ew on Microorganisms Involved in Biodegradation of Plastic

akat^eand Imran Hashmi

viron pental Sciences and Engineering (IESE), National University of Sciences and Technology (NUST) H-12, Islamabad, Pakistan

ng author: Ù` { àælklæ:æ\æćkl}+cic`c^k [-kÒ}çi} [} { ^}cælkU&i^}&^+kæ}åkÒ}*i}^^i}^kQDÙDôčkÞæci [}ælkW}iç^!+ic^k [-kÙ&i^}&^+kæ}åkV^&@} [| [* ^kÇÞWÙVDkÞĔFGÉ \i+œ+kkDE { ællklfazakat@gmail.com

:åR་••∿FÏĖÅG€G€LÅAccepted date:åRヾ|^å€FĖÅG€G€LÅPublished date:åRヾ|^å€ÏĖÅG€G€

G€(1€19æ:æ\æd\UE4^dæ|E4V@i+Åi+Åæ}A[]^}E&&&^•+&da[a]A[ai+clia`c^aA`}a^ld@^dc^l { +[-d@^AÔ!^ædq^AÔ[{ { [}+AExclia`ci[}ASi&^}+^E4_@i&@A]^l {ie+A`}!^+cli&c^a }E4a]qali^]![a`&di[}Ai}kæ}^A { ^ai` {E4]![çia^àdc@^A[li*i}æ|kæ`c@[lkæ}àd+[`!&^kæ!^A&!^aic^àE

Abstract

æ

ior

Yiánh * •nh [-h] [æ ci& h i h [næði} *h c[ælå h c@nh , æcnih æ}ðh •[ih] [] [`ci[}h , @i&@h i =h [-h *:nædh &[}&n!}Èh Ú]æ ci& =h ænh æ:n } •iánin á hæ hæh œl:nædh c[h c@nh ^ çi:[] { ^}ch àn & *nh [-h c@nih i } æðijicnh c[h ån*: æðnh æ}ðh c@ *h æ& * ; ii [] { ^}ch & æ hæh œl:nædh i] [æ ci& hæ ha i] [æ ci& hæ * •nh [-h c@nih i } æðijicnh c[h ån*: æðnh æ}ðh c@ *h æ& * ; ii [] { ^}ch & æ hæh œl:nædh i] [æ ci& hæ *h àn a conth we ha & *nh [-h c@nih i] æðijicnh c[h ån*: æðnh æ}ðh c@ *h æ& * ; ii [] { ^}ch & æ hæ ha i @i & anh c[h c@nh ^}ci:] { /}ch àn a & an a conth we ha & an a mining and a sha a we nh i ha i a we nh a we hæ ha i a a mining and a we nh i ha we nh a we nh a we nh i ha we nh a we nh i ha we nh a wha a we nh a wha a we nh a wha we nh a wha we nh a we nh a we nh a we nh a wha a

the waste, Biodegradation, Plastic degrading Hicrobes

ain n

re oduced from non-renewable source i.e. fossil fuels. in polymers of carbon bonded with other organic or gd as and also with nitrogen, hydrogen and sulphur: ey em non-biodegradable and can resist moisture. Plastics high alli nd can be moulded into any desirable form. ey are pactering industry including cosmetics, food and etc. [1]. Worldwide about 57 million tons of plastic ning menerated each year. Due to resistance of plastic to attack, large molecular mass, strong bonds with halogen itutions and aromatic rings, plastics are unable to breakdown easily in the natural environment and are main reasons of accumulation in the biosphere at a large scale without deterioration and results in environmental pollution. In solid waste management, there is a major focus on plastic waste and it has become a threat to the global ecosystem due to its resilience against degradation [2].

ere s increase of almost 5% in production of plastics each year throughout the world [3]. Plastic waste accumulates in the nature and causes harm to the environment because of its inability to degrade. In the soil it clogs the pores and makes it unsuitable for agricultural purposes. Animals die by swallowing the plastic or by being trapped in it and it cause huge negative impact on ecosystem.

Environmental pollution due to plastic waste is considered as major issue and to solve this problem during last three decades various techniques including chemical and biological degradation have been studed. e use of enzymes and microorganisms for the purpose of degradation is class]f ed as the biodegradation method [4].

Plastics are being widely used because of the resilience and low cost. But t has now become a source of pollution and major problem in management of solid waste [5,6]. It also a ects the natural resreniong m

Types of Plastics and their Uses

ere is increase in production of plastics because of the wide application. ere are various types of plastics which can be used for

d] erent purposes e]r insulating and anti-corrosion properties make them suitable to be widely used in daily life 8] erent types of plastics and their uses are listed in the Table 1 given below.

• Plastic is completely degraded and releases carbon dioxide, water and other metabolites [17,21].

Microbes, if hydrophilic, can attach to the plastics' surface A er getting attached to the surface microbes grow by using plastic as carbon source. Compounds with low molecular weight like monomers, oligomers are formed by microbial degradation of compounds with high molecular weight. ese compounds can also get d] used in the microbial cells [4,22].

Factors Involved in biodegradation of plastics

ere are various factors which a ect the process of biodegradation. Chemical and physical characteristics are important and play an important role in biodegradation. Compounds with side chains are d] cult to degrade as compared to the compounds without side chains Similarly, it is also d] cult to degrade high molecular weight compounds e other factors include temperature at which plastic melts morphology and crystallinity. If melting temperature is high, then it will be hard to degrade the plastic. e amorphous compounds can easily be degraded as compared to crystalline one. All these factors must be kept in mind before initiating the process of plastic biodegradation [23].

Listed below are the physical and chemical characteristics which a ect the biodegradability of plastics

- Presence of functional groups responsible for hydrophobicity (hydrophobic degradation is slower than hydrophilic).
- Morphology of plastic.
- Density and molecular weight of plastic.
- Presence of bonds which can easily be broken like amide or ester bonds.
- Molecular composition.
- · Complexity in the structure e.g. Branches in long chains
- Hardness
- Physical form e.g. Powder, flms etc [20,21,24].

ere are certain exposure conditions upon which biodegradability also depends:

Moisture e process of biodegradation can be Infuenced by the moisture content because of its requirement for microbial growth and reproduction. ereforež the biodegradability can be enhanced by providing enough moisture [25].

pH and Temperature pH can also]nfuence the rate of biodegradation as it changes the acidic and basic conditions of the

Future Prospects

Use of biodegradable plastic is most innovative and environmental friendly method to eliminate the plastic pollution. Biodegradable plastic can be used in packaging industry, health and agriculture industry. ey can be e clently degraded in the environment with the help of microorganisms e microorganisms which are able to degrade the plastic should be isolated and screened to test their degrading potential. Characterization of microorganisms at molecular level is also needed ere are some extracellular enzymes that have capability to degrade plastics ere is a need to characterize these enzymes and also identify the genes responsible for enzymes enthese genes can be used to improve the biodegradability of other microorganisms A er feld application, microorganisms with e clent degrading potential should be multiplied to degrade plastics at larger scale

Condusion

It is concluded that plastic is widely used in our daily life for packaging our goods due to its quality and durability. However, its accumulation in the ecosystem is a great threat. Marine animals die due to blockage in their intestines and gills caused by plastics. In the literature, various methods are present to degrade the 30. Tan GYA, Chen CL, Ge L, Li L, Tan SN, et al. (2015) Bioconversion of styrene to poly (