Enhancement on Microstructure, Mechanical Properities of Mg6zn Due to The Addition of Copper

P.Parameswaran[1], Reno Antony.S[2], Rooban Balaji.G[3], Surendhar.T[4], Suriya.P[5]
[1, 2, 3, 4, 5] Dept of Mechanical Engineering
[1, 2, 3, 4, 5] Ramakrishnan College of Technology, Samayapuram, Trichy-621 112

Abstract- *We come to discuss about the bio degradable properties of metal which found emerging application in medical science. By analysing the limitation of alloying component (MgFe, Cu-Mg, etc.) during bone replacement due to fracture. The discussion was made about the Casting which are suited for degradable and implant property with the help of previous review. By this way degradable pure Mg was identified and the research were done for alloying because of poor mechanical property. With the help of detailed description about the Zn and cu alloying element were chosen (Zn -6%, cu-4%). The following test process are made as IMMERSION TEST, SEM, EDS, XRD, and CYTOTOXICITY TEST. The review about this paper gives the description about the medical application of Mg-Zn-Cu alloy.*

Keywords- Biodegradable Property, Casting, cytotoxicity.

I. INTRODUCTION

In this emerging world outstanding technologies and analytical methods were developed in engineering field but in medical field (surgical therapies) made a serious complication in osteomyelitis (bone infection). During fracture the treatment was done by packing the metal plate and made the arrangement according to original structure.

By this method metal must be removed by second operation that increase the risk of patient therefore with the number of biodegradable materials loaded with antibiotics

Available in Material Science, so that we made a research on material science. The ability of PM to produce high quality, complex parts with close tolerances and high productivity presents significant advantages, such as energy efficiency, with potentially low capital costs.

Some of the degradable materials are Zn, Mg, Cu and some of the polymers. For the past final scientist become increasingly concerned about the antimicrobial ability of degradable metal implant that focused on Mg alloys which offer advantages such as biodegradable property, mechanical property and cost here that our aim is to introduce Mg based alloy with Zn, Cu in ratio 6:4 because of the limitation analysed in biodegradable material also some of them are Mg, carbide.

For making this alloy material there are five machining process is carried out. They are making of alloy component Casting, polishing. The material after completion undergoes various test to check the Mechanical Property, Bio compatibility and antibacterial activity. Some of the tests used for antibacterial activities are EDS, SEM .The method of the process is given below

description is given below.

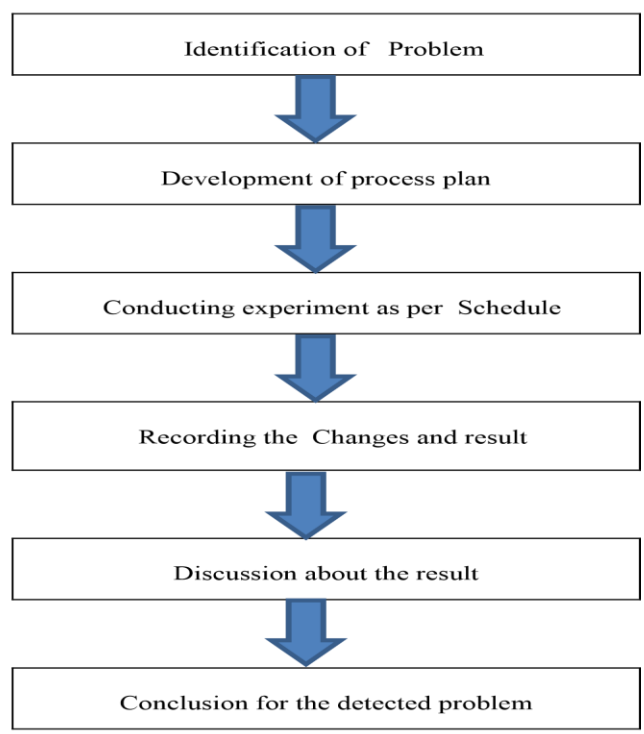

Figure 1.1 Methodology of the process

II. LITERATURE REVIEW

Most of the works have been carried out to Study the growth of life cell on Mg alloy Mg alloy metal of 5mm thickness plate was developed by the process of casting. Its microstructure has been identified for proceeding the further tests. Basic testing process are conducted for checking the mechanical property of metal piece

Experiments are conducted for viability of cell growth on Mg alloy and its life time without side effects. The researchers proposed the growth of life cell in Mg alloy and Zn alloy with varying metal. From the study of literature survey essential elemental powder (Zn, Ca, Cu, Ti, P) is consider, to analyse growth of life cell by following same procedure.

In recent years, much progress has been made on the development of biodegradable magnesium alloys as“Smart” implants in cardiovascular and orthopaedic applications. Mg-based alloys as biodegradable implants have outstanding advantages over Febased and Zn-based ones. However, the extensive applications of Mg-based alloys are still inhibited mainly by their high degradation rates and consequent loss in mechanical integrity. Consequently, extensive studies have been conducted to develop Mg-based alloys with superior mechanical and corrosion performance.

III. CELL CYTOTOXICITY

Biodegradable magnesium (Mg)-based vascular stents have been designed as temporary scaffolds to treat angiostenotic lesions for the maintenance of normal blood flow. Numerous studies have presented in vitro and in vivo tests for the evaluation of the safety and feasibility of Mg based vascular stents and the related materials. Therein the cytocompatibility is a basic and important parameter in the evaluation system. In this review, we summarize the applications and limitations of in vitro evaluation methods including basic characterization methods and direct and indirect cytotoxicity tests. We discuss the influencing factors on cytotoxicity, such as surface roughness, preconditioning of sample surface, cell type for the biocompatibility evaluation in direct contact as well as conditions for the formation of extracts/degradation products for indirect assays. Besides, we highlight the recent in vivo animal tests and clinical trials about Mg based stents along with some associated results. The aim of this review is to provide a meaningful reference in the further developments and related evaluation methods of Mg-based stents

IV. EXPERIMENTAL PROCEDURE

Cell Culture

The use of magnesium and its alloys as biodegradable metallic implant materials requires that their corrosion behaviour can be controlled. We tailored the Mg release kinetics and cell adhesion properties of commercially pure Mg by chemical surface treatments in simulated body fluid, in Dulbecco's Modified Eagle's cell culture medium in the presence or absence of foetal bovine serum (FBS), or in 100% FBS. Helga cells were cultured for 24 h on these Mg surfaces to characterize their biocompatibility. Cell density on all treated surfaces was significantly increased compared with a polished Mg surface, where almost no cells survived. This low biocompatibility of pure Mg was not caused by the high Mg ion release with concentrations of up to 300 mg/L in the cell culture medium after 24 h, as cells grown on a glass substrate showed no adverse reactions to high Mg ion concentrations.

MTT Assay

The ZCCsample was tested for *in vitro* cytotoxicity, using Vero cells by 3-(4, 5dimethylthiazol-2-yl)-2, 5-diphenyltetrazolium bromide (MTT) assay. Briefly, the cultured Vero cells were harvested by trypsinization, pooled in a 15 ml tube. Then, the cells were plated at a density of 1×10^5 cells/ml cells/well (200 µL) into 96-well tissue culture plate in DMEM medium containing 10 % FBS and 1% antibiotic solution for 24-48 hour at 37°C. The wells were washed with sterile PBS and treated with various concentrations of the ZCCsample in a serum free DMEM medium. Each sample was replicated three times and the cells were incubated at 37°C in a humidified 5% CO2 incubator for 24 h. After the incubation period, MTT (20 µL of 5 mg/ml) was added into each well and the cells incubated for another 2-4 h until purple precipitates were clearly visible under an inverted microscope. Finally, the medium together with MTT (220 µL) were aspirated off the wells and washed with 1X PBS (200 µl). Furthermore, to dissolve Formosan crystals, DMSO (100 µL) was added and the plate was shaken for 5 min. The absorbance for each well was measured at 570 nm using a micro plate reader (Thermo Fisher Scientific, USA) and the percentage cell viability and IC50 value was calculated using Graph Pad Prism 6.0 software (USA).

Haibo Gong, Kun Wang et al. (2014) suggested that Corrosion rate of as-cast Zn–1Mg was found to be much lower than that of WE4. In vitro cytotoxicity test results indicated that Zn–1Mg alloy was biocompatible, as cells growing in contact with corrosion products of Zn– 1Mg maintained high cell viability and healthy morphology.

Bahman Homayun, Abdollah Afshar (2014) suggested that the presence of Al up to 3 wt.% in the alloys resulted in lower degradation rates, higher corrosion resistances, and higher tensile and compression strengths due to its positive effect on microstructure refinement. In vitro Cytotoxicity assessments on this alloy demonstrated its good biosafety, making it a potential candidate to be considered for further investigations as a degradable biomaterial.

MATERIAL TO BE USED

Mg plays a critical role in brain function and mood, and low levels are linked to an increased risk of depression. It's characterized by an impaired ability of muscle and liver cells to properly absorb sugar from your bloodstream. The weight % as in the review paper is about 5-7%.

4.2 ZINC AND COPPER

Zinc is used to help blood vessels move blood throughout the body and to help release hormones and enzymes that affect almost every function in the human body. Zinc is the second most abundant mineral in the body. It is present in every cell of the body. Most of the zinc in the body is used to increase the density found in the bones. The reason for using copper as alloying element are corrosion resistant, Antibacterial, easily joined, ductile, tough, nonmagnetic. The copperions in the implant also prevent bacteria growth. This in turn could reduce the need for antibiotics and bone grafting thus also addressing issues with antibiotic resistance.

V. CONCLUSION

The corrosion resistance of the developed alloy was satisfactory and the hardness were found to be increases with the addition of Zn and Cu into the matrix. However, due to the processing route, this present alloy wound begins to corrode at faster rate and can be applicable for tissue, scaffolds, etc. but not the bone. In future, the casted followed by mechanical forming such as forging, extrusion etc., has to be done to induce more strength and corrosion resistance for the Mg metal. Ductility can favour due to the additions of Cu in the alloy which will be affected by the formation of hard phases due to Zn. The alloying elements has to be compensated for both hardness and toughness.This review focuses on the following topics: (i) the design criteria of biodegradable materials; (ii) alloy development strategy; (iii) in vitro performances of currently developed Mg-based alloys; and (iv) in vivo Performances of currently developed Mg-based implants, especially Mg-based alloys under clinical trials.

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