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CHARACTERISTICS OF MINERAL CONTENTS AND ELEMENTS COMPOSING BASALT ROCK FOR HOT STONE MASSAGE

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Abstract

This research seeks to accomplish two objectives: first, to identify the mineral makeup and elements that comprise basalt rock used for hot stone massage, and second, to determine the physical characteristics of the basalt rock employed for this purpose. Currently, basalt rock is not utilized in Indonesia for hot stone massage, and the mineral content and elements that make up this rock remain unknown. Consequently, it is crucial to determine the mineral makeup and physical characteristics of basalt rock used for hot-stone massage. This study employed experimental laboratory research methods using an observation technique to gather data. The samples were analyzed using an experimental approach at the Quality Control Laboratory, using XRD and XRF instruments to determine the mineral content and elements that make up basalt rock for hot stone massage. The results of this research reveal that the mineral contents and elements that make up basalt rock for hot stone massage include oxide compounds, such as SiO2, Al2O3, Fe2O3, K2O, MgO, and Na2O. Additionally, the physical characteristics of basalt rock, including its dark color, fine-grained texture, and igneous origin, make it suitable for use in hot-stone massage. Furthermore, basalt rock is advantageous to human health.

Keywords: *mineral content, elemental composition, basalt stone, hot stone massage.*

Introduction

Spa is one of the treatments used to keep the body, mind, and soul healthy at its maximum. The essence of spa treatment is to gain peace for the mind, body, and soul maximally. Spa treatment can be performed using various methods. One of these is hot stone. Hot stone massage is a hydrotherapy treatment that uses stones. The use of this stone requires deep relaxation and healing (Potter, Stacey. 2018). Hydrotherapy involves the use of water to treat various mental and physical disorders (Anastasia, 2019).

Hot stone massage spas are a spa treatment. It is available in Indonesia, and spa lovers have begun to like it. Heat from the stone can warm the skin, and it helps to absorb spa cosmetics, so that the body muscles relax. This enabled the therapist to reach a deeper layer to reduce fatigue. Massage therapy with hot stones is performed by placing heated

stones in certain body positions along the backbone, chest, face, palm, leg, and toes (Ramova, 2021). Hot stone spas are a non-pharmacological therapy for overcoming back pain (Hayati & Devi, 2020). Pain can be felt throughout the backbone, from the neck to the lower back (Erry 2016).

People start experiencing pain when they are 25 – 65 years old and in their productive years. The pain comes up when someone reaches 25 years old, and there will be more complaints as someone gets older (Kusumaningrum et. Al. 2021). Hot stone therapy also reduces the effect of pain when performing activities if applied for two weeks (Freiwald et. Al., 2021). Therapy with hot stone spas can be used as a pain reliever and can result in better sleep quality (Ghavami, 2016). The rock used for the hot stone spa is igneous rock. The mineral contents and elements composing the stones that are frequently used for hot stone massage are not yet known. A hot stone spa is part of the material of a spa's body. Hot stone materials are learned as a course of body healthcare. The hot stone spa is a course material that discusses how to treat the body healthily. This course provides theoretical and practical perspectives. The courses of the Bachelor of Applied Science in the Make Up and Beauty Department consist of normative, adaptive, and productive subjects. Hot Stone Spa is part of productive subjects since it is skil-oriented. The course of hot stoe spas is a subject of natural therapy using the stone-heating method. Stones were placed in the client's body (Yuliansah, 2019). In this course, students must master how to choose equipment, materials, cosmetics, and treatment from head to toe. This course is expected to equip students with competence and skills in body treatment, especially in hot stone spas. Some basic competencies of Spa and Body Treatment as a course are: (1) understanding the basic concept and history of spa, (2) understanding the therapy and various spa equipment, (3) being able to mention and define equipment, material, linen, and cosmetics in spa; (4) possessing competence and skill in body treatment (spa); and (5) possessing competence and skills on the principal of Occupational Safety, essential oil, and touch therapy.

Hot stone massage is a treatment for stones. The aim is to relax and treat the body. Heat from the stone can warm up the skin and help to absorb cosmetics, so the body relaxes and the therapist does not get too tired when massaging (Heriwaseso et. Al., (2015). The techniques for Hot Stone Spa Treatment include: 1) preparation for equipment: massage oil, burner, big and small towels, cuvette; and 2) refreshment: take two small stones (one hot, one cold), massage the client's chest, and replace the hot stone with a cool stone a few times. Wash the stone for the next use; 3) prepare for treatment: soak the stones in a cuvette, heat the stones for 40-45ºC, cool the other stones with ice, place and arrange the heated stones, and then dry them on the client's back. Ensure that the stones are not too hot and place them on a mat.

Based on the interviews conducted by the researchers with lecturers of the Body Spa Treatment course, it was found that the students practiced the hot stone spa using only the available equipment. This is because of the limited number of stones and their high cost. Still, the stones are bought from abroad, and their contents are still unknown. Interviews with students also emphasized this. They stated that they were in turn with others when they used hot stones. This leads to ineffective learning.

The existing problems were analyzed. Therefore, solutions to overcome these issues are required. Therefore, researchers sought to make basalt rock a hot stone. As Indonesia is rich in rocks, it is not necessary to buy rocks from abroad, and students do not need to be in turn for hot stones. Creating spa hot stones can increase creativity and innovation. It can also enforce and support facilities and infrastructure in laboratories.

Based on the Indonesian geology map, basalt rocks are igneous rocks that are spread throughout Indonesia (Isnugroho et. Al., 2018). Rocks and minerals are easily accessible because Indonesia has numerous volcanoes (Faisal et. al. 2014). Metallic and non-metallic minerals of stones are widespread in many places in Indonesia (Birawidha et al., 2021). Basalt is an igneous rock that is alkaline in nature. It is formed by lava that rapidly cools and consists of volcanic glass (Birawidha et al., 2021). Basalt has been used to replace glass (Hendronursito et al., 2020). Basalt is widespread in many places, but it is not maximally utilized as an advanced material. It is mostly used as building material (Kumbhar et al., 2014). The technology for the utilization of basalt has been growing. Basalt is an advanced mineral. It is used for basalt casts and basalt fibers (Pavlović et al., 2015). Basalt products are used for insulating highly heated pipes, fillers, and fire-resistant products (Saito, 2013).

Basalt rocks are formed when volcanic lava reaches the Earth's surface. As lava reaches the surface, it quickly cools down and some weeks later becomes solid rock. These solid rocks result from crystallized and solidified melting lava. Some rocks resulted from this: granite, rhyolite, andesite, and balanite. The resulting type of rock depends on the composition of the chemical lava, temperature, solidification, and cooling process during crystallization.

The basalt rock is dark gray. It has a low-middle erosion rate and a massive structure. The porphyritic texture was characteristic. This can be clearly seen in the phenocryst plagioclase and pyroxene on the groundmass of the volcanic glass. The main characteristic of the main minerals of andesite rocks is that their textures range from aphyric-glass to porphyritic-aphanitic holocrystalline. Basalt minerals are formed because they are affected by the lava freezing process, and chemical processes occur where basalt is found (Ghavami et al., 2016). Basalt rocks have very tiny grains, so the minerals appear invisible (Putriana, 2015). The basalt rocks are massive and hard. They have an aphanitic texture, and their mineral contents consist of volcanic glass, plagioclase, pyroxene, amphibole, and black minerals. The mineral content is quartz grains in size and weigh 2.70 grams (K and Tare, 2015). One of the most common tests to find out the quality of stones is uniaxial press test (SNI 03-2825-2008). The use of stone is related to its physical properties. SNI No.03- 0394-1989 is commonly applied to determine the physical and mechanical characteristics of stones. The mineral content affected the strength of the stones. The texture of the stone was determined by the size of the mineral grain vesicles.

Chemical compositions are very basic characteristics of mineral because mineral

or the crystal depends on them. The characteristics of minerals depend not only on the space structure of the composing atom, but also on the bonds between atoms composing the mineral or atom. The power that binds the atoms (or ions or a group of ions) of the crystal is naturally electric. Its type and intensity are strongly related to the physical and chemical characteristics of minerals. The hardness, fraction, decentration, electricity, thermal conductivity, and thermal expansion coefficient are directly related to the binding power. Mineral chemistry emerged in the early 19th century after Proust presented the Law of Constant Composition in 1799, Dalton's Atomic Theory in 1805, and the development of an accurate quantitative chemical analysis method. As the chemistry of minerals is based on the knowledge of mineral composition, a probable and limited analysis of the chemistry of minerals must be performed. The chemical principles related to the chemistry of minerals are: 1. Proust's Law of Constant Composition (1799), which states that the comparison of mass elements of every compound is constant; 2. Dalton's Atomic Theory (1805): All matter is comprised of tiny ball-like shapes, which are called atoms of

identical elements and identical properties. Meanwhile, atoms of different elements contain different masses. However, atoms can chemically bind to the forming molecules.

Names of minerals can be determined by comparing the physical characteristics

between them. The physical characteristics include color, lustre, hardness, streak, cleavage, fracture, structure or crystal formation, weight, tenacity, and magnetic level. Basalt rocks can be used for many purposes if their mineral contents and the metallic elements composing them are known. The information on elements contained in a mineral can be found using X-Ray Fluorescence (XRF) and Fourier Transform Infrared (FTIR) spectroscopy (Ratna, 2015). The results of characterization of XRD were used to identify the specific functions of a mineral compound (Raymond and Loren, 2015). Therefore, this study aims at the following:

finding out the mineral content and elements composing basalt rocks for hot stone massage; b. finding out physical characteristics of basalt for hot stone massage. Based on this problem, researchers are willing to study the mineral contents and elements that compose basalt rocks for hot stone massage. Therefore, the researchers titled Characteristics of mineral contents and elements composing basalt rock used for hot stone massage.

Research Method

This research was conducted in an experimental laboratory. Experimental research is the most reliable (the most valid) scientific research because it is conducted by strictly controlling the disturbance variables from what is not experimented (Muhtarom et al., 2015). There are techniques for collecting data; one method for data collection is observation. The observation method was conducted by direct observation at the locations where the samples were taken and in the laboratory where the samples were processed. b. the method for analysing the samples is experimental method. This study was conducted at the Quality Control laboratory using XRD and XRF instruments.

Instruments are equipment or facilities used in research when collecting data, so the analysis is conducted more easily and the results are accurate, complete, systematic, and easy to process (Borg & Gall, 2013). The instrument used in this study was an observation sheet.

The observation sheet contains the introduction, which is the proposal to the panelists, and organoleptic scores of: (1) information elements, which are panelists' names and research date, (2). Instruction elements, which are requests of the panelist on how to fill the observation briefly. The observed aspects in this research were the sample mass before refinery, mass after refinery, chemical composition of basalt rocks based on XRF test results, and chemical composition of basalt rocks based on XRD test results. The data obtained from the XRF and XRD tests were later placed on a table to be analyzed and evaluated descriptively. A descriptive analysis was conducted to identify the presence of dependent variables, both on single and multiple variables, without comparing or finding similarities between variables (Arikunto, 2019).

In this research, the sizes of basalt rocks are turned according to the sizes of hot

stones. The dimensions used were 8 × 8 × 2, 6 × 8 × 2, and 3 × 4. The basalt flakes were refined again to basalt powder. The flakes were tested in the laboratory using XRF and XRD. Duplicates of hot stones made from basalt rock will be tested by students who have already taken the Spa Asia course. In this research, some procedures were made as references to collect data. The steps are:

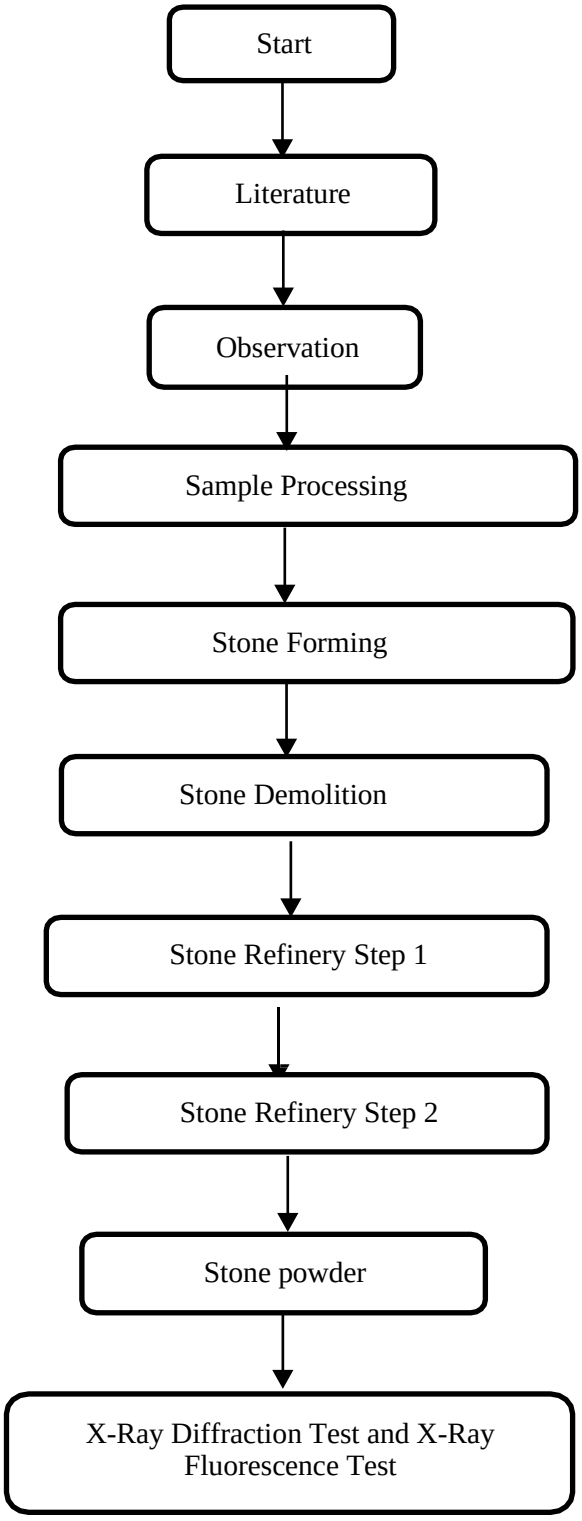

Figure 3.1 The Process of X-Ray Diffraction and X-Ray Fluorescence Tests of Basal Rock Samples

Research Findings

Sample Findings

This research aims to determine the characteristics of the mineral contents and elements that compose basalt rocks used for hot stone massage. Below is a sample of the basalt rock.

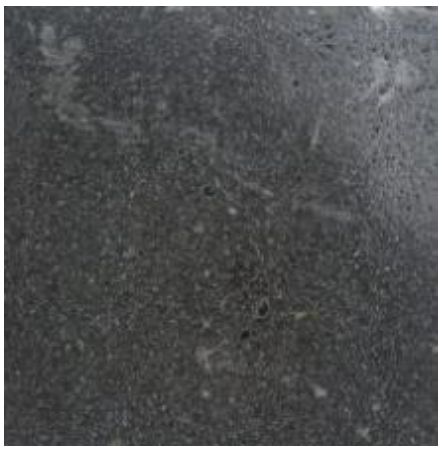

Figure 1: sample of basalt rock

The sample, as seen in Figure 1, was later prepared as stone powder. The results are shown in Figure 2. The results of this preparation were continued by analyzing the XRD and XRF characteristics to analyze the mineral contents and elements that compose the basalt rock.

Figure 2: preparing samples to be turned into stone powder

Characteristics of Basalt Rock

The results of XRF tests are presented in Table 1. This table shows that the basalt powder contained 80.116% SiO2, Al2O3, and Fe2O3. This means that basalt rock meets the chemical requirements for use as a health equipment. The minimum requirement for the SiO2 + Al2O3 + Fe2O3 content was 70%. The total amounts of SiO2, Al2O3, and Fe2O3 were greater than 50%. Therefore, it can be used as health equipment.

The results of the basalt powder sample test using XRD equipment are shown in Table 3. The XRD results indicated that the basalt powder consisted of common phases

comprising elements and compounds, such as calcium, silica, alumina, iron oxide, and magnesium. This was proven by the XRF test of the basalt samples.

Table 1 Results of Basalt XRF test

N0	Chemical Composition of Basalt Rock	Health Benefit
1	SiO^2	Improve and sustain positive energy
2	Al^2O^3	Enable the energy and the body system work at maximum Membuat energi sistem kerja tubuh tubuh optimal.
3	Fe^2O^3	Eliminate Insomnia
4	K^2O	Create positive energy
5	MgO	Keep warmth
6	Na^2O	Enable the energy that controls body strength to work normally, so the body system can work normally as well

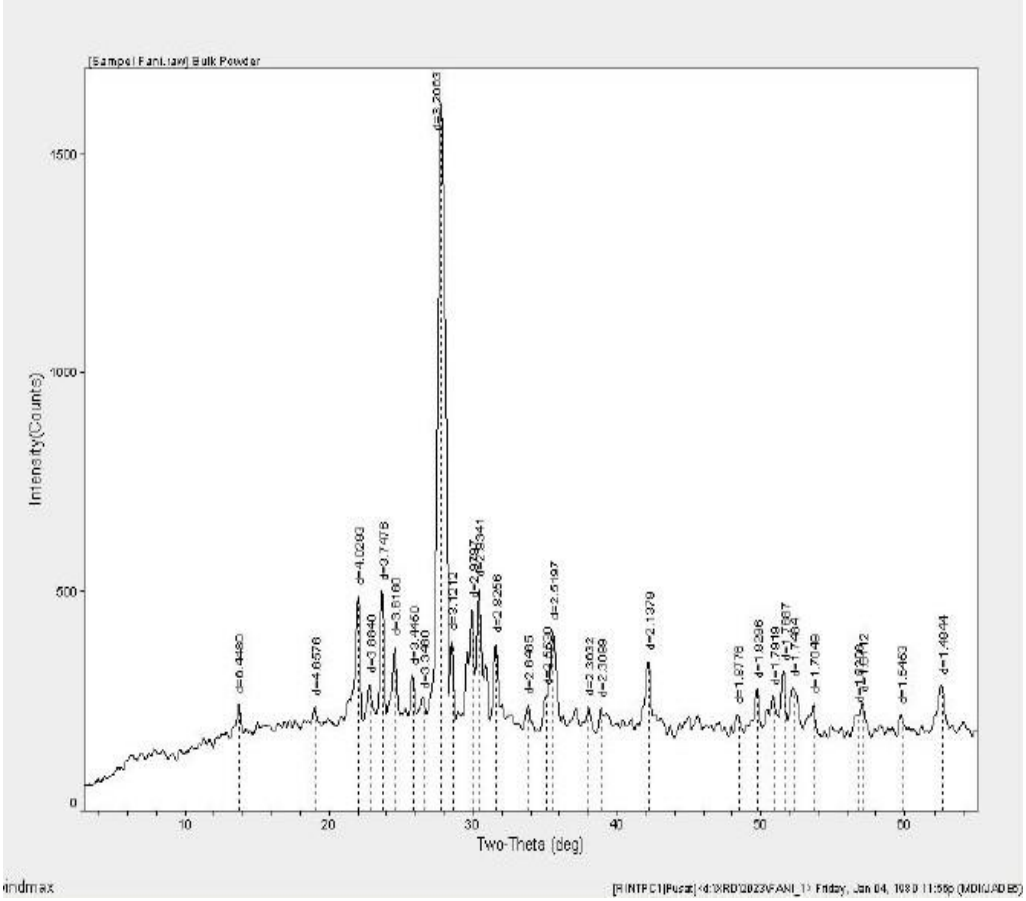

Figure 3. XRD Test results of basalt powder Shapes and Sizes of Basalt Hot Stones

A hot stone spa is a massage therapy that uses a hot stone. It aims to loosen the tense muscle, help relax, and heal the soft tissues of the injured body. Massage was performed

using soft, flat, and heated stones. These stones are placed in certain body parts such as the stomach, chest, face, palm, back, leg, and toe. The sizes and shapes of the stones varied. However, 8 × 8 × 2, 6 × 8 × 2, and 3 × 4 pixels were the most frequently used. Here, are the shapes and sizes of hot stones made from basalt rock.

Table 2 Shapes and Sizes of Hot Stone for Spa

Size	Shape	Basalt Hot stone	Position
8x8x2			back
6x8x2			back arm calf
3x4			toes fingers

Temperature of Stone

The stones for massage were placed on the client's body, both directly on the skin and covered by a towel. Mihina (2010: 81) outlines the ideally safe temperature of stones in hot stone reflexion for human's skin. Looking at the following table:

Table 3 Stone Temperature for Relaxation

Temperature of Relaxation Stone		
Applications	Temperature (F)	Temperature (C)
Hot stone	100- 104	32-40
Warm stone	92- 100	33,3- 40

There is also another opinion on an ideally safe temperature for the human skin (Sugiyono, 2019).

See the table below:

Table 4 Hot Stone Temperature

Level	Temperature	Temperature
Warm	96- 98	33.5 – 36.0
Hot	98-104	36.5 – 40.0
Very Hot	104- 115	40.0 – 46.0

Basalt rock can maintain sensible heat. There are several advantages of using basalt rock: (1) it has abundant sources and is economical, (2) it is applicable for some levels of temperature, (3) the heat directly moves inside the heat storage, (4) the quality does not decrease, (5) it is safe to use, and (6) it is non-corrosive. Table 1 shows the materials for storing heat from various studies with various types compatible with heat-storing systems. According to Ridwan (2022:5), basalt can be used to replace hot stone when it is at 40 °C for 40 min to maintain the heat. After the temperature is measured, the material and media expert validates whether the product is feasible. Subsequently, users tested the product. The users are course lecturers and students. A test was conducted to determine the power of the hot basalt stone to maintain heat. Here they are:

a. Material validation consists of the texture, shape, size, and benefits of hot basalt stone. The average score from the assessment of material experts resulted in 3.62 score (feasible to use).
b. Media validation consisted of feasibility aspects, presentation aspects, and a review of the use of basalt stone. The average score from the assessment of media experts resulted in 3.66 score (feasible to use).
c. User testing consists of feasibility, benefits, presentation, rock aspects, and a review on using basalt stone. The average score from the assessment of user testing results was 89.32 score (worthy of use).

Discussion

The analyzed stones were surface samples of basalt rocka that were refined into powder. The samples were processed and analyzed at the X-Ray Laboratorium to determine the mineral contents and their elements. Xray Diffraction was used to find out the mineral contents of the basalt samples. X-Ray Fluorescence (XRF) was used to determine the elemental or oxide contents.

The physical characteristics of the basalt were determined by direct observation of the basalt rock samples. The basalt rocks are dark, fine-grained, and igneous. They were mainly composed of plagioclase and pyroxene minerals. These stones were mostly formed as extrusive rocks (lava flows). Basalt rocks have a composition similar to that of gabbrostone. The size of the mineral grains becomes distinct. The basalt stone has finer grains. The gabbrostone has coarser grains. Basalt belongs to igenous rock. Igneous rocks were formed by liquid silica and magma. Currently, most basalt rocks are lava. Basalt stones are mostly found on the earth's surface in the form of sheets. It spreads so widely. In fact, it can spread up to 200000 miles^2 with a maximum width of 6000 feet, such as volcanic lava in Indonesia. Basalt rocks have fine-grained, massive-grain, and vesicular structures. A massive structure indicated a similar stone mass. Meanwhile, the vesicular structure shows paralel holes formed by gas discharge during the freezing process.

The characterization of the elemental contents of basalt rocks using XRF revealed that the oxides of basalt rocks were SiO^2, Al^2O^3, Fe^2O^3, K^2O,MgO, and Na^2O. XRD analysis using search-match software revealed that the minerals contained in the basalt stones were SiO^2, Ai^2O^3, Fe^2O^3, K^2O,MgO, and Na^2O.

The samples were processed by pressing them using a press ring. Subsequently, they were analyzed using the OXSAS software. The mineral content of the samples was SiO^2, Al^2O^3, Fe^2O^3, K^2O,MgO, and Na^2O. The XRD and XRF results were analyzed using the powder method. However, this caused some major and minor minerals to be detected by the software. However, some minerals were not detected because the data from the search match software were processed manually. Therefore, user mistakes occurred when they

used the software. Using these two methods, it was found that the results of XRF characterization were much more accurate than those of XRD. This is because of the different software and specifications of the equipment used.

The sizes and shapes of the stones varied. However, the most frequently used were 8 × 8 × 2, 6 × 8 × 2, and 3 × 4. The stones were placed in certain body positions. The hot stones were positioned on the stomach, chest, face, palm, back, legs, and toes. Validations by materials and experts showed that the stones were feasible for use. Based on user testing, basalt stone is worthy of use. Therefore, basalt stone can be used to replace spa hot stone because it has the same shape, size, and function as spa hot stone.

Conclusion

The Mineral Contents and Elements Composing basalt stones for use in hot stone massage were SiO^2, Ai^2O^3, Fe^2O^3, K^2O,MgO, and Na^2O oxides. The physical characteristics of Basalt is dark, fine-grained, and igneous rock, which can be used as an alternative to hot stone massage. Its mineral content is beneficial to health.

Suggestion

Other researchers have the opportunity to study other stones as well.

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