Tritium from Nuclear Wastewater

Prelims: *Current events of national and international importance | Environment*

Why in News?

Recently, a new study published a breakthrough method to filter tritium from nuclear wastewater, using a metal-organic framework (MOF).

- **Tritium –** Radioactive isotope of hydrogen; forms ***tritiated water (HTO)*** when bonded with oxygen.
- **Problem –** Chemically identical to normal water, making separation extremely difficult.

Conventional Approach

- Materials inside the tower that provide surfaces where steam and liquid can interact.
- These packings just sit there; steam and liquid interact only because of gravity.

New Method – Metal-Organic Framework (MOF)

- Stainless-steel mesh coated with a metal-organic framework called *NH_2-MIL-101(Cr).*
- MOF acts like a *microscopic sponge*, increasing surface area 32-fold; more surface area means better contact between steam and liquid.
- The chromium-oxygen clusters inside the MOF *grab tritium atoms*.
- They *swap tritium with normal hydrogen atoms.*
- Nitrogen and hydrogen groups in the MOF help this swapping process.
- **Efficiency –** Achieved 42.5 theoretical plates per metre separation efficiency, a record-setting figure in the world of chemical engineering.

This innovation helps tackle the problem of Japan releasing treated wastewater from the Fukushima nuclear plant into the Pacific Ocean

Significance

- **Environmental Protection –** Reduces tritium release into oceans, mitigating ecological risks.
- **Public Health –** Tritium is easily absorbed by living organisms and rapidly distributed via blood.
- **Nuclear Safety –** Offers a practical alternative to dilution, addressing global concerns over Fukushima wastewater.
- **Scientific Breakthrough –** Nobel Prize-winning work was awarded to Susumu Kitagawa, Richard Robson, and Omar M. Yaghi for the development of MOFs.

Reference

The Hindu | MOF