Non-Stick Pollutants and its removal from drinking water

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Anon-stick surface is a surface that was constructed to reduce the ability of other materials to stick to it. Its common application is non-stick cookware where non-stick coatings allows to cook food without sticking to the pan. These non-stick frying pans often uses to surfaces coated with a chemical Polytetraflurotetraethylene (PTTE), commonly known as TEFLON. In the recent years, many other coatings have been marketed as non-sticks such as anodize, aluminium, ceramics, emerald cast iron and seasoned cook ware. Besides all these coating materials the most commonly used non-stick coating is PTTE. PTTE has several unique properties including corrosion resistance and the lowest coefficient of friction of any substance yet manufactured. It was first used to make seals resistant to the uranium hexafluoride gas that was used in making atomic bomb during World War II. In 1951 Dupont developed the application of TEFLON as commercial bread and cookie-making.

The metallic substrate in the non-stick frying pan is roughened to promote adhesion and contains one to seven layers of PTTE. The quality of the non-stick coating depends on the number and thickness of the layers. Any PTTE based coatings will rapidly lose its non-stick properties if overheated.

When Pans are over heated beyond approximately 3500C, the PTTE coating begins to dissociate releasing by-product Perfluorooctanoic (Per-FLUOR-oh-OCK-teh-NO-ik) acid, in short PFOA. PFOA is one of a host synthetic fluorine rich molecule designed to keep water, oils and other materials from sticking to something and hence used as non-stick coating and fabric treatment (to repel water and stains). Because of the unique chemical and physical properties like both hydrophobicity and oleophobicity, PFOS and PFOA have been widely used in many industries as surfactants, fire retardants, lubricants, and polymer additives. The wide use and relatively inefficient removal have led to the ubiquitous presence in the environment. So far, PFOS and PFOA have been detected in air, water, sediment, soil, livers of human beings, and wildlife species. PFOS and PFOA, with extraordinary chemical stability due to the strong C−F bonds, are difficult to decompose using traditional technologies such as biological degradation, oxidation, and reduction. Adsorption has been proven to be one of the most effective methods to remove PFOS and PFOA pollutants from aqueous solution due to its low energy cost, simple procedure, high adsorption capacity, and environmental friendliness.

In recent years, various adsorbents such as boeh mite, alumina, activated carbon, carbon nanotubes, activated sludge, and quaternized cotton have been used for the removal of PFOS and PFOA. However, these adsorbents are not very efficient. This chemical can persist unchanged in environment for long time-perhaps years or centuries, which can

cause polymer fume fever and can be lethal to birds. In rats and mice, exposure to PFOA raises the risk of certain tumours. It also raises cancer risk in people and thyroid disease. It also pollutes drinking water. Higgis at the Colorado school of Mines notes that other PFC pollutants also cause problems. They found PFOA and nearly 30 other PFC s in affected waters. Scientists only half of the PFC s they turned up.

Recently scientists have discovered a new lab made chemical that can remove PFOA from drinking water. William Dichtel, chemist at North-western University in Evaston, III and his co-workers have recently described their new PFOA "magnet". A common way to remove PFOA from water with a filter that acts like a PFC magnet. It will gather molecules of the pollutant onto the surface of the material. This makes the pollutant easy to remove. Activated carbon is often used for this purpose. But PFOA molecules are only somewhat affected to it leaving a huge fraction of PFOA in the water. Dichtel and his co-workers therefore designed a material to actually target PFC's. This material is a type of polymer made of chains of repeating chemical units of two different molecules. One is giant, ring shaped molecule derived from cornstarch called beta-cyclodextrin. The other is fluorine rich molecule called decafluorobiphenyl (DFB). The fluorine help the polymer to grab onto PFOA.This polymer attracts those hard-to-get fluorine rich pollutants.

This new polymer can grab 95% of pollutant form water where activated carbon serves only half of this. Moreover, some common chemicals present in water make activated carbon less effective. But the new polymer works effectively even when these chemicals are around. Best of all the new diChtel polymer is reusable. BY washing it with methanol, the polymer gets ready to pull out pollutants again. Dichtel and his co-workers are now trying to introduce the product in the market. Such materials one-day help homeowners and businesses filter their water.