ISBN 978-602-19877-3-5

PROCEEDING

THE INTERNATIONAL CONFERENCE ON MATHEMATICS, SCIENCE, EDUCATION AND TECHNOLOGY

ICOMSET 2015

Education, Mathematics, Science and Technology for Human and Natural Resources

October 22, 2015

Inna Muara Hotel and Convention Center
Padang, Indonesia

Published by :
Faculty of Mathematics and Science
State University of Padang
Padang, Indonesia

Address:
Faculty of Mathematics and Science
State University of Padang
Jl. Dr. Hamka Air Tawar Padang - Sumbar

The International Conference on Mathematics, Science, Education and Technology

(ICOMSET 2015)

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Organized by

Faculty of Mathematics and Science
State University of Padang
Padang, Indonesia

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Message

from the

Rector of State University of Padang

Ladies and Gentlemen,

It give me great happiness to extend my sincere and warm welcome to the participants of the International Conference on Mathematics, Science, Education and Technology (ICOMSET 2015). On behalf of Universitas Negeri Padang, let me welcome all of you to the conference in Padang, West Sumatra Province, Indonesia.

We believe that from this scientific meeting, all participants will have time to discuss and exchange ideas, findings, creating new networking as well as strengthen the existing collaboration in the respective fields of expertise. In the century in which the information is spreading in a tremendous speed and globalization ia a trend. Universitas Negeri Padang must prepare for the hard competition that lay a head. One way to succeed is by initiating and developing collaborative work with many partners from all over the world. Through the collaboration in this conference we can improve the quality of our researches as well as teaching and learning process in mathematics, science and technology.

I would like to express my sincere appreciation to FMIPA UNP and organizing committee who have organized this event. This is a great opportunity for us to be involved in an international community. I would also like to extend my appreciation and gratitude to keynote speakers and participants of this conference for their contribution to this event.

Finally, I wish all participants get a lot of benefits at the conference. I also wish all participants can enjoy the atmosphere of the city of Padang, West Sumatra.

Thank you very much

Prof. Dr. Phil. Yanuar Kiram
Rector

Message

from the

Dean of Faculty of Mathematics and Science
State University of Padang

Rector of State University of Padang
Vice-Dean of Faculty, Mathematics and Science
Head of Department in Faculty of Mathematics and Science
Distinguished Keynote Speakers
Organizers of this conference
Dear participants
Ladies and gentlemen

I am delighted and honored to have this opportunity to welcome you to ICOMSET 2015 - the International Conference on Mathematics, Science, Education and Technology, which is hosted by Faculty of Mathematics and Science, State University of Padang.

As the Dean of Faculty of Mathematics and Science, I wish to extend a warm welcome to colleagues from the various countries and provinces. We are especially honored this year by the presence of the eminent speaker, who has graciously accepted our invitation to be here as the Keynote Speaker. To all speakers and participants, I am greatly honored and pleased to welcome you to Padang. We are indeed honored to have you here with us.

The ICOMSET organization committee and also the scientific committee have done a great work preparing our first international conference and I would like to thank them for their energy, competence and professionalism during the organization process. For sure, the success I anticipate to this conference will certainly be the result of the effective collaboration between all those committees involved.

This conference is certainly a special occasion for those who work in education, mathematics, science, technology, and other related fields. It will be an occasion to meet, to listen, to discuss, to share information and to plan for the future. Indeed, a conference is an opportunity to provide an international platform for researchers, academicians as well as industrial professionals from all over the world to present their research results. This conference also provides opportunities for the delegates to exchange new ideas and application experiences, to establish research relations and to find partners for future collaboration. Hopefully, this conference will contribute for Human and Natural Resources.

I would like to take this opportunity to express my gratitude to all delegates and sponsors for their full support, cooperation and contribution to the ICOMSET 2015. I

also wish to express my gratitude to the Organizing Committee and the Scientific Committee for their diligence. The various sponsors are also thanked for their kind support.

In closing, I realize that you are fully dedicated to the sessions that will follow, but I do hope you will also take time to enjoy fascinating Padang, with its tropical setting, friendly people and multi-cultural cuisine.

I wish the participants a very fruitful and productive meeting and with that. Finally, we respectfully request the Rector of State University of Padang to open the ICOMSET 2015 officially.

Thank you,

Faculty of Mathematics and Science
Prof. Dr. Lufri, M.S.

Message

from the

Chairman of Organizing Committee

Firstly, I would like to say welcome to Padang Indonesia. It is an honor for us to host this conference. We are very happy and proud because the participants of this conference come from many countries and many provinces in Indonesia.

Ladies and gentlemen, This conference facilitates researchers to present ideas and latest research findings that allows for discussion among fellow researchers. Events like this are very important for open collaborative research and create a wider network in conducting research.

In this conference, there are about 120 papers that will be discussed from various aspects of mathematics, science, technology, education and other related topics.

For all of us here, I would like to convey my sincere appreciation and gratitude for your participation in this conference.

Thank you very much

Drs. Hendra Syarifuddin, M.Si, Ph.D
Chairman

THE OPTIMIZATION OF CALCINATION TEMPERATURE OF *PENSI* (*CORBICULA MOLTKIANA*) SHELLS TO OBTAIN CALCITE-$CaCO_3$

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ABSTRACT

Calcite-$CaCO_3$ is one of the pioneer crystals in nonlinear optics. In this paper, we report the synthesis of calcite-$CaCO_3$ from *Pensi* shell waste by optimization of calcination temperature. Various calcination temperature of synthesis was varied to identify the optimum one. *Pensi* shell waste has been taken from the Maninjau lake, then washed and dried. The next step is sintering for 24 hours at a temperature of 105^0C to remove water content. *Pensi* shells powder then sieved using a 200 mesh sieve and conducted the calcination with the calcination temperature variation are; 300^0C, 320^0C, $340^{0\circ}$C, 360^0C, 380^0C, and 400^0C with a heating holding time for each calcination temperature is 2 hours. All samples are characterized by X-Ray Fluorescence and X-Ray Diffraction. We found that calcination temperature causes the phase of $CaCO_3$ from *pensi* shell waste changed from the aragonite to calcite associated with changes in the crystal structure of $CaCo_3$ from orthorombic to rhombohedral. Phase change of CaCO3 during calcination will be explained in detailed. The optimum value of calcination temperature is obtained at 400^0C, which at this temperature all phases of the $CaCO_3$ are calcite.

Index Terms— *Calcite-$CaCO_3$, Calcination temperature, Mollusk, Pensi shell, Phase transformation*

1. INTRODUCTION

Pensi (Corbicula moltkiana) is one of freshwater mussel that can be found in Maninjau Lake, West Sumatra. *Pensi* shell generally just be a waste that damage the environment and cause a foul smell. From the viewpoint of eco-friendly and economical disposal, *Pensi* shell is highly desirable to convert these residues into high value-added products for industrial applications.

It is known that the Pensi shell has a Ca content of about 26-30% in the raw state [1]. Corbicula shells of mollusk family from Romania are known to contain 1.83% organic material and 98.17% $CaCO_3$ with calcite and aragonite phase after heated at calcination temperature of 736^oC [2]. Comparison between the phase calcite and aragonite is 9:1. From this result is shown that families of Corbicula shells contain calcium in the form of calcium carbonate ($CaCO_3$) and calcination temperature influence on phase formed inside the shell.

Aragonite-$CaCO_3$ phase, unstable and more dense than the calcite phase. These materials can be made as a biomaterial for medical applications. Based on other research it is known that the transformation of aragonite to calcite phase occurs at temperatures 300-373˚C [3]. Similarly, Aragonite to calcite phase transformation partly occurs at temperatures 280-350˚C and fully transformed at temperatures 380-400˚C [4].

Calcination temperature influences on changes in the structure of the material. When a material is heated with a heating rate remains there will be physical changes such as phase change and increase energy which allows the atoms vibrate at a distance interatomic is greater. The changing structure of the material due to the temperature will be an increase in energy which allows the atoms vibrate at interatomic distances greater [4]. In this paper, we will describe the results of experiments that have been conducted to obtain calcite $CaCO_3$ from a synthesis of *Pensi* shell waste by optimising the calcination temperature.

2. EXPERIMENT

Materials used in this study of *Pensi* shell waste taken from the banks of the lake Maninjau. *Pensi* shell is washed with water and dried by the sun. The tools used in this study are; oven, furnace, desiccator, clamp, mortal and pestle, a sieve, a spatula, and a porcelain cup.

Pensi shell waste collected from one edge of the Maninjau lake. *Pensi* shell waste that has been collected and then washed and dried in the sun. Furthermore, *Pensi* shell, then sintering for 24 hours at a temperature of 105^0 C to remove water content. *Pensi* shell waste which has sintering then crushed using a pestle and mortal until smooth, then sieved using a sieve size of 200 mesh (75 m).

Pensi shell powder is calcined using the furnace by varying the calcination temperature of 300^0C, 320^0C, 340^0C, 360^0C, 380^0C, and 400^0C with a long holding time of each heating calcination temperature for 2 hours. This calcined sample result further characterized using XRF and XRD.

ISBN 978-602-19877-3-5

3. RESULTS AND DISCUSSION

The results of the study consisted of identifying the levels of calcium in the Pensi shells using XRF and XRD to find phase change of $CaCO_3$ in Pensi shell. The calcium content in the Pensi shell is shown in Figure 1. Quantitatively, the percentage content of the elements in the *Pensi* shell is shown in Table 1.

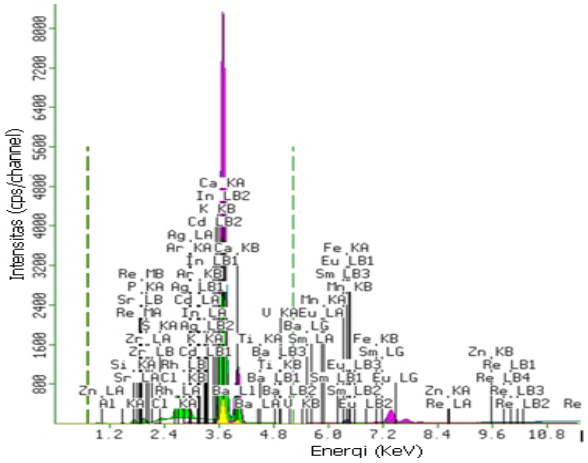

Figure 1. XRF data of *Pensi* shell

Table 1 shows that *Pensi* shells contain elements calcium with the percentage of 93.207% and there is a macro elements such as Si, Al, Ag, Mg, P, and Fe about 6% of the total weight.

Table 1. Elements contents in *Pensi* shell

Atom No.	Formula	Content (%)
20	Ca	93.207%
14	Si	2.144%
13	Al	1.322%
47	Ag	0.775%
12	Mg	0.69%
15	P	0.491%
26	Fe	0.248%

Based on Table 2, the *Pensi* shell from Maninjau lake contains calcium as the major constituent elements with levels of 93.44%, followed by other elements in small amounts, such as 1.88% Si, 1:36% Al, 0.74% Mg, 0 , 79% Ag, Fe 00:51% and 12:36% P. Pensi calcium levels in the body shell is relatively high.

Pensi belong to the species of shellfish, but differ in species. It turns out the amount of calcium (Ca) in the shell Pensi show a greater value than the level of calcium in shells. This is evident from the results of a study of shells taken in marine waters shows the calcium level of 66.70%. Pensi silica content in the shells of 1.88% lower compared to that found in the shells of 7.88% [5].

The phase of $CaCO_3$ from *Pensi* shell before calcined

XRD pattern of *Pensi* shell before calcined is shown in Figure 2. Shows that the highest peaks occur at an angle 26.20˚, 27.21˚, 33.10˚, 36.08˚, 37.85˚, and 45.83˚. These peaks corresponding to database ICDD 00-005-0453 with phase of aragonite.

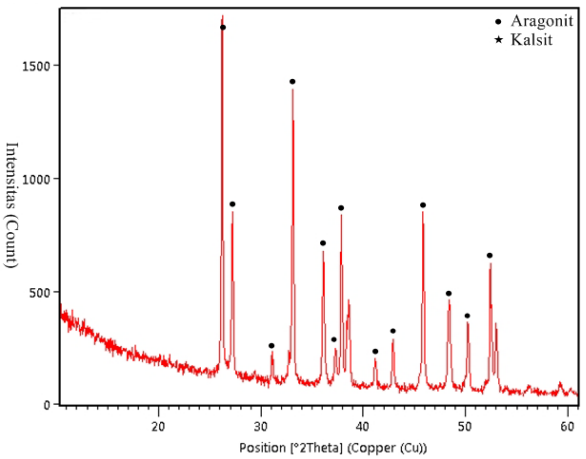

Figure 2. The XRD pattern of *Pensi* shells before calcination

Effect of temperature on phase change of $CaCO_3$ from *Pensi* shell

Figure 3 shows the calcination temperature affects the formation of phase of $CaCO_3$.

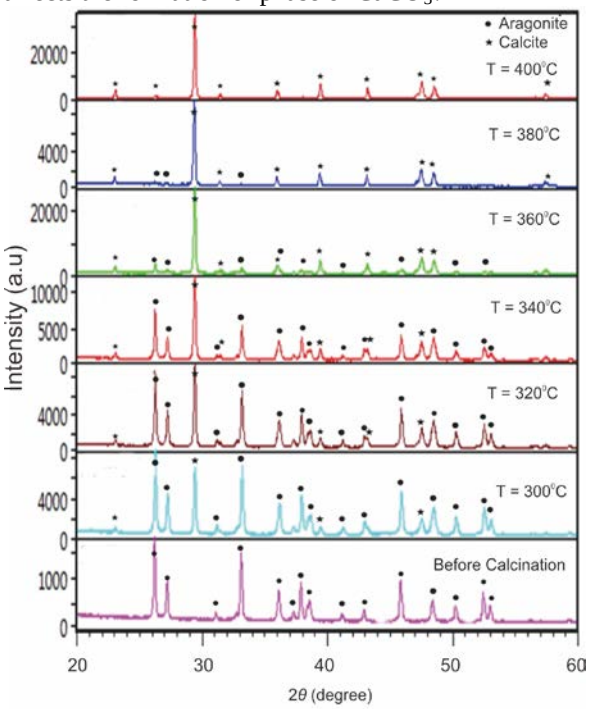

Figure 3. XRD pattern of $CaCO_3$ from *Pensi* shells before and after calcination.

If we compare the XRD pattern of *Pensi* shells after and before calcination shows that there are similarities tendency chart patterns which is the peak intensity increase with calcination temperature

ISBN 978-602-19877-3-5

increased. The percentage of calcite phase of *Pensi* shells on the calcination temperature variations is shown in Table 2.

Table 2. The percentage of calcite phase of $CaCO_3$ varied with calcination temperature.

Calcination Temperature (^{0}C)	Calcite Phase (%)	Aragonite Phase (%)
300	26	74
320	29	71
340	42	58
360	62	38
380	69	31
400	100	0

Crystal structure of $CaCO_3$ along with the phase change of aragonite to calcite causes the structure of calcium carbonate in the *Pensi* shells from orthorombic structure with lattice parameters *a, b, c* are; 4.9590Å, 7.9680Å, 5.7410Å respectively to rhombohedral structure with lattice parameters a, b , c are; 4.9880 Å, 4.9880 Å, 17.0610 Å, respectively.

Based on Figure 3, obtained that *Pensi* shell before calcination shows that contains aragonite phase. Meanwhile, in the sample with calcination temperature of 300^0C, 320^0C, 340^0C, 360^0C, and 380^0C, the phase formed is aragonite and calcite. The previous phase of aragonit turn into calcite due to thermal decomposition. This is consistent with the theory that a phase change is caused by vibration of atoms so that the core (nucleus) in the sample will merge to form a new phase. This occurs because the temperature increase causes the distance between atoms becomes larger so that affects the structure and the phase of the material.

In the sample that has been calcined at 400^0C obtained all phases in the sample are calcite. Along with increasing calcination temperature, intensity of aragonite phase decline and gradually disappear. Conversely, intensity of calcite phase increased with increasing calcination temperature. This provides information that at a calcination temperature of 300^0C starts to phase transformation of aragonite to calcite. It is also consistent with the results from another research that the aragonite phase will change to calcite at temperatures 380-470˚C [3].

Increasing calcination temperature causes the phase changes of a material. It also causes the change structure of the material. In the event of phase transformation of aragonite to calcite, there were also changes in the structure of calcium carbonate from orthorhombic to rhombohedral.

When the temperature is raised, the energy will increase, so will cause the atoms to vibrate and cause the interatomic distance is greater. It is will allow the atoms that have high energy or is above the binding energy and will move to break the bond and jump to a new position. Consequently, the number of vacancies is increasing rapidly. At high temperatures allowing foreign atoms infiltrate deeper crevices between atoms. This will cause foreign atoms bonded and stronger sticks to the material so that the crystals formed will have good characteristics [6].

The phase change of aragonite to calcite in line with the changing structure of orthorombic to rhombohedral. Here it can be seen that the aragonite phase disappears along with rising temperatures. This research obtained that calcite are dominant phase at a calcination temperature of 400^0C. In this research, we not found any vaterite phase in $CaCO_3$ from *Pensi* shell. This is consistent with research on shell Corbicula sp by Ficai et.al [2].

4. CONCLUSIONS

Based on this research shows that the calcination temperature are highly influence on phase changes and the crystal structure of calcium carbonate in the *Pensi* shells. The optimum calcination temperature to obtain calcite-$CaCO_3$ is 400^0C. At this temperature the phase of $CaCO_3$ are dominated by calcite.

5. ACKNOWLEDGEMENT

The authors would like to thank the Laboratory of Materials Physics and Biophysics, Physics Department, Universitas Negeri Padang on research facilities that have been provided.

6. REFERENCES

[1]. Khalil (2003), Analisa rendemen dan kandungan mineral cangkang pensi dan siput dari berbagai habitat air tawar di Sumatera Barat. *Jurnal Peternakan dan Lingkungan*, 09(3), pp. 35-41.

[2]. M Ficai, E Andronescu, G Voicu, D Ficai (2010), Mollusc shell/collagen composite potential biomaterial for bone substitutes. *Romanian Journal of Materials*, 40 (4), pp. 359 – 364.

[3]. A.S. Kamba, M. Ismail, T.A.T Ibrahim, Z.A.B Zakaria (2013), Synthesis and characterisation of calcium carbonate aragonite nanocrystals from cockle shell powder (Anadara granosa). *Journal of Nanomaterials*, 2013, Article ID 398357, pp. 1-9.

[4]. Y. Sayoko, Y. Kitano (1985), Transformation of aragonite to calcite through heating, *Geochemical Journal*, 4, pp. 245-249.

[5]. A. Kurniawan, M. Nizar, M. Rijal, R. Bagas, W. Setyarsih (2014) Studi pengaruh variasi suhu kalsinasi terhadap kekerasan bentuk morfologi dan analisis porositas nanokomposit CaO/SiO_2 untuk aplikasi bahan biomaterial. *Jurnal Pendidikan Fisika dan Aplikasinya* (JPFA), 4 (2), pp. 22-26.

[6]. *R.E Smallman, R.J. Bishop (1999). Modern physical metallurgy and materials engineering 6th Edition , Elsevier, London.*

ISBN 978-602-19877-3-5