

May 1, 2017

MEMO TO: Mike White, Council Chair

F R O M: Gary Saldana   
Legislative Analyst

SUBJECT: **POLYSTYRENE RESEARCH**

As a follow-up to our discussions relating to the Council's deliberations on Bill 127 (2016) entitled "A BILL FOR AN ORDINANCE ESTABLISHING A NEW CHAPTER 20.26, MAUI COUNTY CODE, RESTRICTING THE USE AND SALE OF POLYSTYRENE FOOD SERVICE CONTAINERS," research was conducted with the Environmental Protection Agency and the Food and Drug Administration.

Below is a review of statements, observations, studies, and reports that relates to potential impacts of polystyrene to health and safety of humans, animals, and the environment.

The following inquiries were forwarded to Timonie Hood, Building Waste and Green Building Coordinator for the Southwest Region of the EPA, in an effort to identify potential toxicity of polystyrene; substantiate and determine the source of statements and observations found during research; and identify various positions on polystyrene:

Question One-

1. Can you reiterate if the EPA has an official position on the use of polystyrene food containers?

Answer:

- a. Under the Pollution Prevention Act, Congress clearly established a preference for reducing pollution at the source ("source reduction"). EPA's Waste Management Hierarchy supports this framework:  
<https://www.epa.gov/smm/sustainable-materials-management-non-hazardous-materials-and-waste-management-hierarchy>
- b. *"EPA does not have a specific policy statement on polystyrene food containers; however, the EPA has supported projects to reduce disposable plastic food packaging,"* specifically:
  - i. The Marine Debris and Plastic Source Reduction Toolkit (May 2015) supported the source reduction of disposable plastic (including polystyrene) food service items. The Toolkit provides numerous polystyrene ban policies.

May 1, 2017

Page 2

- ii. The Rethink Disposables project targeting source reduction of takeout food packaging, the largest documented source of trash in urban runoff that in turn ends up in our bays and oceans.

Question Two-

2. Can you identify the source or reference the EPA utilized to make the following statements or observations?

Statement or Observation One-

- a. Organization: Clean Water Action California;  
Document: "Health Effects and Regulation of Styrene" (CASRN 100-42-5);  
Statement: "According to the US EPA, 100% of Americans have styrene in their bodies." "The principle form of styrene exposure [is]...consuming food items in contact with polystyrene foam packaging and to-go containers."

Answer:

- i. The Source of this statement was the U.S. EPA Broad Analysis of the FY82 National Human Adipose Tissue Survey (1986).
- ii. The Study was a broad scan chemical analysis of composite of human adipose tissue samples, conducted by the Office of Toxic Substances for estimating the general population exposure to toxic organic chemicals.
- iii. The Study observed that "several compounds, including styrene, the xylene isomers, 1,4-dichlorobenzene, and ethylphenol, were detected in all composite samples."
- iv. Which confirms that statement that "100% of Americans have styrene in their bodies".
- v. However, the Study does not address the cause of the exposure.

Statement or Observation Two-

- b. Organization: City and County of San Francisco (SFO);  
Document: Ordinance Number 140-16 (c): "Findings" (November 2016);  
Statement: "Due to the physical properties of polystyrene foam, the U.S. Environmental Protection Agency (EPA) states: "that such materials can have

serious impacts upon human health, wildlife and aquatic environment, and the economy.”

Answer:

- i. The source of the statement was from an EPA study entitled “Assessing and Monitoring Floatable Debris,” August 2002.
- ii. The Study is based on floatable materials, debris and trash, which is defined as “foreign matter that may float or remain suspended in the water column and includes plastic, aluminum cans, wood, projects, bottles, and paper products.”
- iii. In its discussion of the floatable debris the Study states: “Unless we better control the disposal of trash and other wastes, it is likely that the amount of such debris entering our waterways will increase.” It further states: “It has now become evident, however, that such materials can also have serious impacts on human health, wildlife, the aquatic environment, and the economy, and therefore the problem of floatable debris should be addressed.” This confirms the statement from the SFO Findings Ordinance 140-16, which was used in part according to the reference source.

Statement or Observation Three-

c. Organization: “Way to Go”;

Document: “Polystyrene Fast Facts” copyrighted 2008;

Statement: “Polystyrene food containers leach the toxin Styrene when they come into contact with warm food or drink, alcohol, oils and acidic foods causing human contamination and posing a health risk to people.”

Answer:

- i. Unfortunately, EPA was unable to substantiate this statement, however, please refer to question 5 below referencing a report by the Agency for Toxic Substances and Disease Registry.

Question Three-

3. Can the EPA substantiate the above referenced statements?

Answer:

- a. See responses to Questions Two and Five.

Question Four-

4. Has the EPA made a determination that polystyrene food containers are a hazard to the health of humans, marine or wildlife?

Answer:

- a. The EPA points to two reports on this matter, they are:

- i. "Summary of Expert Discussion Forum on Possible Human Health Risk from Microplastics in the Marine Environment," April 2014.

1. The report received recommendations and perspectives on possible human health risks from the ingestion of seafood contaminated with microplastic-derived persistent bioaccumulative, and toxic chemicals (PBT).

2. Participants concluded:

- a. A split of opinion on the connection between PBT to aquatic life tissue and to human tissue.  
b. More research is required on this subject.  
c. Research is needed to determine if the PBT's in seafood are derived by microplastics or other sources.  
d. Research is needed to identify sources of other PBT into marine life tissue.

- ii. "State of the Science White Paper: A Summary of the Effects of Plastic Pollution on Aquatic Life and Aquatic-Dependent Wildlife," December 2016.

1. The report focused on the science of chemical toxicity of ingested plastic and associated chemicals on aquatic organisms and aquatic-dependent wildlife. The report noted the following:

- a. There is growing concern about the toxicological impacts of chemicals associated with plastics on aquatic-organisms.  
b. The report noted various studies that identify marine and wildlife that have ingested plastics which have impacted reproduction, feeding, and growth.  
c. One study, referenced Lavers et al. (2014), found that body condition is negatively influenced by the amount of ingested plastic in flesh footed shearwaters.

- d. Another study by Avio et al. (2015) observed neurotoxic effects and genotoxicity on mussels.
  - e. In a study by Rochman et al. (2013), certain fish were found to have induced liver toxicity, glycogen depletion, fatty vacuolation, and single cell necrosis.
2. The report concluded the following:
- a. "Numerous research studies demonstrate that plastics are ingested by aquatic, invertebrates, fish, seabirds, sea turtles, and marine mammals."
  - b. "Plastics in aquatic systems contain chemicals originating from the plastic material, chemicals added during the manufacturing process."
  - c. "Many of these chemicals have been found to have harmful effects once in the aquatic environment, the potential toxicological impacts of these chemicals associated with plastic once ingested by aquatic organisms and aquatic-dependent wildlife is an area of concern."
  - d. "There is evidence that aquatic organisms and aquatic-dependent wildlife accumulate chemicals from ingested plastics."
  - e. "Because organisms in the environment can accumulate the same classes of chemicals from other sources, further research on the relative role plastics play in chemical contaminant to the tissues of organisms compared to other exposure pathways is needed."

Question Five-

5. Beyond the obvious that polystyrene can be ingested by marine and wildlife, is there any conclusive scientific/unbiased studies you can identify that prove toxicity of polystyrene food containers?

Answer:

- a. Under the Pollution Prevention Act and EPA's work to advance Sustainable Materials Management, EPA encourages consideration of the full lifecycle impacts of products. Polystyrene

is made from styrene, and the toxicity of styrene has been well documented:

- i. "EPA lists styrene in our Toxics Release Inventory, and has found red blood cell, liver, and central nervous system effects but has not evaluated styrene as a carcinogen":
  1. Styrene – EPA Toxics Release Inventory - <https://www.epa.gov/sites/production/files/2016-09/documents/styrene.pdf>
  2. Styrene – EPA Integrated Risk Information System - [https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance\\_nmbr=104](https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=104)
- b. The Centers for Disease Control and Prevention and the Agency for Toxic Substances and Diseases Registry provided the following report in response to this question:
  - i. "Toxicological Profile for Styrene," November 2010.
  - ii. The profile explores various issues associated with styrene, such as: effects on health, what is styrene, exposure, how it enters or exists in the body, and impacts to children.
  - iii. Section 6 of the profile focuses on "Potential for Human Exposure," this includes such observations as:
    1. Contaminated indoor air, tobacco smoke, emissions from building materials, emissions from laser printers and photocopiers.
    2. Additionally, it states that "most styrene associated with food is the result of packaging of the food material in polystyrene containers."
    3. The profile further states that the migration of styrene is not only from polystyrene food containers, but also has been found in yogurt, dairy products, corn and sunflower oil, alcohol, coffee, and tea.
    4. The profile also states "smokers and those eating a high proportion of foods packaged in polystyrene, may have above average exposure to styrene."
- c. Another resource provide by the EPA was a document entitled "Polystyrene: A review of the Literature on the Products of Thermal Decomposition and Toxicity," January 1987.
  - i. The report is an accumulation of 11 studies on the effect of heat on polystyrene and the toxicity of gases associated with combustion.

- ii. The various studies in the report utilized different forms of polystyrene, such as crystal, impact, or expandable, rigid, and sheet foam.
- iii. In each study, laboratory rats were used to determine the toxicity of gases produced when polystyrene was heated.
- iv. The conclusions of the various studies were:
  1. The main volatile product is the styrene monomer.
  2. Carbon monoxide and carbon dioxide (CO and CO<sub>2</sub>) were formed during the heating process and appeared to be responsible for the subject animals' deaths.
  3. Effluents produced during flaming of the polystyrene were more toxic than those produced under non-flaming conditions.
  4. In non-flaming conditions of polystyrene, CO and CO<sub>2</sub> were not attributed to deaths, however, "other toxicants, perhaps styrene, was responsible."

#### Food and Drug Administration (FDA)

According to the FDA, Code of Federal Regulations, Title 21, Food and Drugs, Chapter 1 Food and Drug Administration, Department of Health and Human Services states the following:

Section 177.1640 Polystyrene and rubber-modified polystyrene.

"Polystyrene and rubber-modified polystyrene identified in this section may be safely used as components of articles intended for use in contact with food, subject to the provisions of this section.

- a. Polystyrene is identified as basic polymers produced by the polymerization of styrene.
- b. Polystyrene polymers shall contain not more than 1 weight percent of total residual styrene monomer

In response to an inquiry of the FDA, Catherine McDermott, FDA/Office of Foods & Veterinary Medicine, provided the following response in answer to a question relative to FDA performed studies on impacts of polystyrene on health of humans, marine or wildlife and environment:

"In evaluating the safety of an intended food contact use of a substance, FDA reviews the toxicology information submitted by the proponent of the use. This includes toxicological studies on any chemicals

May 1, 2017

Page 8

that might migrate into food as a result of the intended use of a food contact substance.”

“In addition to the toxicological information provided by industry when submitting their intended use for approval, FDA also reviews applicable publicly available information on substances that migrate to food as that information becomes available.”

International Agency for Research on Cancer

Report titled “Styrene 1, Exposure Data”, noted the following:

1. “Polystyrene and its copolymers have been used widely as food packaging materials, and residual styrene monomer can migrate into food from such packaging (WHO, 1983).”
2. In a United Kingdom study, it noted that “Within each food type, higher levels of styrene were generally found for products with high fat contact or packed in small containers (ministry of Agriculture, Fisheries and Food, 1994).”
3. The report concludes: “Exposure to the general population occurs at levels of micro-grams per day due mainly to inhalation of ambient air and cigarette smoke and intake of food that has been in contact with styrene-containing polymers.”

The above research summary is submitted to assist the Council in its consideration of Bill 127 (2016). Should you require additional research, or would like copies of any of the documents referenced in this memorandum, please let me know.

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cc: Corporation Counsel  
Deputy County Clerk  
Director of Council Services