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ADVANCES IN BIOCOMPOSITES AND THEIR APPLICATIONS

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Biocomposites with polyamide fibers (nylons and aramids)

4

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4.1 Introduction

Polymers find innumerable applications in human life cycle due to availability, cost-effectiveness, easy handling, and desired shaping property (Winnacker & Rieger, 2016). Polyamides represent a very important class of polymers with global polyamide market size predicted to be USD 62.10 billion in 2030. Steady growth of polyamide is due to various factors such as increasing demand from the automotive industry and electrical and electronics equipment production. On the negative side, polyamide is not completely biodegradable and pose environmental concern due to several factors, such as the composition of some polyamides, the degree of recyclability and reusability of the material, or gas emissions during the manufacturing process. Bio-based alternatives could wind up being more sustainable than recycled options. Many bio-based composites are still in an early stage of their development, and research and development (R&D) is going on in the field. An amount of ~30% of total manufactured polymers are consumed in composites every year, along with 53 million tons of reinforcing agents. Composites are blends of two or more components and being developed for improving the constituents' properties. In composites different systems are combined to achieve a system-improved structural or functional properties than the constituent alone (Shaw et al., 2010). A composite consists of matrix(es) and reinforcing agent(s). The matrix phase is the primary phase having a continuous character, more ductile, holds the reinforcing phase, and shares load with it. The reinforcing phase is discontinuously embedded in the matrix phase. Usually, the reinforcing phase is stronger and harder than the matrix phase (Josmin et al., 2012). Recently, research has been devoted for the fabrication of composite materials with natural fibers as reinforcing agents for sustainable environment approach.

Cost-effectiveness is also a driving factor for the development of sustainable bio-based composites for sustainable development and circular economy. Maximum utilization of resources has led to the concept of sustainable development and circular economy (Kawashima et al., 2019). In the circular economy approach, the product is retained within the economy, maximizing its economic productivity at the end of each service life. The approach promotes a reduction in material input and

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FLUORIDE CONCENTRATION IN GROUND WATER AND ITS CORRELATION WITH PHYSICOCHEMICAL PARAMETERS

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Abstract- Groundwater quality problems have emerged in many geographical areas due to natural environmental processes and human intervention in the geosystems. Among the water quality parameters, fluoride ion exhibits unique properties as its concentration in optimum dose in drinking water is advantageous to health and if the concentration exceeds the limit, this affects the health. High fluoride concentration in the ground water in many parts of the world is a cause of great concern. India has acute public-health problems induced by utilization of groundwater as a source of drinking water. The health problems arising as a result of fluoride contamination are far more widespread in India. The main source of fluoride in ground water is fluoride-bearing rocks such as fluorspar, fluorite, cryolite, fluorapatite and hydroxylapatite. Also the fluoride content in ground water is a function of many factors such as availability and solubility of fluoride minerals, velocity of flowing water, pH, temperature, concentrations of calcium and bicarbonate ions in water. This paper will focus on fluoride concentration in ground water and its relationship to water-quality parameters.

Keywords: Groundwater, Geosystem, Contamination, fluoride-bearing rocks.

1. INTRODUCTION

Among the water quality parameters, fluoride ion exhibits unique properties as its concentration in optimum dose (up to 0.6 mg/L) in drinking water is essential for normal mineralization of bones and formation of dental enamel and if the concentration exceeds the limit (more than 1.4mg/L), it causes dental and skeletal fluorosis (Bureau of Indian Standards 1992). The permissible limit of fluoride in drinking water for a region depends on climatic conditions, because the amount of water consumed and consequently the amount of fluoride ingested is being influenced primarily by the climate and temperature of that particular region (Vekata Mohan et al., 1995; Galan and Lamson, 1953). Ground water is considered to be in purest form, but as it comes in contact with rocks due to dissolution of minerals it becomes polluted.

Fluoride enters in body by many ways such as through water, food, industrial exposure, drugs, cosmetics, etc., but the major source of fluoride exposure to human being is drinking water (Sharma et al., 2011). Ground water is the prime source of drinking water for the people. Therefore ground water contaminated with fluoride becomes the main cause of fluoride exposure to human beings. Due to the strong electronegativity of fluoride, it is attracted to positively charged calcium present in teeth and bones. The severe health issues caused by fluoride are dental fluorosis, teeth mottling, skeletal fluorosis and deformation of bones in children and adults (Susheela et al., 1993). High fluoride concentration in body can interfere with carbohydrates, lipids, protein, vitamins, enzymes and mineral metabolism. Skeletal deformation and weakening of joints are typical forms of fluoride at high levels of fluoride intake (WHO, 1985). Fluoride is primarily excreted in urine. The severity of injury is determined by duration of fluoride exposure and concentration.

The main source of fluoride in ground water is fluoride-bearing rocks such as fluorspar, fluorite, cryolite, fluorapatite and hydroxylapatite (Farooqui et al, 2007). But the fluoride content in ground water is a function of many factors such as availability and solubility of fluoride minerals, velocity of flowing water, pH, temperature, and concentrations of calcium and bicarbonate ions in water. This paper will focus concentration of fluoride in ground water and its relationship to water-quality parameters.

FLUORIDATED AREAS

It is estimated that around 200 million people among from 25 nations the world over are under the dreadful fate of fluorosis. The dissolution of fluorite, apatite & topaz from local bedrocks leads to

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19

Biocomposites for Bone Engineering: Recent Advances and Possibilities

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Abstract

The rapid increases in applications of biocomposites in various new areas has become important in research due to environmental concerns and availability. In the healthcare sector, biocomposites are being utilized in medical tools, sensors, and drug delivery protocols. This review will focus on the new trends in the application of biocomposites in bone engineering. Biocomposites as bone scaffolds has become an advanced tool for bone repairing. Modularity, strength, biocompatibility, non-toxicity, and ease of blending with other molecules are the properties which make the biocomposites useful for bone engineering. Experiments on use of biocomposites in bone repairing had already done in animal successfully and its application on human beings are under process. The present review will explores the advancement and future scope of use of biocomposites in bone related treatments.

Keywords: Bone scaffolds, Biocomposites, Bone engineering.

Introduction

Bone-related defects and diseases are a serious concern for the life of patients. Bone defects require medical procedures for bone regeneration and replacement. Autografts, allografts, and synthetic grafts used for this purpose possess osteoconductive, osteoinductive, and osteogenic properties to facilitate bone-like functions (Fillingham *et al.*, 2016). Large bone defects from conventional scaffolds cannot be spontaneously reconstructed sometimes, with poor healing efficiency, especially in elderly patients (Li *et al.*, 2019). Thus, there is an urgent need for advanced and effective therapeutic interventions for bone regeneration. The required role is not only to fill the bone fissure but also to provide both structural and mechanical support. Research on alternative bone graft materials such as polymers, metals and ceramics is ongoing in the medical sector with emphasis on naturally derived biocomposites. The present review will address the issue of bone implant materials, including chitosan and flavonoids and will also focuses on advancement and future scope of use of biocomposites in bone related treatments.

Bone Regeneration and Grafting Process

Complete or partial bone break is a very common condition with numerous cases reported every year (Kashte *et al.*, 2017). In these health emergencies, bones have the ability to reproduce