



MEDICAL POLYMERIC BIOCOMPOSITES

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Abstract: Medical biocomposite materials have the following structure: metallic, ceramic, polymeric and biological biomaterials: biocomposites reinforced with natural fibers; bionanocomposite or nanobiocomposite. Medical biocomposites have a very wide range of medical applications. For this reason, they meet multiple requirements in which biocompatibility is a priority. Within medical biocomposites the weight is given by polymeric biocomposites. This particularity is also found in the significant share that biocomposites reinforced with natural fibers have.

Keywords: biocomposites, medical biocomposites, biocompatibility

1. INTRODUCTION

In a systemic approach, biocomposite materials or „biocomposites” are “often interpreted as biomass-based composites (Fig.1) or biomedical composites [5]. The former have a wider significance than the latter because they are available for various industrial purposes” [4, pp.3].

In terms of the nature of the matrix and the reinforcing component, biocomposites are polymeric composite materials with matrices of polymers based on PP oil, PE and epoxy resin, or of biopolymers such as PLA and PHA and the reinforcing component of natural fibers and / or synthetic (Fig.1) [9], [1], [10].

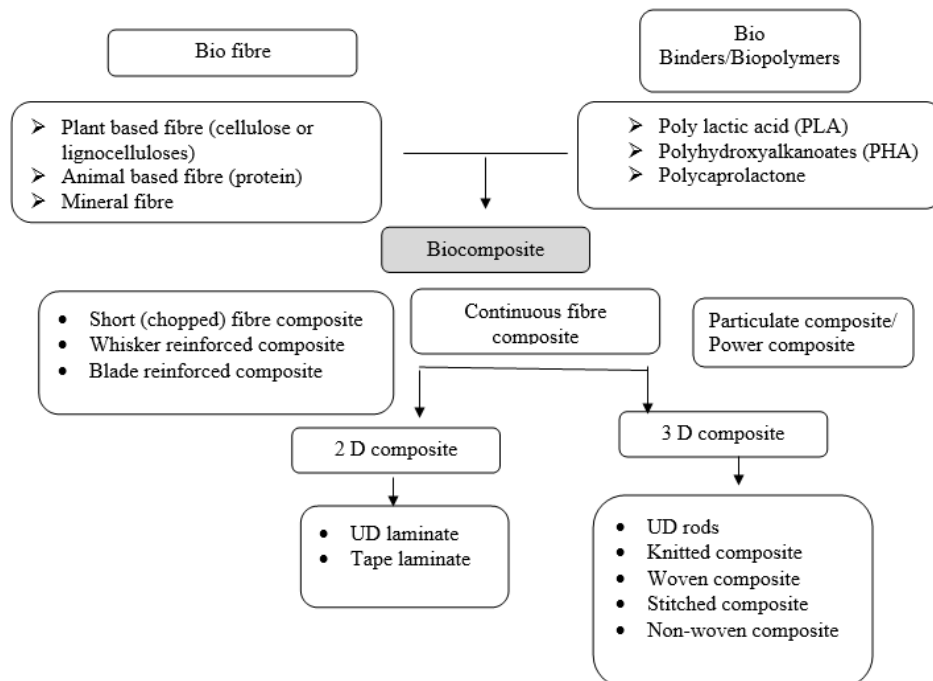


Figure 1: Different type of composites from bio-fibre and bio-binders, after [10]

In the field of medical bioengineering, biocomposite materials are used in the manufacture of medical devices for therapeutic and non-therapeutic purposes, implantable medical devices in the orthopedic, cardiovascular or other fields, in the manufacture of artificial tissues and organs (Fig.2), in micro and nano- biotechnologies for the repair and reconstruction of destroyed, damaged or non-functional tissues, etc. [5], [14], [15].

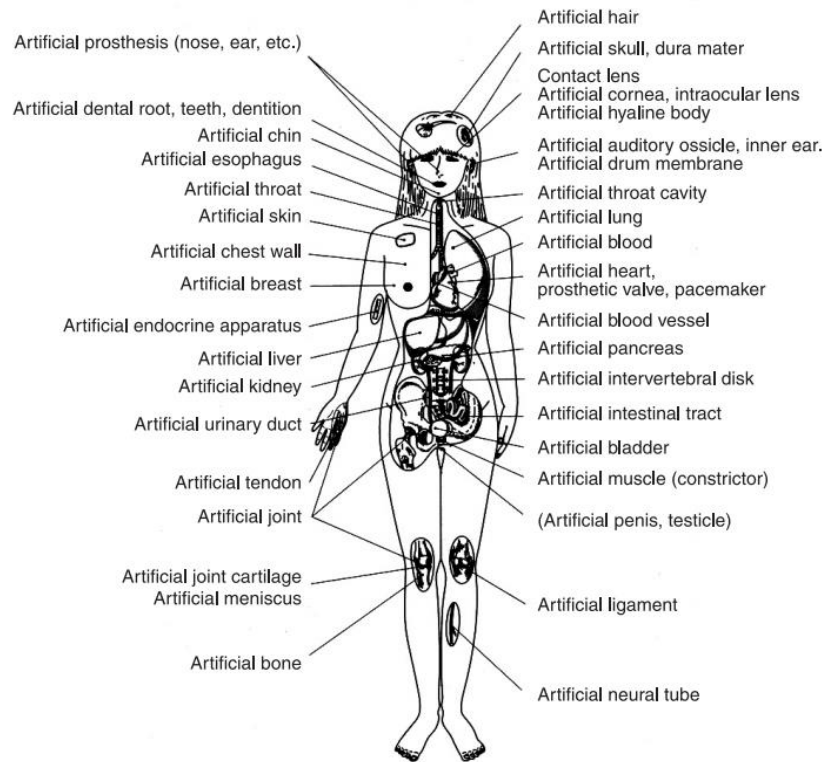


Figure 2: Artificial tissues and organs after [7]

2. FEATURES OF POLYMERIC MEDICAL BIOCOMPOSITES

Synthetic medical biocomposite materials are composed of the following synthetic biomaterials: metals, polymers and ceramic materials as well as biological biomaterials. Synthetic biomaterials hold the share. Synthetic biomaterials are used in the structure of the matrix and reinforcement elements (Tab.1)

Table 1: Examples of the use of biomaterials in the composition of medical biocomposites, after [5]

Matrix	Fibers	Particles
Thermosets	Polymers	Inorganic
Epoxy	Aromatic polyamides (aramids)	Glass
Polyacrylates	UHMWPE	Alumina
Polymethacrylates	Polyesters	Organic
Polyesters	Polyolefins	Polyacrylate
Silicones	PTFE	Polymethacrylate
Thermoplastics	Resorbable polymers	
Polyolefins (PP, PE)	Poly lactide, and its copolymers with polyglycolide	
UHMWPE	Collagen	
Polycarbonate	Silk	
Polysulfones	Inorganic	
Poly(ether ketones)	Carbon	
Polyesters	Glass	
Inorganic	Hydroxyapatite	
Hydroxyapatite	Tricalcium phosphate	
Glass ceramics		
Calcium carbonate ceramics		
Calcium phosphate ceramics		
Carbon		
Steel		

Titanium		
Resorbable polymers		
Poly(lactide, polyglycolide and their copolymers)		
Polydioxanone		
Poly(hydroxyl butyrate)		
Alginate		
Chitosan		
Collagen		

Polymeric medical composites are defined by the following main characteristics, [13], [2]:

- are stable in body and in vivo without suffering, in the long run, changes in strength, rigidity and reliability;
- have a lower rupture rate than other categories of biomaterials used in the construction of medical devices;
- in some medical devices, ceramic composites are preferable as an alternative material;
- thermoplastic composites are biocompatible while thermoset composites vary in biocompatibility, not being, for this reason, recommended in orthopedic applications;
- thermosetting composites are preferred for fixing bone fractures;
- currently, in the orthopedic field, the most used are polymeric medical composites reinforced with fibers;
- polymeric medical composites (reinforced especially with natural fibers) have mechanical properties (modulus of elasticity) closer to those of bones, with positive effects for orthopedic applications. Ex .: the use of osteosynthesis plates made of polymeric medical composites, instead of metal ones, leads to the reduction of the "stress-shielding" effect.

Polymeric medical composites, thermosetting and thermoplastics, are used in a wide range of medical applications in various forms of medical devices in various fields such as (Fig.3): dental, orthopedic, vascular, etc.

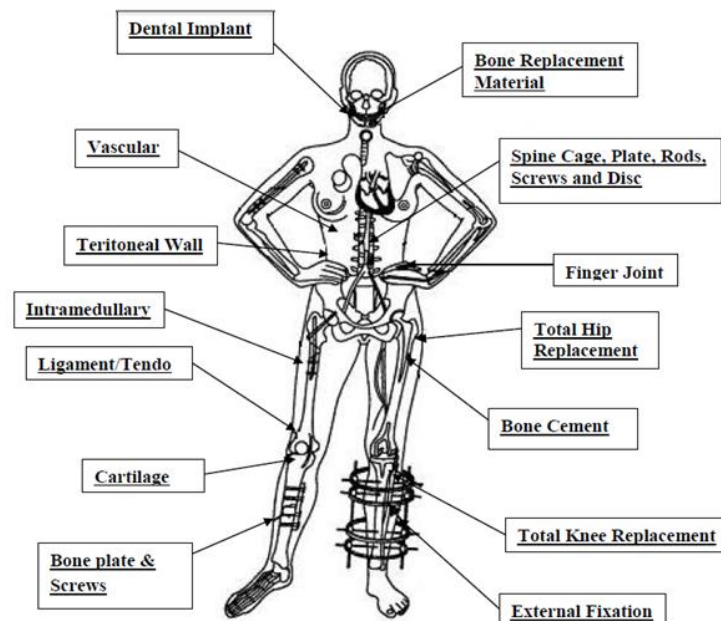


Figure 3: Various applications of polymeric medical composites [15]

An aspect of current interest is the medical biocomposites based on hydroxyapatite and polylactide, and its copolymers with polyglycolide [6], [8], [11], [16], [17].

3. CONCLUSION

Medical biocomposites comprise three main groups: biocomposites made of synthetic and natural biomaterials; biocomposites having as reinforcing elements natural fibers; nanobiocomposites. Polymeric biocomposites are most used in various medical applications (Fig.3). They have different structures and characteristics specific to the medical application. As a result of current medical applications, biocomposites based on polylactic acid and hydroxyapatite are currently of particular interest.

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