



## Forever Chemicals

**For Prelims:** Per- and Polyfluoroalkyl Substances (PFAs), Forever chemicals, Incineration, Supercritical Water Oxidation, Plasma Reactors

**For Mains:** Impacts of Environment Pollutants on Human body

### Why in News?

According to a recent study, scientists have found that rainwater from many places across the globe is contaminated with **Per- and Polyfluoroalkyl Substances (PFAs)**.

- Further, they are called **Forever chemicals** because of their **tendency to stick around in the atmosphere, rainwater, and soil for long periods of time**.
- PFAs are also listed in the [Stockholm Convention](#).

### What is Stockholm Convention?

- **About:**
  - It is a global treaty to protect human health and the environment from **persistent organic pollutants (POPs)**. POPs are chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of living organisms and are toxic to humans and wildlife.
- **Objectives:**
  - Support the transition to safer alternatives.
  - Target additional POPs for action.
  - Clean up old stockpiles and equipment containing POPs.
  - Work together for a POPs-free future.
- India **ratified the Stockholm Convention in 2006** as per Article 25(4), which enabled it to keep itself in a default "opt-out" position such that amendments in various Annexes of the convention cannot be enforced on it unless an instrument of ratification/ acceptance/ approval or accession is explicitly deposited with UN depositary.

### What are Per- and Polyfluoroalkyl Substances (PFAs)?

- **About:**
  - They are **man-made chemicals used to make nonstick cookware, water-repellent clothing, stain-resistant fabrics, cosmetics, firefighting forms**, and many other products that resist grease, water, and oil.
  - They can **migrate to the soil, water, and air** during their production and use.
  - Most PFAs do not break down, they remain in the environment for long periods of time.
  - Further, some of these PFAs can **build up in people and animals if they are**

repeatedly exposed to the chemicals.

▪ **Harmful Effects:**

- They cause a variety of **health risks** that are attributed to PFA exposure, including **decreased fertility, developmental effects in children, interference with body hormones, increased cholesterol levels, and increased risk of some cancers.**
  - Recent research has also revealed that **long-term low-level exposure** to certain PFAs can make it **difficult for humans to build antibodies after being vaccinated against various diseases.**

## What can be done to Remove these Chemicals?

▪ **Incineration:**

- The most common method of destroying PFAS is **incineration**, but most PFAS are remarkably resistant to being burned. That's why they're used in firefighting foams.
- PFAS has multiple fluorine atoms attached to a carbon atom, and the bond between carbon and fluorine is one of the strongest.
- Normally to burn something, you have to break the bond, but **fluorine resists breaking off from carbon.**
- Most **PFAS will break down completely at incineration temperatures around 1,500 degrees Celsius (2,730 degrees Fahrenheit)**, but it's energy intensive and suitable incinerators are scarce.

▪ **Supercritical Water Oxidation:**

- Scientists have developed **supercritical water oxidation** to destroy PFAS.
  - **High temperatures and pressures change the state of water, accelerating chemistry in a way that can destroy hazardous substances.**

▪ **Plasma Reactors:**

- Researchers are working with **plasma reactors**, which use water, electricity, and argon gas to break down PFAS.

▪ **Filtration System:**

- Filtration system can be used with activated carbon in the rain water harvesting system.
  - The activated carbon will need to be removed and replaced regularly. Also, the old contaminated material must be destroyed.

- There are several other experimental techniques that are promising but haven't been scaled up to treat large amounts of the chemicals.

## UPSC Civil Services Examination Previous Year Question (PYQ)

**Q. Which of the following can be found as pollutants in the drinking water in some parts of India? (2013)**

1. Arsenic
2. Sorbitol
3. Fluoride
4. Formaldehyde
5. Uranium

**Select the correct answer using the codes given below:**

- (a) 1 and 3 only  
(b) 2, 4 and 5 only  
(c) 1, 3 and 5 only  
(d) 1, 2, 3, 4 and 5

**Ans: c**

**Exp:**

- Drinking water in some parts of India have contaminants like Arsenic and Fluoride.
- The sources of **arsenic** include run off from orchards, metal smelting among others. **Hence, 1 is**

**correct.**

- The sources of Fluoride are erosion of natural deposits, discharge from fertilizers and Aluminium factories. **Hence, 3 is correct.**
- The drinking water in some parts of India also contains traces of Uranium. The main source of the Uranium contamination is natural, but human factors such as groundwater-table decline and Nitrate pollution may exacerbate this problem. **Hence, 5 is correct.**
- Some naturally occurring elements in drinking water are Lead, Arsenic, Mercury, Radium, Chloride, Iron and Copper compounds. Most of these are not harmful when consumed in small quantities. But when the consumption is higher than the prescribed amount, it could be harmful and sometimes even fatal.
- Water in India is contaminated with salinity, Arsenic, Fluoride, Iron, Nitrate, and heavy metals.
- Sorbitol is a sugar alcohol found in fruits and plants with diuretic, laxative and cathartic property.
  - Unabsorbed Sorbitol retains water in the large intestine through osmotic pressure, thereby stimulating peristalsis of the intestine and exerting its diuretic, laxative and cathartic effect.
  - In addition, Sorbitol has one-third fewer calories and 60% the sweetening activity of sucrose and is used as a sugar replacement in diabetes. Hence, 2 is not correct.
  - Formaldehyde is a colourless, strong-smelling gas used in making building materials and many household products. Formaldehyde quickly broken down in the air - generally within hours. It dissolves easily in water, but does not last long there, either. **Hence, 4 is not correct.**
- **Therefore, option (c) is the correct answer.**

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