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Applications of Advanced Green Materials

Polylactic coglycolic acid (PLGA)-based green materials for drug delivery

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17.1 Introduction

Polylactic coglycolic acid (PLGA) is a copolymer of lactic acid and glycolic acid. Polylactic acid (PLA) and polyglycolic acid (PGA) are used in different ratio of quantity to form the PLGA of different degradation time. PLGA also used in alternative combination with PGA like PLGA-PGA-PLGA or PGA-PLGA-PGA. PLGA-like polymers are the renewable resources in the pharmaceutical sciences to achieve the maximum use and minimum waste target in drug processing and procurement [1].

The green materials are increasingly vital in the pharmaceutical sciences these days due to the fact of worldwide environmental challenges. Although this concept has been applied in pharmaceutical approaches for last three decades but recent environmental condition indicates to apply it in more ways like in drug targeting, dose modifications, nanoparticles, and microparticles development. Green materials has suggested to reduce waste (by-products), toxicity, cost, safety issues, and environmental impact because these are nonhazardous, reproducible, and biodegradable (breaks organically). Use of green materials is reasonable because the resources of the world are limited, so it is necessary to be consumed with caution [2]. The use of green materials in pharmaceutical industry strongly focuses on utilizing natural materials, safe solvents, waste reduction, and environmental-friendly methods for drug delivery.

PLGA is biodegradable green polymer with nil generation of typical waste material, so PLGA can be used as green material in drug formulations to minimize the health hazards [3]. The physicochemical properties of PLGA can be modified according to the specification of drug delivery by change in ratio of lactic acid/glycolic acid. It is useful base of green materials from last three decades by considering its:

1. Compatibility—Physical (shape and size) compatible for developing nanoparticles, microparticles, and composites for site-specific delivery, drug targeting, extended release preparations as well as conventional dosage forms. In addition, it is chemically compatible with different drugs, amino acids, nucleic acids, antigens as well as for larger compounds.

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2. Biodegradable—When it contacts with water its polymeric ester bonds break and also it degrades by increasing the temperature above its glass transition temperature (Tg). Degradation rate can be modified because the PLGA polymer has amorphous structure, while its monomeric units (lactic acid and glycolic acid) are crystalline in nature.
3. It is approved by US-Food and Drug Administration and European medical agency for its application in clinical use as a part of drug delivery system and medical device [4].

Appropriate selection of the polymeric matrix is essential for good manufacturing practice (GMP), new drug application, and desired dosage forms, due to the aforementioned cited specifications PLGA-based green materials is suitable for advance