alternatives to incineration citing several key reasons why thermal treatment could fail. These

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1 The author cites : Yamada, T., P.H. Taylor (2003). Laboratory scale thermal degradation of perfluorooctanyl sulfonate and related precursors. Final Report, 3 M Company , https://clu-in.org/download/contaminantfocus/pfas/UDR-TR-03-00044.pdf

2 The author cites: Wang 2011, and Wang 2013, see also Wang 2018, Mineralization Behavior of Fluorine in Perfluorooctanesulfonate (PFOS) during Thermal Treatment of Lime-Conditioned Sludge. Environ. Sci. Technol. 2013, 4762621-2627

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include: 1) Too little information about the temperature and handling requirements for optimal PFAS breakdown in incinerators, 2) The potential for incomplete incineration to emit hazardous PFAS chemicals back out in the environment and 3) The potential that partial breakdown forms of new, harmful chemicals that are damage human health or deplete the ozone layer

We recommend Maine not allow incineration of biosolids with detectable PFAS chemicals until it can ensure 1) whether PFAS are totally destroyed by standard industrial incineration processes or 2) whether other hazardous byproducts are or are not produced during these process.

On the Federal level, Congress is also starting to question the practice of PFAS incineration, spurred by the fact that destruction of chemicals is not currently regulated under RCRA or CERCLA.

Representative Andy Levin sponsored an amendment in the House National Defense Authorization Act that would require incineration of PFAS to be proven effective and conform to the Clean Air Act requirements limits for chemicals like hydrogen fluoride. The NDAA will be finalized in October.

Representative Ro Khanna introduced HR 2591, which would prohibit the incineration of PFAS-containing fire fighting foams due to safety concerns.

We hope the state will consider these comments when planning for the long term management of PFAS-contaminated biosolids.

Thank you,

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