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Proceeding

The 1st Almuslim International Conference on Science, Technology, and Society

The Institute of Research and Community Services
ALMUSLIM UNIVERSITY BIREUEN - ACEH

COORDINATION OF PRIVATE HIGHER EDUCATION REGIONAL XIII ACEH

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Message from the Rector

Assalamu'alaikum Wr. Wb.
Greetings.

Ladies and gentlemen,

It is an honor indeed to open this conference, the 1st Almuslim International Conference on Science, Technology, and Society (AICSTS). On behalf of Almuslim University (Umuslim), I would like to extend a warm welcome to all participants and our speakers who are with us to make this a notable and exciting event a success.

At Almuslim University, we emphasize the best possible achievements in education and research and are also committed to innovation and technology. Today, we are faced with more challenges in these spheres, and therefore, as members of the academic community, we have a duty to find innovative research solutions for them. Hence, this conference is an excellent forum for experts, professionals, researchers, and students as well, to present, share, and discuss their knowledge and experiences with all of us. In line with such idealism, it is really a privilege for us to host you, not just this year, but for years to come, to give and provide opportunities to contribute lasting and practical solutions to the challenges that confront us from time to time. This conference includes keynote speeches, oral and poster parallel sessions on topics in the field of sciences, life sciences, engineering, social sciences and humanities.

Finally, we know that in the origination of this conference there may be some shortcomings, for which we would like deeply apologize in advance to all of you. This is the University's first experience in organizing an international conference like this. With deepest sincerity hereby we would also like to thank all the keynote speakers for your contribution, time and support for this conference. Our heartfelt appreciation goes to all the authors of the selected papers for their effort and hard work. I also would like thank the organizing committee of the conference for their hard work in making this event a success. I wish to encourage them to continue organizing more events and to take other initiatives as well in future. To support and sustain important research linkages for dialogue and facilitate exchanges of ideas such as this will certainly generate more new discoveries and innovations in years to come. It is everyone's optimism that all we will learn from this first international conference in 2015 will be used as a reference for the development of research, as well as guidance for the readers in education and in academic profession.

I am sure the committee of this conference has served you in the best way they can to make your brief stay with us a lasting memory.

Thank you.

Dr. Amiruddin Idris, SE, M.Si

Message from the Committee Chairman

Assalamu'alaikum Wr. Wb.
Greetings,

Ladies and Gentlemen,

I would like to take this occasion to cordially welcome all participants of the 1st Almuslim International Conference on Science, Technology, and Society (AICSTS). This conference is held at our beloved campus of Almuslim University (Umuslim), Bireuen, from November 7th to November 8th, 2015. Almuslim University, the home of 7 faculties, is one of the major private universities in Aceh. We are assured that the 416 scientific participants will contribute to productive discussions and exchanges of scientific experiences that will bring about success to this conference. Participants from 9 countries, Indonesia, Malaysia, Thailand, Philippines, United States, India, Taiwan, England, and Qatar, have optimally marked an international scope to the conference.

I would like to express my gratitude to the Coordination of Private Higher Education Regional XIII Aceh, the Institute of Research and Community Services of Almuslim University and the committee members for helping us in organizing the conference. The conference and proceedings are a credit to a large group of people and everyone should be proud of the outcome.

We are delighted with the vast responses of 152 submissions from researchers and practitioners. The knowledge bases that we are aiming to generate in the conferences topics are overwhelming due to the involvement of these experts from various fields of studies. Their papers will be published in the proceedings to provide permanent records of what has been presented. The proceedings are divided into four, Life Sciences, Engineering, Social Sciences and Humanities (Science Educations), and Social Sciences and Humanities (Economics, Social and Arts), and the papers published here will exhibit the current state of development in all aspects of important topics that are instrumental to all researchers in the various fields. They have succeeded in bringing together various aspects of developments and innovations in knowledge and technology that will benefit not only the academic community, but the society itself as well.

We realize that there are still many shortcomings in the implementation of the arrangements of this conference. Therefore at this opportunity we also expect criticism and constructive suggestions from all stakeholders so that the conference arrangements in future will be more successful. Finally we would like to thank you all for all the support and assistance you have contributed to making this conference and its proceedings successful.

Thank you,

Drs. Marwan Hamid, M.Pd

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Hardness Properties, Microstructure and X-ray diffraction of *Hydroxyapatite-Glass Ionomer Cement Biocomposites*

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Abstract

Development of bioactive materials for the replacement or repair of body tissue is being rapidly developed today. This research aims to develop material of biocomposite hydroxyapatite (HAp) - glass ionomer cement (GIC) for hard tissue restoration. Glass ionomer cement is biocompatibility in nature, that it shows good biological effect on the structure of hard tissues (bones and teeth). Another advantage of this material is that glass ionomer cement is anti-bacterial. In this study, specimens prepared by mixing hydroxyapatite (HAp-200) with glass ionomer cement of GC Fuji IX with composition of 10% of HAp: 90% of GIC, 20% of HAp: 80% of GIC, and 30% of HAp: 70% of GIC, all in% of weight. Hydroxyapatite was mixed with glass ionomer cement (GIC) for approximately 60 minutes to obtain a homogeneous powder mixture. To cause bonding between the particles, the catalyst of GC Fuji IX was added in the amount of 70% wt and stirred thoroughly. The growth of apatite can be seen from the SEM test at 30% of weight of HA200-70% of weight of GIC after soaking in SBF for 28 days. The results showed that the highest hardness value was of 20% of HAp- 80% of GIC, which was 45 VHN.

Keywords: Hydroxyapatite, glass ionomer cement, catalyst, SBF, VHN

Introduction

The need of rehabilitation material is huge so that much effort has been made to find alternative rehabilitation materials which are good, affordable and can replace the damaged tissue structure with the

ability to adapt well to the body's tissues. Development of synthetic biomaterials as the material rehabilitation of the hard tissues of the body that are bones and teeth are expected to be able to replace the role of the tissues replaced. Synthetic biomaterial that is being developed is bioceramic. Bioceramic is known to have bioactive material - material that can provide specific biological response at the encounter of the material with the tissue that will lead to the process of bone formation (osteogenesis) between the material and the tissue [Hench, 1991]. Bioceramic material that is often used in the field of tissue rehabilitation is synthetic hydroxyapatite [HAp, CA10 (PO 4) 6 (OH) 2]. Hydroxyapatite contains Ca2 + ion and when it reacts with body fluids, it can bind to specific ions to form bone like apatite interphase. Besides, it also has very good biocompatibility and bioactivity (Suzuki, *et al,.* 2003). HAp material has characteristics that resemble HAp of bone and teeth tissues. To develop HAp which has characteristics similar to the bone and teeth tissues, the glass ionomer cement chosen as the matrix material.

In this study, hydroxyapatite was mixed with glass ionomer cement to replace the role of the matrix. Glass ionomer cement is a material that can be chemically bonded to the hard tissue. Glass ionomer cement is also adhesive, not irritating, has low solubility, and heat insulator.

Literature Review

Some previous researchers have developed hydroxyapatite biocomposite as hard tissue rehabilitation material. Na-Young *et al.,* (2003) investigated HAp-Ag and HAp-ZrO2 biocomposites and acquired fracture toughness was slightly increased with the addition of Ag content of 5% of volume on HAp matrix. Ang *et al*., (2002) developed chitosan and hydroxyapatite biocomposites for hard tissue rehabilitation candidates. Basically, it is hydroxyapatite powder dispersed into chitosan. The study of the literature shows that this biocomposite has good biocompatibility properties of the cell growth. Kishi *et al*., (2004) investigated hydroxyapatite - alumina-zirconia biocomposite and it was obtained that by the addition of alumina-zirconia (Al2O3-ZrO2), 20% by weight, may increase the value of the material hardness. While addition of hydroxyapatite concentration will lower the hardness value. Nugroho *et al*., (2007) synthesized HA of calcite and produced HA biphasic material and calcite which can be developed as a bone substitute material. The Hydroxyapatite was then made hydroxyapatite-gelatin bicomposite and macro porosity between 80-400μm and micro porosity between 0,5-10μm were generated which are suitable for the growth of osteoblast cells. The biggest compression strength was obtained at composition of 50% of weight, in the amount of 7-8 MPa..

Materials and Methods

The materials used in this research were commercial Hydroxyapatite (HA200, Taihei Co. Ltd., Tokyo, Japan), Glass ionomer cement powder of GC Fuji IX and GC Fuji IX catalyst, Tokyo, Japan. The size of particles ranging from 15-50μm, stirring time of 25-30 seconds, maximum working time was 120 seconds and setting time of 150 seconds. Simulated Body Fluid (SBF) used was made by Basic Dentistry Laboratory of Gajah Mada University referred to Kokubo and Takadama journals [2004]. Table 1 shows the composition of glass ionomer cement.

Preparation of Hydroxyapatite-Glass Ionomer Cement Biocomposite. Weighing hydroxyapatite powder and glass ionomer cement in several composition variations (10% of HAp: 90%of GIC, 20% of HAp: 80%

of GIC, and 30% of HAp: 70% of GIC) weight (in grams) sequentially = 0.045; 0.09; 0.135 for Hydroxyapatite and 1.035; 0.92 and 0.80 for glassionomer cement. All the test specimens were soaked and not soaked in SBF for 28 days hydroxyapatite and glass ionomer cement powder was mixed and 0.67 grams of catalyst was added to cause a hardening reaction. The mixture was put in a mold and left to harden at room temperature.

Table 1. Composition of GIC

Composition	(%)
Silica	41,4
Alumina	28,6
Aluminium Florite	1,6
Calsium Florite	15,7
Sodium Florite	9,3
Aluminium Fosfat	3,8

Hardness test. The hardness test used was Vickers test, JIS Z 2251 standard, using a diamond pyramid indenter with a face angle of 136°. Former stamping of diamond pyramid indenter was then measured for its average diagonal to calculate the hardness value of the tested material on a load of 100 grams (0.1 kg). Before testing the hardness, firstly, specimen surface was sanded until it is shiny. Vickers hardness testing variables shown in **Table 2** and Scheme of Vickers indenter can be seen in **Fig. 1.**

Tabel 2. Variable *Vickershardness* spesimen with and without treatment *SBF*.

Materials	Composition (%wt)	Load (gr)	Specimen
GIC	100%	100	2
HAp/ GIC	10%/ 90%	100	2
	20%/ 80%	100	2
	30%/ 70%	100	2
HA_{200}/ GIC	10%/ 90%	100	2
	20%/ 80%	100	2
	30%/ 70%	100	2

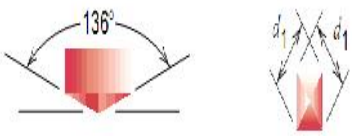

Figure 1. Indentor *Vickers*

Vickers hardness value can be calculated using the formula:

$$VHN = 1{,}8544\frac{P}{d^2}$$

VHN = Vickers hardness (kg / mm2)

P = load suppression (kg)

d = diagonal suppression results (mm)

$d = \frac{d_1 + d_2}{2}$ = diagonal load (mm)

Results and Discussion

Hardness Testing. It can be obtained from hardness test that the material hardness value of GIC without HAp showed the average strength value of 87.5 HVN while at the compositions of 10% of HAp,20% of and 30% of HAp, the Vickers hardness obtained were 38; 45 and 42.5 HVN. It shows a decrease in inter-particle bonding of GIC by the presence of HAp particle resulting in the decrease of hardness value. However, with the addition of HAp particles in GIC, it is expected that it will be able to support the growth of living cells of hard tissues (bones and teeth) because of the nature of the biocompatible hydroxyapatite and its morphology that resembles hard tissues (bones and teeth). Figure of hardness test results can be seen in **Figure 2.**

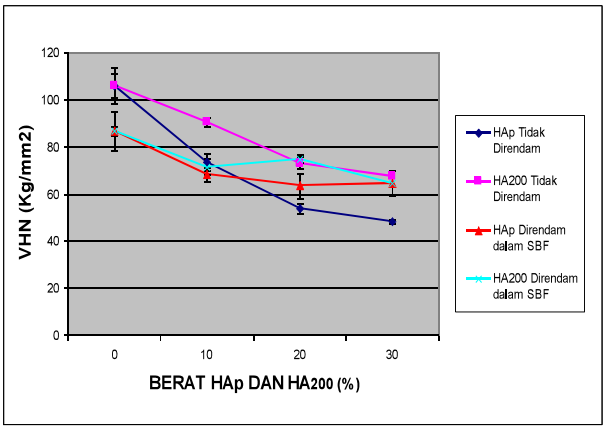

Figure 2. *Vickers Hardness*

X-Ray Diffraction of Hydroxyapatite Powder. X-ray diffraction patterns of HAp synthesized from calcite is shown in **Figure 3** which shows the peaks that resemble the peaks of hydroxyapatite HA200 and KPHAp. HAp showed several peaks that have very strong intensity on the angle between $25^o \leq 2\theta \leq 26^o$ that form the crystal field of 002 and the angle between $31{,}8^o \leq 2\theta \leq 34^o$ that form the crystal field of 211, 112 and 300. Based on the results of testing for HAp (prior to the development of composites), it is known that the synthesis of HAp has successfully transformed calcite into HAp which characterized by X-ray diffraction pattern at about $25{,}5\theta^o$ and $32{,}5\theta^o$ corresponding well with the database of HAp on XRD machine, there

were also peaks of X-ray diffraction as a marker of calcite, at about 29.5θo. A diffraction pattern on HAp as the synthesis result of calcite was almost the same as that carried out by Morales et al. (2001), that the X-ray diffraction pattern of HAp showed strong intensity on 25,839θº (002), 31,859θº (211), 33,039θº (112) and 34,099θº which is a reflection of the crystal field of 300. X-ray diffraction (HA_{200} Jepang) can be seen in **Figure 4.**

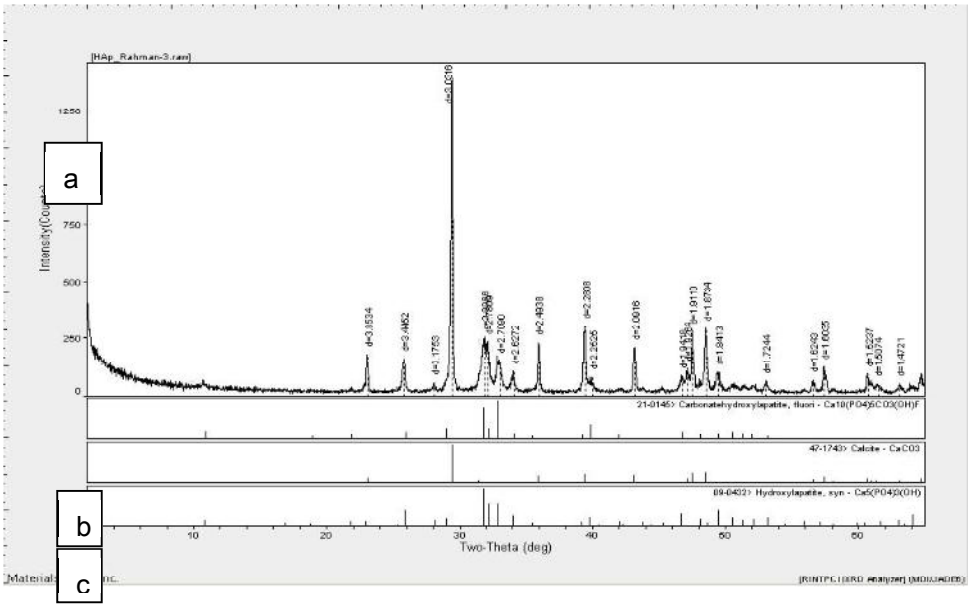

Figure 3. X-Ray Diffraction (a) hydroxyapatite synthesized from calcite (HAp), (b) Basic data of calcite on *XRD machine*, dan (c) Basic data HA on *XRD* machine

Microstructure of Hydroxyapatite-Glass Ionomercement. SEM Test conducted on specimens with a composition of 100% of GIC weight, 30% of weight of HAp-70% of weight of SIK and 30% 0f weight of HA200-70% of weight of GIC with different treatments which were to be soaked and not soaked in SBF for 28 days. SEM Testing was done with the power of 20kV with a magnification of 10,000 times. The test was carried out on the fracture surface of specimens. Before the test, specimens were put into cup and first specimens were coated (gold coating) using sputtering to determine the microstructure of the test specimens.

Results of SEM test performed on specimens with a composition of100% of weight of GIC, 30% of weight of HAp-70% of weight of GIC and 30% of weight of HA 200-70% of weight of GIC with different treatments which were to be soaked and not soaked in SBF. SEM testing results conducted with 20kV power with10,000 times magnification are presented in **Figure 5-10**.

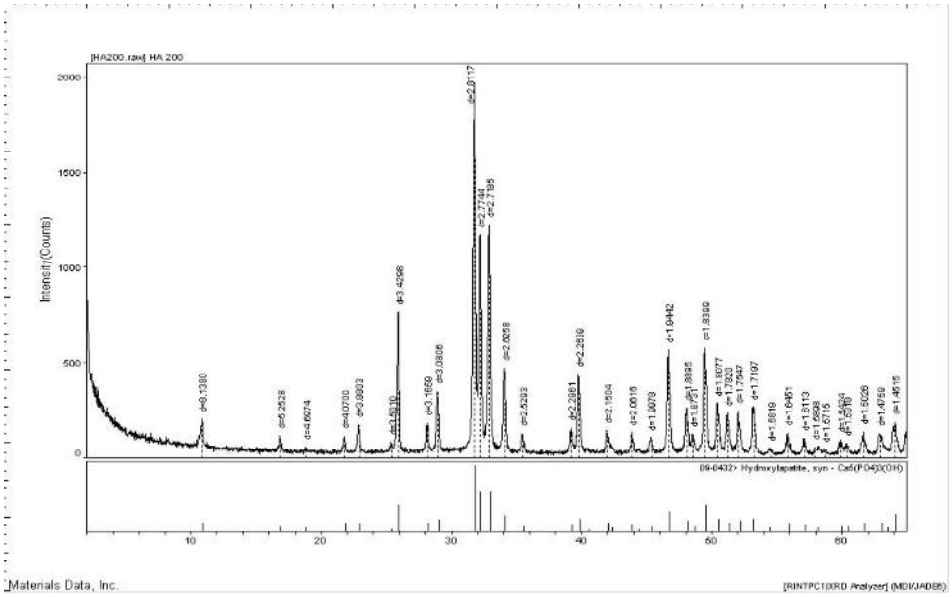

Figure 4. X-ray diffraction (HA_{200} Jepang)

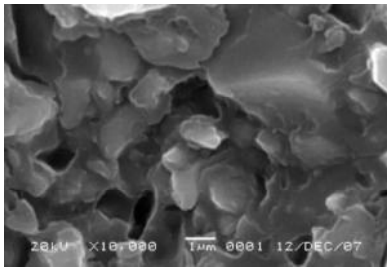

Figure 5. GIC 100% without treatment, 10.000x

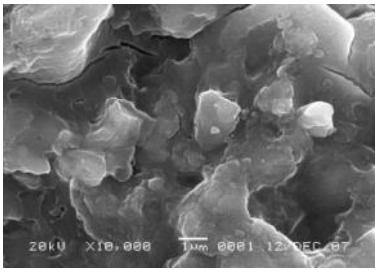

Figure 6. GIC 100% with treatment *SBF*, 10.000x

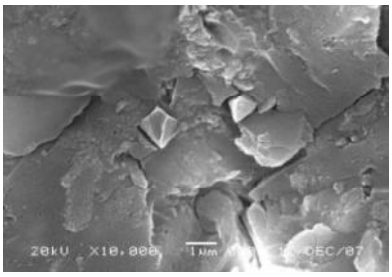

Figure 7. Biocomposites 30% HA_{200}-70% GIC without treatment, 10.000x

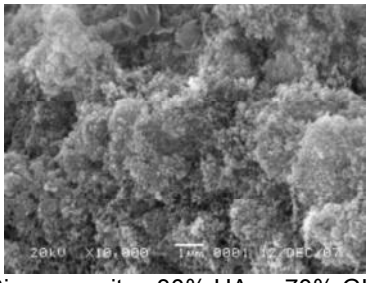

Figure 8. Biocomposites 30% HA_{200}-70% GIC with treatment *SBF*, 10.000x

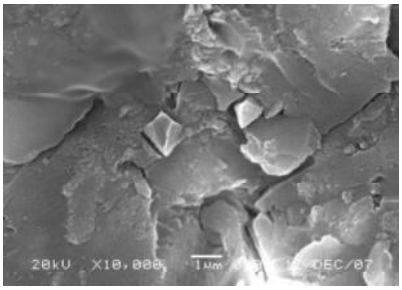

Figure 9. Biocomposite 30% HAp-70% GIC without treatment 10.000x

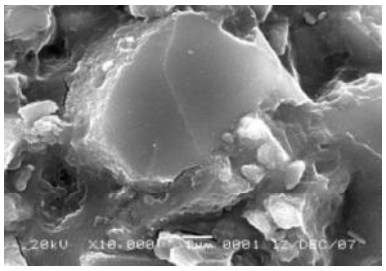

Figure 10. Biocomposite 30% HAp-70% GIC without treatment *SBF*, 10.000x

Conclusion

The graph shows that the hardness value of GIC decreased on the three compositions of 10%, 20% and 30%, but their hardness levels were not different significantly and the highest hardness value was obtained in composition of 20%. The synthesis of HAp has successfully transformed calcite into HAp which characterized by X-ray diffraction pattern at about 25,5θ° and 32,5θ° corresponding well with the database of HAp on XRD machine, there were also peaks of X-ray diffraction as a marker of calcite, at about 29.5θ°. Apatite growth can be seen from the SEM on specimens with a composition of 30%wt of GIC $_{HA200\text{-}700\%}$ after immersion in SBF for 28 Days.

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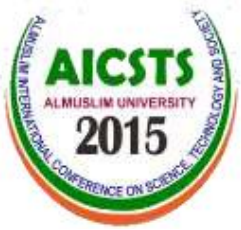
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