

Tribochemical Method for Degradation of Polymers in Water

IITM Technology Available for Licensing

Problem Statement

- **Polytetrafluoroethylene (PTFE)** or **Teflon®** is most common chemically inert synthetic polymer due to its **stability** in acids, bases, & in high temperatures. It is highly **durable** in nature.
- The **degradation of PTFE** may happen in presence of highly reactive alkali metals (Li & Na).
- Polymers are incinerated, landfilled or chemically treated for degradation. But these methods **lethal** environment by **causing pollution & hazardous effects on living organisms**.
- Microbial degradation of plastics takes **long time**, and some plastics cannot be **completely decomposed** and assimilated by microorganisms.
- Hence there is a need to formulate a new method to overcome above mentioned issues.

Technology Category/ Market

Green Technology, Chemical Analysis,

Industry: Polymer & Plastic Industry

Applications: Degradation of PTFE, making kitchen appliances.

Market: The Global Polytetrafluoroethylene (PTFE) Market size is expected to grow from **197.09 Kilo metric tons in 2023 to 250.65 Kilo metric tons by 2028, at a CAGR of 4.93%** .

Key Features / Value Proposition

> Technical Prospective:

- The unusual reaction between **PTFE** and various **metal ions derived from bulk** like gold, copper, zinc, silver, and iron (stainless steel) **in an aqueous solution of carbohydrates** like glucose and cyclodextrins.
- A red luminescent product was obtained by the reaction between **gold and PTFE** and **non-luminescent products for other metals**.
- Triboelectric charging generates **negative charges** to the polymer surface coated with magnetic pellet.

> User Prospective:

- PTFE is utilized as a coating for **different cooking appliances**.

TRL (Technology Readiness Level)

TRL – 3; Proof of Concept

Intellectual Property

IITM IDF Number: 1881

IP Patent Number: 378255 (Granted)

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Research Lab

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Technology

The present invention describes a **tribochemical method** for significant **degradation** of **PTFE** in water in presence of common metals and carbohydrates producing nanoplastics in solution.

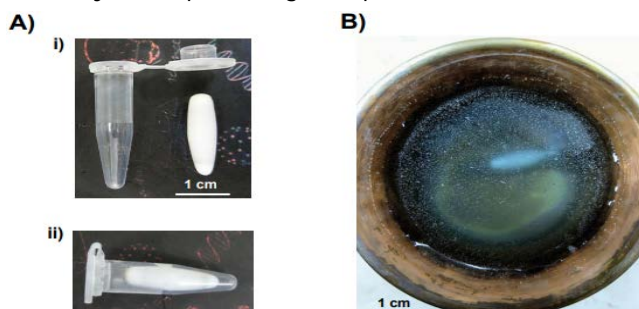


Fig 1: A i) Photograph of polypropylene vial. ii) magnetic pellet was inserted into this vial. B) Reaction of polypropylene with glucose solution in copper vessel. Degradation of polypropylene was noticed after 10 days of reaction.

Method

- Stirring a polymeric pellet with carbohydrates in water at a temperature range of **60 °C-70 °C** in a metal vessel for **3-30 days** to induce triboelectric charging of the polymer surface;

- Interaction of the charged surface with the metal ion wherein, stirring induces triboelectric charging of the polymer surface and the carbohydrates in water induces corrosion of the metal vessels bringing metal ions to the solution to generate a tribochemical reaction between the charged surfaces of the polymer with the metal ions resulting in degradation of polymers.

- Degradation of polymer polytetrafluoroethylene (PTFE) in water in presence of copper and glucose comprises; stirring about 920 mg of PTFE pellet with 1000 ppm glucose in 70 mL water at a temperature of **70 °C** in a copper vessel; triboelectric charging of the PTFE surface during 30 stirring and interaction of the charged PTFE surface with the copper ions, wherein the said method separates of about 53 mg of solid materials consisting of PTFE fragments and copper in 15 days

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