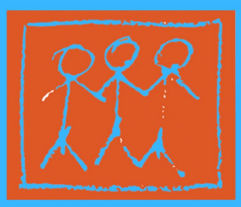

CAG

Citizen consumer and civic Action Group

Chemicals in Plastics

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CHEMICALS IN PLASTICS

Plastics release toxins into the environment right from production to use to disposal. The level of chemical inertness and concentrations of dangerous chemicals vary depending on the resin types that are being used in the plastics. The level of toxicity whether it is high or low creates harm and distress to the living creatures and natural systems. Plastic is relatively cheap to manufacture, it is produced in staggering amounts and then is discarded as litter frequently.

Around 8300 million metric tons (MT) of virgin plastics have been produced to date. As of 2015, approximately 6300 Mt of plastic waste had been generated, around 9% of which had been recycled, 12% was incinerated, and 79% was accumulated in landfills or the natural environment. If current production and waste management trends continue, roughly 12,000 MT of plastic waste will be in landfills or in the natural environment by 2050[1].

Some toxins used in the production of plastic resins include:

- **Polyethylene Terephthalate (PET, #1):** antimony oxide, diazomethane, lead oxide, nickel, ethylene oxide, and benzene
- **High Density Polyethylene (HDPE, #2):** chromium oxide, benzoyl peroxide, hexane, and cyclohexane
- **Polyvinyl Chloride (PVC, #3):** benzene, carbon tetrachloride, 1,2-dichloroethane, several phthalates, ethylene oxide, lead chromate, methyl acrylate, methanol, phthalic anhydride, tetrahydrofuran, and tribasic lead sulfate
- **Low Density Polyethylene (LDPE, #4):** benzene, chromium oxide, cumene hydroperoxide, and tert-butyl hydroperoxide
- **Polypropylene (PP, #5):** methanol, 2,6-di-tert-butyl-4-methyl phenol, and nickel dibutyl dithiocarbamate
- **Polystyrene (PS, #6):** styrene, ethylbenzene, benzene, ethylene, carbon tetrachloride, polyvinyl alcohol, antimony oxide, and tert-butyl hydroperoxide, benzoquinone

Some effects of substances used or emitted in plastic production include:

- Benzene: used as a solvent in the production of PVC and LDPE and as a raw material for styrene, the chemical (monomer) used to make polystyrene. A recognised human carcinogen that causes leukaemia. Acute exposure to benzene in the workplace depresses the central nervous system, causing headaches, fatigue, insomnia, nervousness, nausea and loss of muscular coordination.

- p-Benzoquinone: used as a retardant in the polymerisation of polystyrene. Extremely toxic on ingestion. A suspected tumorigenic and mutagen.
- t-Butyl Hydroperoxide: used as a radical initiator in the polymerisation of polystyrene and linear low-density polyethylene (LLDPE). Although the toxic hazard to humans is not known, has produced severe depression, incoordination, cyanosis, and respiratory arrest in laboratory animals.
- Carbon Tetrachloride: used in the polymerisation of PVC and polystyrene and as a solvent for other resins. Causes cancer in laboratory animals. Suspected human carcinogen. Workers subject to prolonged or repeated exposure can develop severe liver and kidney failure.
- Chromium (VI) Oxide: uses as a catalyst in the polymerisation of HDPE and LDPE. Has produced both cancer and mutagenic and teratogenic effects in laboratory animals. Chronic exposures in the workplace have led to severe liver and nervous system damage.
- Cumene Hydroperoxide: used as a radical initiator in the polymerisation of LDPE. Acutely toxic by ingestion, inhalation, and skin absorption. A suspected mutagen and teratogen.
- Dioxins and other chlorine-based chemicals (PVC, PS): known human carcinogens, damaging to the immune system, hormonal system, and fetal development; prolonged exposure to chlorine-based gases in the workplace can damage the eyes, skin, respiratory system, and nervous system
- Ethylene Oxide: used in the manufacture of ethylene glycol (a raw material for PET) and acrylonitrile. Has caused cancer, changes in genetic material, and reproductive problems in laboratory animals.
- Lead (PET, PVC): damaging to the cardiovascular system, digestive system, renal system (urinary tract and kidneys), blood formation, eyes, and the development of fetuses and children
- Nickel (PET, PP): suspected human carcinogen, damaging to the cardiovascular system, nervous system, respiratory system, and skin
- Phthalates (PET, PVC): damaging to the hormonal system
- Styrene: used as a monomer in polystyrene. Styrene has been linked with increased levels of chromosomal damage, abnormal pulmonary function, angiosarcoma of the liver, and cancer in workers at styrene or polystyrene plants.
- Acrylonitrile: Used as a key ingredient in the production of many synthetic fibres. Frequently co-polymerised with polyvinyl chloride. Acrylonitrile has been shown to cause cancer and birth defects in laboratory animals and has been linked to an increase in cancer among exposed workers.
- Antimony Oxide: A crystalline substance used as a catalyst in the polymerisation of PET, as a flame retardant in polystyrene, and as a pigment (white). A suspected carcinogen. May cause birth defects.

- Diazomethane: used in the polymerisation of PET. A known animal carcinogen.
- 1,2-Dichloroethane: used as a solvent in the production of PVC. Extremely toxic by ingestion or inhalation. A suspected human carcinogen and mutagen.
- Dimethylphthalate: used as a plasticiser in PVC. Listed as a hazardous waste
- Di-N-Butyl Phthalate: used as a plasticiser in PVC. Listed as a hazardous waste.
- Di-N-Octyl Phthalate: Used as a plasticiser in PVC. Listed as a hazardous waste.
- Lead Chromate: used as a pigment in PET, LDPE, HDPE, PP, PS, PVC, and other plastics. Very toxic and accumulates in the body over time producing anaemia, headaches, sterility, miscarriages, kidney and brain damage.
- Lead Oxide: used as a catalyst in the polymerisation of PET and as a colourant. Very toxic and accumulates in the body over time producing anaemia, headaches, sterility, miscarriages, kidney and brain damage.
- Methyl Acrylate: used in the preparation of thermoplastic coatings and as a copolymer for PVC. High levels of inhalation may cause lethargy, convulsions, and death from lung damage.
- Methanol: used as a solvent in the polymerisation of PVC and other resins. Also known as methyl alcohol or wood alcohol. Swallowing methanol, or breathing high concentrations can cause headaches, weakness, drowsiness, lightheadedness, nausea, vomiting, drunkenness, eye irritation, blurred visions, blindness and death. Symptoms may recur without additional exposure and recovery is not always complete.
- Nickel Dibutyldithrio Carbamate: used as a UV-stabiliser in LDPE, HDPE, and PP. Nickel is a toxic heavy metal. Has been shown to be associated with an increased incidence of nose and lung cancer in occupationally exposed workers. Present in the air emissions and ash from incinerators.
- Phthalic Anhydride: used as a plasticiser in PVC. Toxic. Polyvinyl Alcohol: widely used in the production of textiles, paints and other synthetics. Also used as a suspension stabiliser in the polymerisation of PVC, PS, ABS, and other resins. Has produced positive results for carcinogenicity in animal tests.
- Tribasic Lead Sulfate: used as a heat stabiliser in PVC. Very toxic and accumulates in the body over time producing anaemia, headaches, sterility, miscarriages, kidney and brain damage.

Toxins released during USE of plastic

Use of products made from plastic also exposes consumers to toxins. Chemicals in plastic containers can seep into foods and beverages during heating and this is the most common concern in this regard. Toxin styrene is leached into warm food or drink

from polystyrene (PS) food containers, posing health risks to the gastrointestinal tract and kidneys. Bisphenol A (BPA) and phthalates are other problematic chemicals commonly used in making plastic food containers and drinking bottles from PET, HDPE, and PP plastics. BPA and phthalates are known endocrine disruptors that interfere with the hormone system, and safe levels of exposure have not yet been established.

Polyvinyl chloride (PVC) is generally used in plastic food wrap and flexible plastic food containers. Di-ethylhexyl adipate (DHEA) is one of the plasticiser chemicals contained in PVC to make it flexible and various researches have found that DHEA can be released and absorbed by fatty foods, such as meat and cheese when they are wrapped or microwaved/heated in these plastics[2].

Toxins released after DISPOSAL

Plastics release over 90 different chemicals into the atmosphere when incinerated. Plastics that are thrown away as litter or escape from landfills on wind and water, they leach countless chemicals into our soils, air, rivers, and oceans. In landfills, plastics are exposed to an extraction solvent in the form of acidic (pH 5–6) leachates with high ionic strength and neutral or alkaline leachates containing high-molecular-weight organic compounds. The different leachates have not only different potentials to extract and transport, but also different biological populations with the potential to degrade or transform the released additives.

Considerable amounts of plastics are disposed of in municipal landfills. As indicated earlier, certain additives and monomers can be released from plastic and will consequently be present in landfill leachate. Detection of BPA, phthalates and the alkylphenols NP and octylphenol (OP) in landfill leachate has been reported[2].

Researchers have discovered for the first time that plastics produced measurable quantities of methane and ethylene under environmental conditions[4]. The results also showed that hydrocarbon production rates are higher in plastics exposed to air compared to plastic in aquatic environments in warmer climates.

Because so many different types of plastic are burned and degrade every day (PVC, PS, PP, HDPE, LDPE, etc.), and because they release so many different toxic chemicals into our environment (PCB, BPA, dioxin, chloride, styrene, etc.), it is impossible to quantify the level of toxicity that plastics pose to life on earth. For every known biological system – including the nervous system, reproductive system, immune system, hormonal system, and the regulation of cell reproduction and cancer – research has found a variety of plastic component substances to be toxic.

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