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Investıgatıon Of The Properties Of Artıfıcıal Marble Produced Usıng Waste Lımra Wıth Polyester Bınder

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Abstract: *The fundamental principle of sustainability is to prioritize human life while preserving diversity and ongoing production. With the use of marble in buildings for facade cladding, flooring applications, vertical surfaces, floor covering, stair steps and decorative purposes, resulting in the emergence of 1 million tons of marble waste, the number of businesses and factories is increasing in response to the increasing demand. It is produced annually in Turkey. The aim of this thesis is to examine the effect of the polyester binder used in artificial marble production on the physico-mechanical and sustainability properties of artificial marbles. Cement negatively affects the environment with CO_2 emissions. Storage and disposal methods of waste in regular landfills bring great economic costs and increase environmental problems. In this study, fossiliferous limra, which are industrial waste materials, were used. Artificial marbles were produced using casting type polyester binder. With the physico-mechanical experiments carried out on artificial marble products, artificial marbles produced from fossil limra were compared with natural marbles. As a result, it has been observed that the produced artificial marble has better properties compared to FLM. More efficient use of domestic resources by transforming fossil limra into artificial marble, less demand on mines and less damage to nature, and minimizing the damage to the environment by utilizing marble paste stored as waste from mines will make a significant contribution to the regional economy.*

Keywords: *Artificial marble, binding, sustainability, limra*

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I. Introduction

Turkish natural stone industry; It has an important position in the world natural stone market with its reserve diversity and richness, sector expertise, abundance of raw materials, ease of transportation in maritime transportation, dynamic cross-section structure, new technologies used and wide color scale (Yücetürk, 2010; Tandırcı, 2022; Yıldız, 2011). Due to the rapid increase in the demand for marble, which is a natural stone, the number of businesses and factories related to marble is also increasing. Depending on the capacity of these factories, mud, dust and marble waste are generated; the amount of waste reaches up to 75% (Yılmaz, 2020; Yazıcı, 2010). The emergence of various products as waste, storage or abandonment to nature creates serious difficulties and results in major problems for society and environmental pollution (Bilgin, 2010; Kocabağ 2018; Yazıcıoğlu, 2017). Nowadays, great importance is given to the evaluation of by-products or waste obtained during the production of products. Intensive efforts are made to evaluate these wastes and contribute to the country's economy. Limra, a natural stone, is commonly known as limra. Limra, especially called Limestone, has a special place among natural stones (Fatoye and Gideon, 2013; Deltamarble, 2020; Oates, 2000; Biçer, 2022; Barani, 2016).

Within the scope of the study, it is aimed to use fossil limra, which is an industrial waste material. Artificial marbles were produced using three different binders: fossil limra, white cement, magnesium oxychloride cement and casting type polyester. By turning fossil limra into artificial marble, more efficient use of domestic resources, reduced demand for mines, less damage to nature, and minimization of environmental damage by utilizing marble pulp stored as waste from mines will therefore contribute significantly to the economy of the region and the country.

II. Material and Methods

The study was carried out at Süleyman Demirel University Natural and Industrial Building Materials Application and Research Center (SDÜ DEYMAM). This study aims to evaluate marble waste. For this purpose, fossiliferous limra wastes from a limra quarry located in Antalya Finike region were used.

This study was conducted at Süleyman Demirel University Natural and Industrial Building Materials Application and Research Center (SDÜ DEYMAM). The aim of the study was to evaluate limra waste, and for this purpose, various selected waste limra pieces were subjected to sifting, crushing, mixing, molding, pressing and curing processes to obtain artificial block marbles. The dimensions of the mortar sample were 160 × 40 × 40 mm and 5 × 5 × 5 mm. The prepared mixture mortars were placed in steel molds and samples were taken from the molds after 24 hours. Cured in water at 20 ± 2 °C until the test day. The samples cured for 28 days were tested for some properties according to different standards. Preliminary studies were carried out primarily on the surface appearance (pattern) of the artificial marble planned to be obtained. In these trials, FLM marble wastes were crushed in a laboratory type jaw crusher at SDU DEYMAM and aggregates with different largest grain sizes (D_{max}) were obtained. The grain size distribution of 0-1 mm aggregates was examined. The spread table test of the prepared mixtures was carried out according to TS EN 1015-3 standards.

Dry unit volume mass, water absorption, bending strength, compressive strength, abrasion resistance and shrinkage tests of the produced artificial marble were carried out.

III. Results

The wear resistance values obtained from the test results of the produced artificial limra marbles and natural limra are given in Figure 1. The water absorption rate values are given in Figure 2.

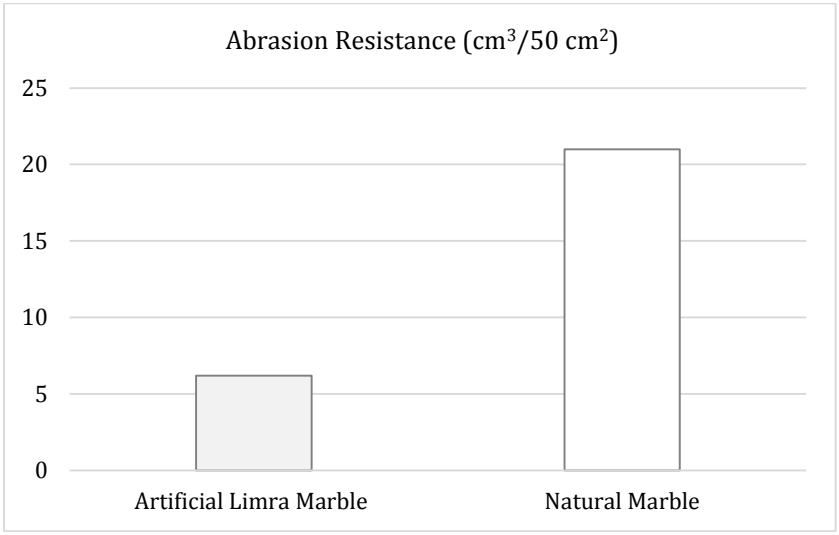

Figure 1. Abrasion resistance of prepared mixtures

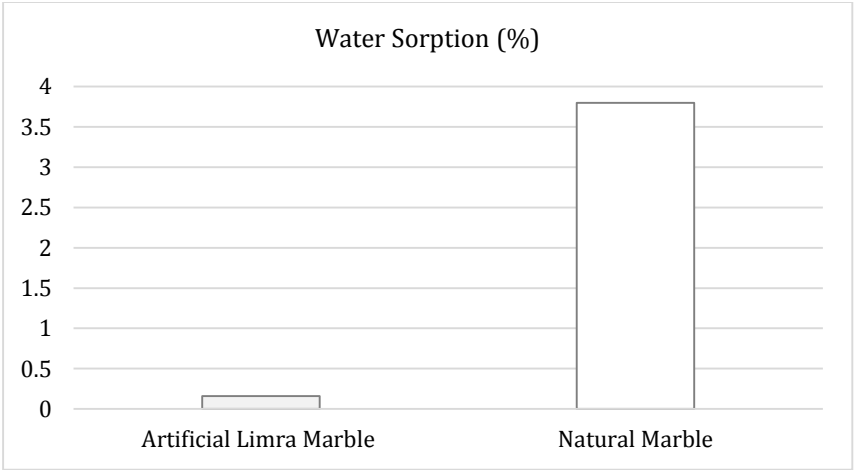

Figure 2. Water absorption of prepared mixtures

When the wear rates of the artificial limra marbles produced are examined; It has been determined that polyester added artificial limra marble has a much lower wear value than natural limra, and the wear value of natural limra is higher. The compressive strength values of artificial limra marble and natural limra marble produced as a result of the experiment are given in Figure 3.

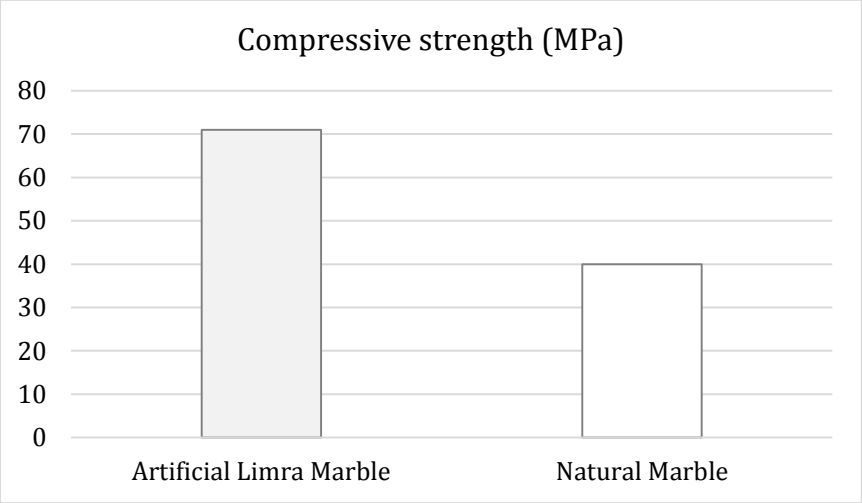

Figure 3. Compressive strength of prepared mixtures

When the compressive strength values of the prepared mixture are examined, it is seen that the compressive strength value of polyester added artificial limra marble is 71.4 MPa, which is quite high. The compressive strength value of natural limra marble was obtained as 40 MPa. According to the results, it is seen that the compressive strength value of artificial limra marble is much higher than that of natural limra marble.

IV. Conclusion

In this study, artificial limra marble was produced by using 0-1 mm sized leftover limra marbles as polyester resin binder. The mechanical and physical properties of the obtained artificial limra marble were examined. It was determined that the dry unit volume masses of the artificial limra marbles produced were very close to the values of the samples obtained from natural marble. This situation is of great importance in comparing the experiments carried out on artificial marble with natural marble. For mass water absorption and capillary water absorption experiments, it was determined that the water absorption rate of artificial marble produced with polyester resin was very low. For this reason, polyester resin artificial marbles can generally be used in areas that are heavily exposed to water and moisture, such as bathrooms. When the compressive strength values are examined, it is seen that artificial limra marbles reach very high compressive strength values. As a result of this study, it has been seen that by converting the leftover limra pieces into artificial limra marbles, the leftover limra pieces will be prevented from harming the environment, and the damage done to nature to produce limra marble will also be prevented.

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Reference

[1]. Akkurt, I., Kilincarslan, S., Basyigit, C., 2004. The photon attenuation coefficients of barite, marble and limra. Ann. Nucl. Energy 31, 577–582. https://doi.org/10.1016/ j.anucene.2003.07.002
[2]. Barani, K. ve Esmaili, H., 2016. Production Of Artificial Stone Slabs Using Waste Granite And Marble Stone Sludge Samples, JME, 7 (1): 135-141.
[3]. Biçer A., 2022. Thermal and Mechanical Properties of Certain Building Stones Located at Mediterranean Region. Araştırma Makalesi, Uluslararası Doğu Anadolu Fen Mühendislik ve Tasarım Dergisi, ISSN: 2667-8764 , 4(1), 67-76, 2022
[4]. Bilgin, N., 2010. Mermer Tozu Atıklarının Yapı Malzemesi Üretiminde Kullanımı. Yıldız Teknik Üniversitesi, Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, 114s., İstanbul.
[5]. Deltamarble, 2020. Erişim Tarihi: 16.05.2020. https://www.deltamarble.com/ tr/kategoriler/limestonelim
[6]. Fatoye, F. B., Gideon, Y. B. 2013. Geology And Occurrences Of Limestone And Marble İn Nigeria. Geology, 3(11), 60-65.
[7]. Kocabağ, D., 2018. Sürdürülebilir Madencilik Bağlamında Mermer Sanayi ve Mermer Atıklarının Değerlendirilmesi: Mermer Madenciliğinde Çevresel Yaklaşımlar, Editörler: Güler, T. Polat.E., Muğla Büyükşehir Belediyesi Kültür Yayınları, Muğla, sf:51-92. Yayınları No: 220, İzmir.
[8]. Oates, T. 2000. Lime and limestone. Kirk-Othmer Encyclopedia Of Chemical Technology.

[9]. Tandırcı E, 2022. Sorel Çimentolu Hafif Malzemeli Levhaların Mekanik ve Yalıtım Özelliklerinin İncelenmesi, Kahramanmaraş Sütçü İmam Üniversitesi, Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi,157s., Kahramanmaraş.

[10]. Yazıcıoğlu, S. ve Kara, C. 2017. Betonda Atık Mermer Tozu Kullanımının Karbonatlaşmaya Etkisi. Politeknik Dergisi, 20 (2), 369-376. Retrieved from https://dergipark.org.tr/tr/pub/politeknik/issue/33083/368169

[11]. Yazıcı, Ş., Anuk, D. ve Arel, H. Ş. 2010. Influences of Metakaolin on The Mechanical Properties Of Mortars Acar, H. 2004. Doğaltaşlarda çatlak tamir ve gözenek dolgu sistemleri, Türkiye IV. Mermer Sempozyumu, Afyon.

[12]. Yıldız, T., Yıldız, S., Keleştemur, O., Bölükbaş, Y. 2011. Atık Mermer Tozu ve Cam Lif Katkılı Betonların Basınç Dayanımlarının Yapay Sinir Ağları ile Tahmini. Engineering Sciences.,6 (4), 1292-1303. Retrieved from https://dergipark.org.tr/tr/pub/nwsaeng/issue/19856/212707

[13]. Yılmaz A. 2020. Sürdürülebilirlik Açısından Mermer Atıklarının Karayolu İnşaatında Değerlendirilmesi, Ekonomik Analiz Örneği. Süleyman Demirel Üniversitesi Fen Bilimleri Enstitüsü Dergisi Cilt 24, Sayı 2, 402-410

[14]. Yücetürk, G. 2010. Göller Bölgesindeki Kayaçların Mineralojik ve Petrografik Özelliklerinin Yapay Mermer Kalitesine Etkileri. Süleyman Demirel Üniversitesi, Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi,121s., Isparta