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Characterization and Application of Dolomite Rock in Perlis

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Abstract

Dolomite which is known by the local as ‘batu reput’, is a primary sediment mineral and abundantly found in Perlis. Perlis is one of the major producers of dolomite in Malaysia that contain large deposit of high-purity dolomite [$CaMg(CO_3)_2$]. Pure samples of dolomite recently explored in the Koperasi Rimba Mas Padang Besar Quarry were investigated for their physical, chemical and mineralogical composition. The dolomite, was also thermally treated up to 800ºC to decompose the carbonate bonding. SEM with EDS (Energy Dispersive Spectroscopy), XRF and XRD analysis method were applied in this study.

Keywords: Materials-Dolomite-SEM-XRD-XRF.

1.0 Introduction

Generally, dolomite is a kind of primary sediment mineral and has a widespread geologic distribution [1]. The mineral dolomite derives its name from Deodat Dolomieu (1750-1801), named after a French Engineer and mineralogist. Dolomieu first described the rock now called dolomite in 1791 and described its occurrence in nature [2, 3]. In this study, two types of dolomites were used, that is Perlis dolomite and Ipoh dolomite. Perlis dolomite is locally known as ‘batu reput’ in Perlis, while Ipoh dolomite is a dolomitic limestone found in Ipoh area. Order to enhance the properties and usage of Perlis dolomite the two types of dolomies are compared.

In Perlis, dolomite has been used as a main substance in making roads before it is paved. Besides limestones Perlis dolomite is also produced for this state. Dolomite can reduce the industrial cost of road making. However, the usa is still in minimal. The main objective of this study is to explore the potentials of Perlis dolomite by identifying its nature.

XRD method was used to analyze the structure of dolomites qualitatively the effect of high temperature on both samples are determined. The results were interpreted in the form of peak intensity.

2.0 Materials & Method

The materials studied were Perlis Dolomite supplied by Ipoh Dolomit and Ipoh Dolomite supplied by Ipoh Seramik Sdn Bhd, respectively. The samples were crushed into powder and then sieved to 200 meshes for XRD, XRF and SEM studies purpose. The period of operation

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for this equipment was one and half hours. Perlis dolomite was prepared via heating process at 800°C, 900°C and 1000°C while Ipoh dolomite was fired up only at 800°C.

XRD experiments were performed by SHIMADZU XRD6000 diffractometer with Cu Kά. The experimental conditions were as follows: 45 kV, 30 mA, divergent beam slits 2 and 3 mm, receiving slits 1 and 0.2 mm, 2θ = 5-70°C, and continuous scan with a scan rate of 2°C/min.

SEM experiments were done using light scanning microscope, SEM JEOL model JSM-6460LA, to study the morphology of crack samples and circumstance of sample surfaces. SEM constructs the images as dots called pixels using electron instead of light to produce the image. Using a tiny detector electron through the whole specimen surface, it emitted varied signals that are proportional to the amount of radiation. These dots are joint together quickly so that the image of every dots becoming a line, which is moving fast under the screen to be seen as a proper image by harsh eyes. This image is wholly recorded by letting the dot information rebuild consecutively on photographic film. The microstructure images of dolomite together with chemical compositions were acquired simultaneously by SEM-EDS.

Both dolomite samples were also analyzed using x-ray fluorescent (XRF) to determine the chemical composition and identify the element and substance absent in the samples. XRF is able to analyzed sample graded up to 100 ppm. This equipment can also identify boron element (5B) to uranium element (92U). For sample preparation, 0.6 g of samples were grounded to 75 μm, added with 6.0 g flux in platinum crucible and heated in metal blend. Glass bits produced by the heating process were analyzed.

3.0 Results and Discussion

3.1 XRD Analysis

(i) Perlis Dolomite

Figure 1 represents XRD patterns of the unheated and three varied temperature heated samples for Perlis dolomite. Neither the peak intensity nor the peak position of dolomite has altered before and after 800°C. This indicates that the unit cell of dolomite is still intact after the heating process at 800°C which proved that Perlis dolomite has a very stable structure. The structure begins to change after heating to 900°C. At 1000°C, the trigonal-rombohedral cristal system and R3 of space group of dolomite were modified to be face centered-cubic and Fm-3m.

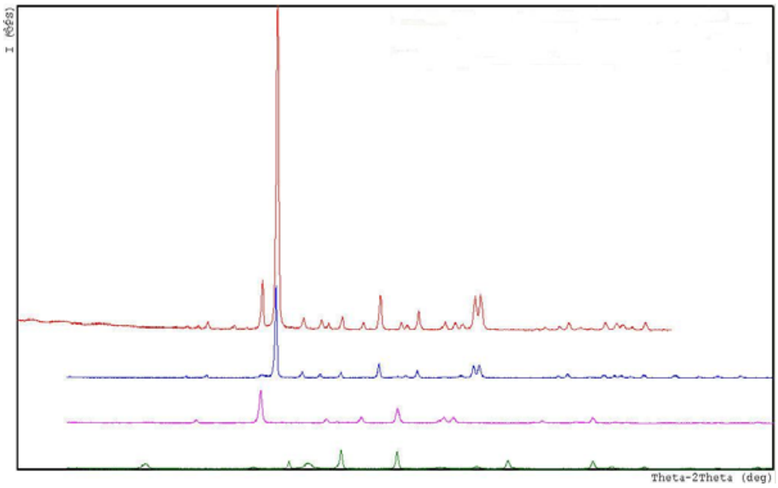

Figure 1 The XRD pattern for Perlis Dolomite before and after being heated at 800°C, 900°C, and 1000°C.

(ii) Ipoh Dolomite

The XRD pattern (Figure 2) for unheated and heated Ipoh dolomite shows few changes. The R3 space group of dolomite was altered to be R3C, resulted by distortion of the lattice planes. This affects the chemical activity of dolomite particles. Hence, leads to the mechanochemical changes.

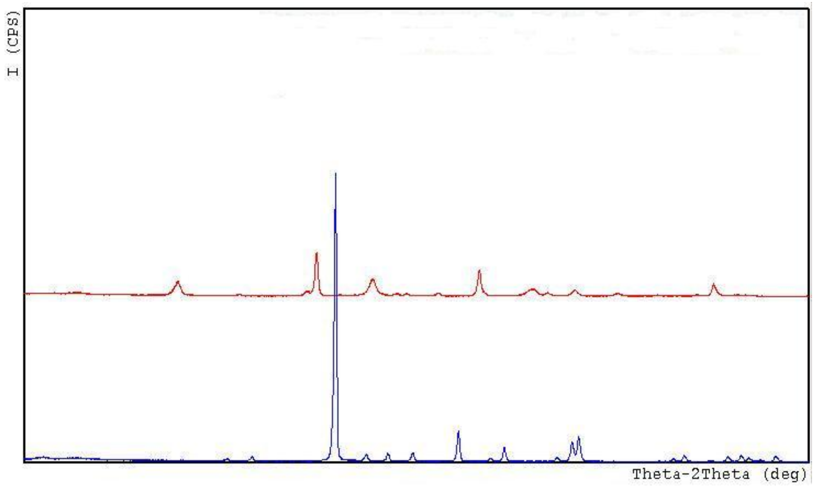

Figure 2 The XRD pattern for Ipoh Dolomite before and after being heated at 800°C.
(b) Results Comparison between Perlis Dolomite and Ipoh Dolomite

The XRD pattern for Perlis dolomite and Ipoh dolomite before heating shows an almost similar. This result is in agreement with the previous study by M. Samtani et.al [4] that the dolomite samples have almost the same properties as the other dolomite. Through XRD analysis in Figure 3, results obtained indicated that peak intensities for both samples heated at 800°C were quite different. Ipoh dolomite heated at 800°C undergoes little changes of space group from R3 to R3C. This happen as the atom bonds were unstable compared to Perlis dolomite. For that reason, the Ipoh dolomite atoms have the tendency to slip and strained, giving changes in the structures.

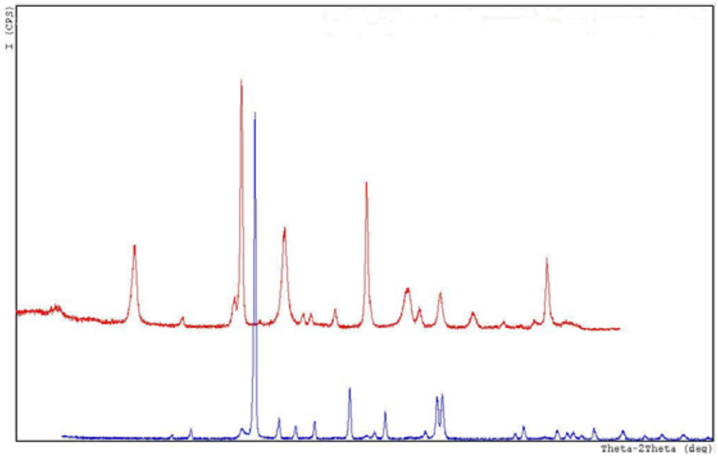

Figure 3 The XRD pattern for Perlis Dolomite and Ipoh Dolomite heated at 800°C.

3.2 SEM Analysis

Perlis Dolomite heated up to 800°C shows high percentage of CaO and MgO as shown in Table 1 and Figure 4. Three usual elements were traced that are Ca, Mg, and O with highest concentrations. Si element also absent with the lowest concentration. The elements changes slightly with the heating process.

Table 1 Chemical compositions in Perlis Dolomite heated at 800 °C.

Content	Compositon Percentage (%)
CaO	70.91
MgO	16.80
SiO_2	2.19
Al_2O_3	4.43

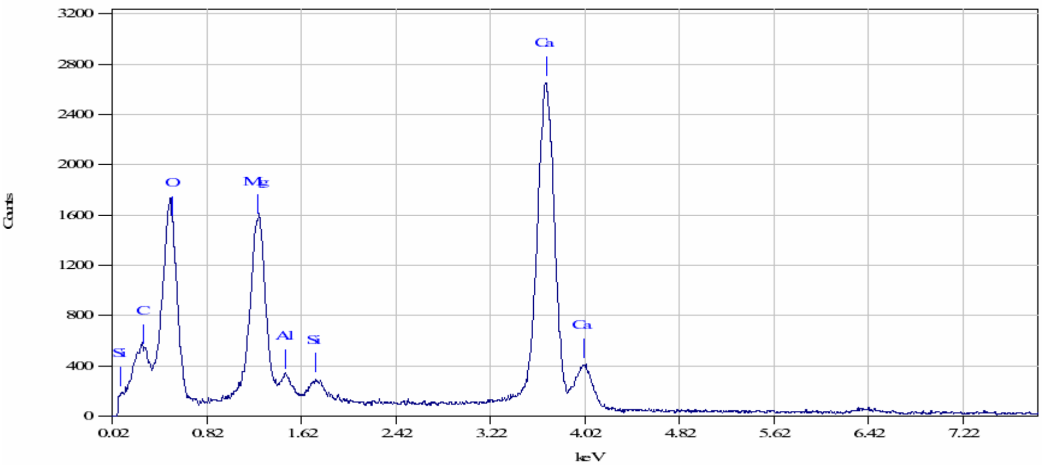

Figure 4 Quantitative analysis of Perlis Dolomite heated at 800°C.

Analysis on heated Ipoh Dolomite showed that CaO content is increased, while MgO is decreased in so much degree. This happen because of MgO content in Ipoh Dolomite was decomposed after being heated at 800°C. The finding clarify that Ipoh Dolomite has less stability compared to Perlis Dolomite especially after heating process.

Table 2 Chemical compositions in Ipoh Dolomite heated at 800°C.

Content	**Compositon Percentage (%)**
CaO	70.91
MgO	16.80
SiO_2	2.19
Al_2O_3	4.43

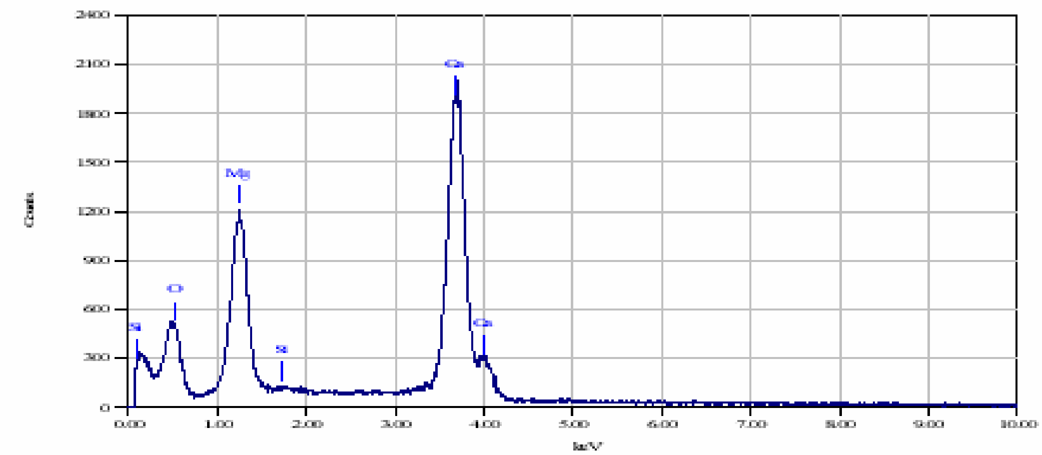

Figure 5 Quantitative analysis of Ipoh Dolomite heated at 800°C.

3.3 XRF Analysis

Based on XRF analysis, the main element of Perlis Dolomite consists of 31-32 % of CaO and 23 % of MgO (Table 3). Also, it was found that MgO content is more than 20 %. Thus, it is assumed as pure dolomite. For Ipoh Dolomite, the chemical composition is not much different to Perlis Dolomite. There were 30.0 % of CaO and 21.0 % of MgO. There were also other elements such as Al_2O_3, SiO_2, Fe_2O_3, and LOI, with the contents less than 0.01 %.

Table 3 Comparison of chemical composition between Ipoh Dolomite and Perlis Dolomite

Contents	Chemical Composition	
	Ipoh Dolomite	Perlis Dolomite
SiO_2	0.42	0.08
Al_2O_3	0.28	0.08
Fe_2O_3	0.46	0.06
MgO	21.0	23.7
CaO	30.0	31.5
LOI	48	46.2

4.0 Conclusion

Perlis Dolomite is more stable compared to Ipoh Dolomite. XRD and SEM analysis shows that the structure remains intact even after being heated at 900^{o}C, before it begins to show significant changes. Therefore, the quality of Perlis dolomite is better compared to Ipoh Dolomit. Further studies should be done in future to evaluate its other properties that extent its application of fields.

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