

Usability of Obsidian With Special Refraction as an Ornamental Stone by Bonding With Epoxy Resin

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Abstract: Ornamental stones have been used quite a lot from past to present, and they are produced both naturally and synthetically in terms of visuality, durability and rarity. Naturally used ornamental stones are divided into two different classes as precious and semi-precious, and obsidian with two different colors belonging to the Nemrut volcanics used in the study is classified as semi-precious stones. Obsidian is a volcanic glass, showing a special fracture (conchoidal) and fracture surfaces give the rock a distinctive shine. In this study, obsidian was classified by breaking in different sizes (8-4.75 mm, 4.75-2 mm and 2-0.6 mm) in order to achieve this brightness. While black obsidian shards were obtained from 4.75-2 mm in size, brown obsidian shards were obtained from 2-0.6 mm shards and chose with the help of tweezers. Obsidian fragments with both colors were bonded with epoxy resin mixed at a ratio of 2:1 (epoxy and hardener) and placed in jewelry apparatus. The known durability properties and gloss of epoxy and the gloss on the broken surfaces of obsidian have been highlighted, and it has been observed that obsidian which has been used with different cutting and polishing techniques until now, can be obtained as a new product by using binder material. It is suitable to be used as an ornamental stone in jewelry making as a result of binding the obsidian fragments with epoxy by making use of the shines that occur on the fractured surfaces of the obsidian. In addition, it has been revealed that new products can be obtained as a result of bonding many natural rocks and minerals by using different binding materials.

Keywords: Ornamental Stone, Obsidian, Conchoidal Fracture, Epoxy, Jewelry

INTRODUCTION

People have always preferred naturalness from the past to the present, and since the first natural materials that people encounter are stones and minerals, these geomaterials have always taken place in people's daily lives. Ornamental stones (precious and semi-precious) have been cut in different ways processed with various methods, and polished as a result of increasing their visuality making them attractive to people and used as a status determinant throughout human history [1]. Diamond, emerald, ruby, kemeterite, uvarovite and obsidian such as Materials can be counted among various ornamental stones (or minerals) [2].

Obsidian, which is among the semi-precious stones, is an amorphous, glassy feature that does not have a certain crystal structure, naturally consisting of approximately 70% silicon as a result of the rapid cooling of volcanic lavas, and is a conchoidal (mussel shell) observed in glass and glassy materials shows fracture. As an ornamental stone, obsidian has a hardness of 5 (Mohs hardness scale) [3],

and is highly resistant to external effects and abrasion, both physically and chemically. In order for the mineral or stone to be used as an ornamental stone, hardness is an important concept (in terms of processing, polishing and preservation of its structure) and it is desired that the material to be used should be close to or equivalent to the hardness of the quartz mineral (Mohs hardness scale 7).

Obsidians, present wide exposures generally at plate boundaries, in regions where volcanic activities in Anatolia, Italy, America (west coasts) and Caucasus are very intense [4].

In addition to the brightness and durability of obsidian, it has been used as an ornamental stone from ancient times until today, in terms of having various colors. In addition, in the early periods, it was used in making mirrors by making use of its brilliance due to its special refraction. Obsidian has been extracted and processed from prehistoric times to the present day and has been used in many areas. Today; It is used in a wide variety of fields, including cosmetics, alternative medicine, spa (therapy and massage), decoration (trinkets, sculptures, etc.) and jewelry.

In this study; Obsidian with two different colors belonging to the Nemrut volcanics was used, and it was aimed to reveal the brightness of the broken surfaces of the obsidian used in ancient times and to investigate its usability as an ornamental stone. Moreover; On the fractured surfaces of obsidian, in terms of its durability (physical and chemical resistance), as well as the brightness (transparency) it gives and its resistance to high temperatures, In recent years, epoxy, which has been used in many fields including in the artistic field, used as a binder material.

MATERIAL and METHOD

Broken pieces of obsidian

The obsidian belonging to the Nemrut volcanics used in the study has two different colors (black and brown) (Figure 1a) and has been broken and classified in different sizes (8-4.75 mm, 4.75-2 mm and 2-0.6 mm) (Figure 1b, c, d). While the black obsidian pieces were obtained from the 4.75-2 mm shards in terms of the coarseness of the crystals (Figure 1c), the brown obsidian fragments were obtained from the shards in the 2-0.6 mm range for easy selection and differentiation (Figure 1d). Among the broken pieces, brown obsidian pieces were selected with tweezers (Figure 1d, f).

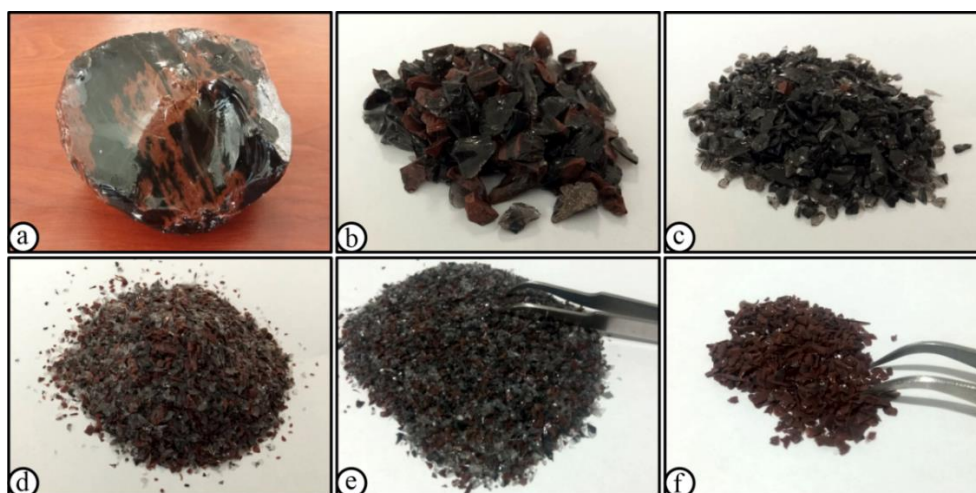


Fig. 1 a) Obsidian (rock), b) Obsidian fractures in the 8-4.75 mm grain size range, c) Obsidian fractures in the 4.75-2 mm grain size range, d) Obsidian fractures in the 2-0.6 mm grain size range and with tweezers selection of obsidian (brown) shards, e) Selected obsidian (brown) shards.

Properties of the epoxy used

Epoxy resins are generally materials with high adhesion strength, water and chemical resistance. Epoxy used in the study; Resistant to acids (dilute), alkalis (dilute and concentrated), cleaning agents (detergent, disinfectant, etc.), oils (vegetable, animal, mineral), solvent-containing substances (gasoline, diesel, alcohol, etc.) and sea water, for wet environments; 50°C, for dry environments; It can maintain its durability up to 130°C. It is known that industrially used epoxies can withstand temperatures of 1500°C thanks to the carbon fiber structured flexible fibers added into it. The epoxy and hardener used during the study were mixed at a ratio of 2:1.

Usage areas of epoxy

With its many properties, epoxy is used in exterior coatings, high performance floors (mosaic floors, sealed floors, chip flooring, colored aggregate flooring, etc.), in the production of adhesives for forest products (wood, furniture, etc.), in the construction-building industry (paint, coating, lining etc.), industry, aviation and space industry; moreover, It is used in many areas as artistic and decorative. In the artistic field, many products such as earrings, rings, necklaces and coasters are obtained by mixing different colors into epoxy resins. However, studies on epoxy bonded jewelry products made using natural minerals are limited.

RESEARCH FINDINGS

Ornamental Stones

Ornamental stones (precious and semi-precious stones) have been preferred and used by people since they represent wealth and beauty since ancient times. Precious and semi-precious stones have some basic criteria accepted in the world in order to be evaluated as ornamental stones. These criteria are:

Durability: It is defined as resistance to external factors and is represented by resistance to impacts, brittleness and hardness.

Beauty: Although it is a relative concept, the fact that the stone can be processed easily, is transparent and clean, besides, has different attractive colors is also decisive for this criterion.

Rarity: What makes a stone or an object valuable is its scarcity.

Apart from these known basic criteria, there are some desirable features in ornamental stones. Stones; Being pure, reflecting light (light refraction), having features such as being easily cut and polished are the elements that increase their value. Although there is no precise definition that distinguishes between precious stones, from semi-precious stones, sapphires, rubies, diamonds and emeralds known over the years are represented by precious stones, while other stones are represented as semi-precious stones. Precious stones (sapphire, ruby, diamond and emerald) are called noble stones if they are subjected to certain processes [3]. when it comes to ornamental stones, natural origin stones come to mind, ornamental stones are organic origin pearls, coral, amber, etc. It also includes materials produced as synthetic (imitation) made in the laboratory environment in developing technology with materials. In recent years, ornamental stones produced in a laboratory environment have become very popular in the world market. Natural stone in the world market; In addition to being frequently used in decoration (interior and exterior), medicine and dentistry, facade (exterior) coatings, their use in the production of jewelry materials and ornaments is increasing considerably. For this reason; There is need for a lot of information on increasing the use of natural stones (ornamental stones) as precious and semi-precious.

Ornamental stones are the result of different geological events; it can be found at or near the surface, in igneous, metamorphic rocks, in pegmatites and in hydrothermal storage areas. The ornamental stones formed in the mantle are; it can rise to the surface due to some tectonic movements such as faulting and volcanism. Gemology, a sub-discipline of mineralogy that deals with ornamental stones is closely related to stone cutting and jewelry making although helping to identify, classify and examine materials.

Obsidian

Obsidian is a type of amorphous rock with a glassy form that occurs spontaneously as a result of the rapid cooling (without crystallization) of an acidic magma in generally nature. Obsidian with acidic composition has a mono type texture, has a special fracture known as conchoidal (mussel shell) (Figure 2a, b). Obsidian can shown different colors depending on the formation environment. It usually shows black, brown and green color tones, as well as rarely different colors (yellow, red, orange, blue, etc.). Obsidian is named as volcanic glass by Raymond (1995) because of its rapid cooling, obsidian has sharp fractures because it is hard, amorphous and brittle feature. With this feature, it has been used quite a lot in the making of cutting

and piercing tools (in the field of surgery) in the past ancient [6]. In addition to the making of sharp tools (arrowheads, spearheads, etc.), it has also been used extensively in the making of artistic objects and jewellery [7].

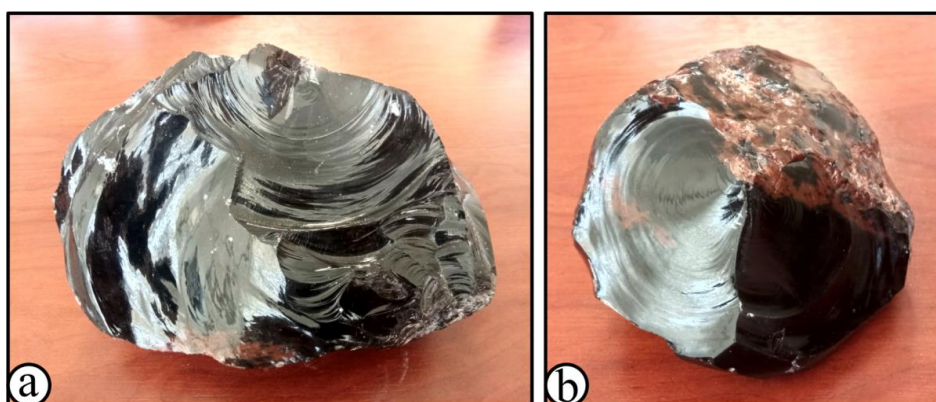


Fig. 2 a; b) Obsidian belonging to the Nemrut volcanics used in the study and showing conchoidal (mussel shell) fracture

Although obsidian was first found in Kenya in archaeological descriptions, it was not found in abundance in the Neolithic period (polished stone age) [8]. At the end of the Neolithic age, the use of obsidian developed was used extensively in many areas including Sicily, Anatolia, Mesopotamia, Europe, the Middle East, America and Oceania.

Usage areas of obsidian

The use of obsidian stone by humans by making various tools dates back to the stone age. In studies conducted by some archaeologists, obsidian pieces were found, obsidian was used in ancient times, people combined these pieces with cherts and flints and made spearheads, arrowheads and various digger products [9, 10, 11, 12, 13, 14, 15] agree that these products are exchanged and traded among each other. It is known that cutting tools made of obsidian, From obsidian that people discovered during the stone age, are now developed and used in modern medicine in surgery, and obsidian scalpels perform better or equal to steel scalpels. It is known that obsidian is a popular and semi-precious stone, and it is used as an ornamental stone by being cut with different cutting techniques (cabachon etc.) in jewelry production. In addition to being used in jewelry making especially such as earrings, pendants and brooches, new design products are produced by combining various opal minerals with as composites (different color contrasts are obtained). The broken pieces of obsidian have a very high brightness (high contrast), and in ancient times they were used to make mirrors by being polished with this feature. In addition, it has relatively low hardness, has facilitated its use in various decorative areas (trinkets, sculptures, etc.) over the years.

In addition to being used in a wide variety of areas, it is also actively used in spa (during massage). Many people can face negative events during the day. These negative events (bad energies), remove with therapies or massages in spa centers.

Obsidian is also called a spa stone or therapy stone because it is believed and used in obsidian stone to have negative effects and bad energies on humans. Benefits of obsidian stone; Since it has a high effect in therapy, it helps to control stress by reducing excessive excitement and feeling. It is believed that with this effect, it provides logical thinking and decision-making, and it gives self-confidence and energy in men. Thought to cause relaxation by reducing pain in the joints and muscles.

Obtaining a product from obsidian shards with binder epoxy

In the study, the reason for using epoxy as a binding material; In addition to having high durability (heat, adhesive strength and chemical resistance), it is transparent (does not give any color), easy to work with and does not cause any unwanted curing and matting during drying. During the application, the broken parts of the obsidian were not completely covered with epoxy, the adhesive property of epoxy was used, because of taking care not to lose the shine caused by the special fractured structure of the obsidian. The epoxy and hardener used were mixed at a ratio of 2:1 and applied. The obsidian belonging to the Nemrut volcanics used in the study contains two different (brown and black) colors, jewelry was applied by using obsidian fragments of both colors (Figure 3).



Fig. 3 a) Brown and b) Black colored, from obsidian fragments belonging to Nemrut volcanics, jewelry (necklace and ring) produced using epoxy binder material

DISCUSSION

Unlike previous studies, the study was carried out to obtain ornamental stones as a result of bonding natural minerals with epoxy binder. The obsidian used in this study is both widely known (popular) among people and is classified as semi-precious stones. Therefore, in addition to being used in many areas today, the areas where it is used as an ornamental stone are generally based on cutting and polishing the obsidian stone with different cutting methods, and it is used as various jewelry apparatus (necklace, ring, earring, etc.). In this study, it was

thought that as a result of bonding natural stones or minerals with different binding materials, it would increase its usability as an ornamental stone in terms of visuality by gaining various properties such as brightness and durability. For this, which has been used quite a lot in recent years, as well as its robustness and durability, which epoxy has high resistance to various chemicals and temperatures, is easy to work on, and is clean (transparent) has been preferred. The epoxy used as a binder in this study not only adhered the obsidian shards on the jewelry well, but also give these shards resistance and shine (in addition to the brightness of the obsidian shards). Moreover, It has been seen that natural rocks and minerals that may be in waste form can be used as ornamental stone by gaining different properties as a result of bonding with epoxy binder material. Many ornamental stones can be produced by bonding natural materials (rocks and minerals) with different binding materials, and there is a need for much research and development in this regard.

CONCLUSIONS

When we list the usability of the final product obtained by the study as jewelry, according to the categories existing in the classification of ornamental stones:

- In terms of durability: It has been seen that the hardness of obsidian is 5 and the epoxy used as the binding material may be suitable in terms of having sufficient physical and chemical resistance.
- In terms of visuality: Although it is a relative concept, besides obsidian being clean and transparent, the shine on the broken surfaces have increased the visual usability of the product.
- In terms of rarity: Obsidian is in the class of semi-precious stones and is currently used in various production methods (cutting and polishing, etc.).

As a result, with this study, it has been seen that all natural stones and minerals that can be waste, durable and visually beautiful can be reused with a binder material. Moreover, It has been determined that epoxy, which is used as a binder, both durability (physical and chemical resistance) and cleanliness (transparency) can be used for different applications in the production of ornamental stones. It has been seen that the broken pieces of obsidian with two different colors belonging to the Nemrut volcanics are suitable for jewelry production by using them as ornamental stones.

REFERENCES

- [1] Schumann, W. (1993). Handbook of rocks, minerals, and gemstones Boston: Houghton Mifflin Company.
- [2] Caran, S. and Bilgin, A. (2003). Süs taşlarının genel özellikleri, bulunuşu ve değerlendirilmesi, 1. Gemoloji Sempozyumu, Ankara.
- [3] <https://www.mta.gov.tr/v3.0/bilgi-merkezi/sustasi> (Accessed 28 Jul. 2022).
- [4] Bilgin A., Polat S., Bilgin N. and Arslan S. (2012). Erciş Obsidyenlerinin Mineralojik-Petrografik, Jeokimyasal Özellikleri ve Süs Taşı Olarak Değerlendirilmesi Üzerinde Ön Çalışma. Iğdır Univ. J. Inst. Sci. & Tech. 2 (2, Ek:A): pp. 85-92.

- [5] Raymond, L.A. (1995). *Petrology: The study of igneous, sedimentary, metamorphic rocks*. Dubuque, IA: Wm. C. Brown. p. 27. ISBN 0697001903.
- [6] Cotterell, B. and Kamminga, J. (1992). *Mechanics of pre-industrial technology: an introduction to the mechanics of ancient and traditional material culture*. Cambridge University Press. pp. 127-. ISBN 978-0-521-42871-2. Retrieved (9 September 2011).
- [7] <https://www.mta.gov.tr/v3.0/bilgi-merkezi/obsidyen> (Accessed 28 Jul. 2022).
- [8] Merrick, H.V., Brown, F.H. and Nash, W.P. (1994). *Society, Culture, and Technology in Africa Import*. 11. Univ Museum Pubns. ISBN 1931707057.
- [9] Bordaz, J. (1970). *Tools of the Old and New Stone Age*. NY: Dover.
- [10] Branigan, K. (1974). *Aegean Metalwork of the Early and Middle Bronze Age*. London: Oxford Pub.
- [11] De Jesus, P. (1980). *The development of prehistoric mining and metallurgy in Anatolia*. BAR International Series 74 (I) and (II). British Archaeological Reports, Oxford, London.
- [12] Collon, D. (1989). *Materials and techniques of ancient near eastern cylinder seals*. In: Hackens, T., Moucharte, G., (Eds) *technology and analysis of ancient gemstones*. PACT, Strasbourg.
- [13] Türe, A. and Savaşçın, M.Y. (2000). *Kuyumculuğun Doğuşu*. İstanbul: Goldaş Kültür Yayınları.
- [14] Türe, A. and Savaşçın, M.Y. (2002). *Anadolu Antik Takıları*. İstanbul: Goldaş Kültür Yayınları.
- [15] Çoban, E. (2013). *Karya Bölgesi (Muğla) antik süstaşlarının mineralojik ve gemolojik açıdan araştırılması ve bölgedeki mineral ve kayaçlarla ilişkisi*. MSc. Dokuz Eylül Üniversitesi.

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