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MICROBEADS: GENERATION, THREAT TO BIOLOGICAL AND ECOLOGICAL SYSTEMS AND USE OF NATURAL ALTERNATIVES

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ABSTRACT

Microbeads are solid plastic particles which are less than 1 mm in size and added to personal care products such as soap, facial scrub and toothpaste as exfoliating agents mainly to remove dead cells from the skin. They are often added as an exfoliant or application enhancer in personal care products such as rinse off cosmetics, and cleaning products. The over use of plastic results in accumulation of plastic waste in our ecosystems. They are not captured by most of the waste water treatment systems. Now a days, various countries started to ban microbeads for avoiding possible hazards and future consequences related to ecosystem. In present work, we have covered details of sources of microbeads, their toxic effects on biological and ecological system, precautions to be taken and finding of alternatives for microbeads.

Keywords *– Microbeads; Microparticle; Cosmetics; Human; Ecosystem.*

1. INTRODUCTION

Microbeads also known as microplastics are solid plastic particles which are less than 1 mm in size and added to personal care products such as soap, facial scrub and toothpaste as exfoliating agents mainly to remove dead cells from the skin [1]. These products have replaced our traditionally used natural exfoliating agents like ground almonds, oatmeal, and pumice. Commonly used synthetic microbeads are polyethylene, polypropylene and poly methyl methacrylate. They act as bulking agents, exfoliants, as a tooth polisher and apart from that, the incorporation into cosmetics, improves the shelf life by absorbing degradable ingredients. But prior to this, only natural abrasive materials had been used in these products, which are biodegradable in nature [2-3].

2. PLASTICENE

Plastics are synthetic polymers which also contain other chemicals to improve performance, commonly derived from petrochemical sources and have high ranges of molecular mass and plasticity. Microplastic particles have been ubiquitously detected in a broad range of shapes, polymers, sizes and concentrations in the environments of marine water, freshwater, agro-ecosystems, atmosphere, food and drinking water, biot and other remote locations [4].

Microplastic has been reported in every major open ocean and many fresh water lakes and rivers. As it is small in size which makes it bioavailable to thousands of species across nearly trophic levels. These contaminants are generally within almost all marine environments at present. The durability of plastics makes it highly resistant to degradation and through in discriminated disposal they enter in the aquatic environment **(Fig. 1)** [5-6].

Fig. 1: Microbeads in water contamination.

3. APPEARANCE

Microbeads are generally referred to particles with assize lower than 5mm. The appearance of plastic particles likes spherules of translucent to clear polystyrene, opaque to translucent polyethylene discs, pieces of styro foam, sheets of thin and flexible wrapping materials on the surface water. These microbeads are tiny plastic granules and used as scrubbers in cosmetics, hand cleansers, air-blasting [8] **(Fig. 2)**.

Fig. 2: Microbeads in personnel care product.

4. SOURCE OF MICROBEADS

Primary microbeads and secondary microbeads which are developed from breakdown of primary due to environmental conditions are major threat to biodiversity. The microbeads exit as microfibers, microbeads and plastic pellets. All the plastic wastes that originate from domestic or industries or through other activities ends up on land. These find their ultimate destination in to sea or ocean through wind or rain [9].

Fig. 3: Microbeads source at seashore.

5. TYPES OF MICROBEADS

There are two types of microbeads.

5.1. Primary microbeads

Primary microbeads are defined as microscopic plastic fragments on the basis of size. On the basis of chemical composition, these primary microbeads are produced by the unintentional release of intermediate plastic feedstock and occur as by-products of processes such as particulate emissions from industrial production, maintenance of plastic or plastic-based materials, release of dust and fibres, and deterioration of plastic products. The plastic pellets are the raw material for manufacturing of plastic products (pellets to made plastic bags) and microbeads in human health care commodities [10-11].

The plastic pellets comprises of poly- ethylene (PE), polypropylene (PP) , polystyrene (PS) and polyolefin particles and are lipophilic in nature, i.e. they readily adsorb harmful and toxic chemicals from surrounding marine water on its surface. These tiny synthetic primary microbeads are also used as abrasives in various industries (cosmetics, cleaning products, pharmaceuticals and air-blasting media) [12-13].

Many hydrophobic and aromatic compounds such as polychlorinated biphenyls (PCBs), polycyclic aromatic hydro- carbons (PAHs) and dichlorodiphenyltrichloroethane (DDT) have been detected to bond on the surface of pellets collected from marine environment [14-16].

5.2. Secondary microbeads

Secondary microbeads are defined as fragments of larger plastic items that suffer fragmentation found both in marine and terrestrial habitat. Another important process is photo degradation by ultraviolet radiation from sun- light which results in chemical bond cleavage of polymer matrix by the oxidation process [17].

6. EFFECTS ON BIOLOGICAL AND ECOLOGICAL SYSTEM

6.1. Threat to human life

A recent report from the *World Health Organization* emphasized the ubiquitous microbeads presence in the environment and aroused great concern regarding the exposition and effects of nano and microbeads on human health. One of the major nano and microplastic entry points into the human system is represented by the ingestion of contaminated food [18].

In a recent study, 0.44 MPs/g of nano and microbeads were found in sugar, 0.11 MPs/g were found in salt, 0.03 MPs/g were found in alcohol, and0.09 MPs/g were found in bottled water. Humans is also assuming an estimated intake of 80 g per day of microbeads via plants (fruits and vegetable) that accumulate microbeads through uptake from polluted soil.

6.2. Effect on ecological systems

These small pieces of plastic, resemble a plentiful food source for fish and different aquatic creatures that are in distinguishable as plastic particles. These creatures often mistake microbeads for sediment, zooplankton, or other small organisms. This consumption of plastic can cause a variety of dangerous complications. The beads can physically clog up the fishes' stomachs and prevent them from getting adequate nutrition as a result [19-20]. The beads cannot be expelled through normal processes and instead become stuck in the animal's stomach or intestines. With the buildup of plastic, the animals are unable to eat and eventually die from lack of food or health complications caused by the plastic build up [21]. Sadly, list of consequences from the prevalence of micro beads goes beyond marine death. When marine ingest these beads, they are ingesting more than just plastic, an already harmful substance on its own. Microbeads can act as like sponge like material that soaks up different chemicals and toxins [22].

7. NATURAL ALTERNTIVES

There can be a number of alternatives such as crushed walnut shells, oats, sugar, baking soda, finely ground sugar, coffee grounds, finely ground almonds, oatmeal, finely ground sea salt, cinnamon and jojoba seeds to the plastic microbeads, often promoted as 'natural' alternatives **(Fig. 4)**. There has also been a renewed effort to develop synthetic biodegradable microbeads based on materials such as cellulose. With many non-plastic alternatives already in use in PCCPs and others under development, care must be taken so that the alternatives do not come with environmental costs that potentially outweigh the benefits resulting from the bans. In this study, therefore, we compare the environmental performance of a wide range of alternatives used as microabrasives on a life cycle basis [23-30].

Fig. 4: Natural alternatives to microbeads.

8. ANALYSIS OF MICROBEADS

Microbeads are analyzed by routine quality control methods. These methods are also used for various phyto as well as pharmaceutical, non-pharmaceutical and other cemical products. These includes high performance thin layer chromatography, high performance liquid chromatography, UV-spectrophotometry, gas chromatography, etc [31-81].

9. CONCLUSION

Thus, microbeads are proving as a great threat to the humans, animals and environment. There is urgent need to search non-plastic microbeads in cosmetics to prevent their possible hazards.

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11. DISCLOSURE OF CONFLICT OF INTEREST

The author declares no conflict of interest.

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