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Research Article

Durability Performance of Concrete Incorporating Two Diverse Aggregates Acquired From Şanlıurfa Quarries

Emre Danışman [1], Hamid Farrokh Ghatte [2*]

[1] *Department of Civil Engineering (Grad. School), Faculty of Engineering, Antalya Bilim University, Antalya, Türkiye*

[2] *Department of Civil Engineering, Faculty of Engineering, Antalya Bilim University, Antalya, Türkiye*

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*Corresponding author: Cagatay Tasdemir
E-mail: ghatte@itu.edu.tr;
hamid.ghatte@antalya.edu.tr

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ABSTRACT

In recent decades, Türkiye has dramatically increased the use of concrete as a main construction material and has become the leader among European concrete-producing countries. Therefore, the preparation of proper material for concrete is one of the great changes in terms of using sustainable components in concrete. Türkiye has considerable aggregate resources owing to its extensive mountains, which sets a foundation for investigating the aggregates. The granulometry of rock samples is one of the main sources of the aggregates. By employing the experimental methodology, the current study examines and compares the physical, mechanical and chemical properties of aggregates and the granulometry of rock samples from Seferoğlu quarry and Yetimoğlu quarry in Şanlıurfa province. For this purpose, physical properties were determined by specific gravity, volumetric weight, organic matter determination, alkali-silica rectification, freeze-thaw resistance, Los Angeles abrasion, high-temperature experiment, capillary water permeability, ultrasonic velocity measurement and pressure test. Calculating the concrete mix according to the ASTM standard prepared cubic concrete compressive strength of 15x15x15 cm. The results of compressive strength of 7 and 28 days of concrete were obtained. The results revealed that the aggregates demonstrated better physical and mechanical properties concerning the depletion of natural aggregates.

1. Introduction

Aggregate is the most common material used in the concrete and construction industry. The importance of using the right type and quality of aggregate cannot be overemphasized. Bituminous and concrete surfacing are made up of aggregates as aggregates play a major role in the behaviors of pavement surfacing and provide strength and durability to road structures economically [1]. Coarse aggregates are used in greater amounts as compared to fine aggregates in concrete mix design because they show greater strength and bonding and are cheaper as compared to other concrete materials. For suitability and serviceability of aggregates as road materials, the aggregates must satisfy all international specifications – i.e. specifications from the US and UK are commonly used [2]. In Pakistan, the properties of the selected aggregates from different areas sometimes exceed the minimum requirements of the ASTM/BS specifications [3]. This mostly happens with easily available aggregates, which are used rather than those that are fit for usage [4]. Selection of aggregates plays an important role as less consideration is given to their suitability and cost savings with appropriate quality. When a study is conducted on aggregates from various quarries near a construction project, a good rational decision could be made on the choices and sources of aggregates and alternatively, this will lead to more cost-effective pavement designs of road structures [5]. Aggregates are evaluated through tests to determine their suitability for various applications such as in road pavements. Aggregates are used in pavement layers as a base material and as a chipping for the surface dressing of roads and they generally comprise 95% asphalt mixes [6].

Selecting the aggregates and utilization is a critical issue in terms of sustainability parameters. Different hills all over the world provide widely used aggregates, but they are depleting, necessitating the evaluation of new sources to alleviate strain on aggregates. Environmental concerns arise from mining activities, highlighting the urgency to identify alternative quarries of aggregates. During the last decades, the construction industry in Türkiye has experienced significant growth due to an increasing demand for constructing different kinds of infrastructure. As a result, concrete production, as a primary material used in construction, has become a critical area of study in Türkiye. Türkiye has established itself as a leader in concrete production within Europe, underscoring the importance of quality control in the materials used. On the other hand, aggregates, such as sand, gravel and crushed stone, form the backbone of concrete production and are essential for providing the necessary strength, durability and volume to concrete mixtures. The study encompasses to examine their physical, chemical and mechanical properties by British Standards (BS) and American Standard for Testing Materials (ASTM) by comparing them with international specifications (EN 13242 and EN 13285) and NHA specifications [7,8].

In the case of the mechanical properties of aggregate in concrete, a group of researchers in the world worked on how aggregate variability affects the properties of concrete. Güçlüer [9] tested the textural properties of aggregate in the concrete industry considering the surface roughness factor, different compressive strength values and high compressive strength concrete. The mechanical specification of concretes produced with aggregates in 4 different type of mineralogy has been investigated by Beshr et al. [10]. The results demonstrate that aggregate quality was directly related to concrete compressive strength. The compressive strength quality of concrete was evaluated by Özturan and Çeçen [11] through samples with different types of aggregates and depending on the aggregates' textural and mechanical properties. In another investigation, Yılmaz and Tuğrul [12] represented the effect of aggregate mineralogy and surface roughness on the strength of concrete.

The methodology employed in this study involves the natural and crushed stone aggregates obtained from the Seferoğlu and Yetimoğlu quarries in Şanlıurfa province and concrete experiment samples were produced. The effects of aggregates on mechanical and chemical properties such as compressive strength, volumetric weight, organic matter determination, alkali-silica rectification, resistance, Los Angeles abrasion, high-temperature experiment, capillary water permeability, ultrasonic velocity measurement were investigated. The main goal is to assess whether these local materials meet the necessary standards for producing high-quality concrete that can be used in various construction projects across the region. The primary objective of the current study is to evaluate the physical and mechanical properties of aggregates obtained from the Seferoğlu and Yetimoğlu quarries in Şanlıurfa and assess their suitability for use in concrete production. The study aims to determine whether these local aggregates meet the standards set by Turkish regulations (TS 706 EN 12620) for use in construction materials [13]. In addition, the research aims to provide local valuable data to concrete producers, enabling them to make informed decisions about the sources of aggregates they use in their products. On the other hand, by focusing on local materials, the study also explores the potential economic benefits of using readily available resources, reducing the need for imported materials and promoting sustainable construction practices in the region.

2. Experimental Program

Aggregates play a crucial role in determining the properties of concrete and general specifications of concrete are controlled based on ASTM C1611 [8]. The aggregates comprise almost 60-70% of the concrete mix by volume, which means their characteristics have significantly affected the final product's performance. The properties of aggregates, such as particle size distribution (granulometry), shape, specific gravity and resistance to environmental stressors, are critical factors that influence concrete strength, durability and workability. Well-graded aggregates in size distribution ensure better compaction and reduce voids within the concrete, leading to higher strength and durability. On the other hand, the shape of aggregates also affects the workability of the mix; more angular aggregates might require more water to achieve the desired consistency, potentially reducing the strength of the concrete. This study focuses on evaluating these characteristics to determine the suitability of the Şanlıurfa aggregates for concrete production. While Seferoğlu quarry is located in Haliliye district, Yetimoğlu quarry is located in Karaköprü district. The geological locations of the quarries from which aggregate is supplied are marked on the map of Türkiye and represented in Figure 1.

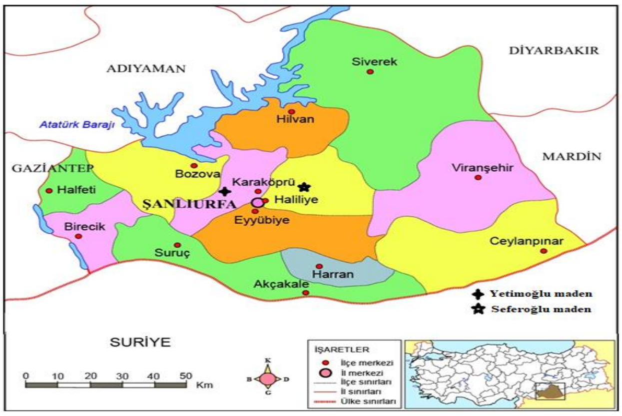


Figure 1: Locations of quarries on the map [14]

In this study, aggregate materials taken from crushed stone facilities in Şanlıurfa and its surroundings were examined. These aggregates are produced by Şanlıurfa's Yetimoğlu Mining and Seferoğlu Quarry and Mining. Natural aggregates extracted in this area are used as fine material for ready-mixed concrete or as non-load-bearing concrete such as mortar concrete and mortar concrete. In concrete production, Portland cement (TS-EN 197-1 CEM 142.5) taken from Şanlıurfa's Harran ready-mixed concrete factory was used as binder, extra sand taken from Şanlıurfa's Yetimoğlu quarry was used as fine material in the mixture and Şanlıurfa drinking water was used as mixing water. In all experimental studies, the standards determined by the Turkish Standards Institute for aggregate concrete tests were used. Figure 2 and Figure 3 show the images of Yetimoğlu and Seferoğlu Quarries in Şanlıurfa.

Figure 2: Yetimoğlu quarry (Yetimoğlu, 2020).

Figure 3: Seferoğlu quarry (Seferoğlu, 2019).

Aggregates constitute 60 to 70 percent of the volume of concrete, one of the most important construction equipment. They come from mineral-based and hard grains. Aggregate structures can be mixed with a binder to form mortar or concrete, as well as used in foundation layers, railway ballasts, etc. It is defined as a material with mineral composition granules (granular) such as sand, gravel, seashells, slag crushed stone. Approximately 90% of the tools used for asphalt surfacing are in the form of aggregates. Aggregate plays a vital role in the road design process. Therefore, some basic qualities must be present in the aggregates used. Depending on the nature of the ongoing design, the mass that must be included in the aggregate will also change. The road layer consists of many layers of different thicknesses and different functions. The wearing layer is the top and is one of the most important layers and does not show one of the parameters that are important for road safety. Aggregates for road use are expected to complete their service life safely and maintain the desired quality in the long term, have a high coefficient of friction and show high resistance to polishing throughout their service life. However, limestone minerals, which are abundant in Türkiye, are used for surface shear layers. Aggregates are inorganic substances like sand, gravel, etc. that are combined with the binding material formed in the mixture of cement and water in concrete production.

Natural resources or blast furnace slag, expanded perlite, expanded clay, etc. are granular tools purchased by hand. Natural and man-made industrial minerals and rocks used in building materials are called mineral aggregates. The components of natural mineral aggregates are rocks and minerals. Minerals are natural substances with a special crystal structure and a chemical composition. When these minerals come together as a whole, rocks are formed. Rocks that form rubble that appear as natural aggregates are divided into three categories according to their origins: magmatic, metamorphic and sedimentary. Two kinds of aggregate are very popular, natural aggregate: these are unbroken or broken aggregates obtained from streams, seas, deserts, old lakes and streams and quarries. The most commonly used aggregate types are obtained from stream beds because they consist of clean and smooth grains. Another kind of aggregate is artificial aggregate. These are aggregates obtained by breaking the stones extracted from quarries with a crusher or as material waste, such as crushed stone, expanded perlite, slag, etc. The most common artificial aggregate type is granite. Aggregate gradation determined by the specifications should provide the necessary sliding friction resistance and the surface texture of the aggregates spread homogeneously on the surface. Gradation refers to the distribution of particles forming the aggregate mixture according to their sizes. As the maximum grain size increases, workability and compaction become more difficult, segregation increases, the amount of voids decreases, the total surface of the aggregate grains decreases and density and stability increase. Three aggregate samples prepared from two different aggregate quarries were studied in the study. The first aggregate material is basalt-based crushed stone aggregate obtained from Yetimoğlu mine in Şanlıurfa. The second aggregate material is basalt-based crushed stone aggregate obtained from Seferoğlu quarry in Şanlıurfa. The necessary amounts for aggregate tests were taken to the concrete laboratory and concrete pressure tests were performed.

Cement is a powdery substance made of calcined lime and clay. The main component is calcined lime. The used clay provides silica, alumina and iron oxide, while calcined lime provides calcium oxide. During the calcination process, at high temperatures, the oxides in the material react to form more complex compounds [14]. Cement constitutes only 20% of the total volume of the concrete mixture. Cement is the active part of the binding medium. It is the only scientifically controlled component of the concrete mixture and is usually the most sensitive link in the chain. The function of cement is, first of all, to bind sand and stone together and, secondly, to fill the voids. Ordinary Portland cement is a fine powder obtained by grinding clinker and is the most important type of cement. High-quality limestone has been made possible by using modern equipment to improve the quality of cement and provide better grain size distribution and finer grinding. Cement has both a strength-increasing and void-reducing effect. On the other hand, cement dosage cannot be increased as much as desired due to economic reasons. High cement dosage not only increases the mechanical strength of concrete but also makes the concrete structure more homogeneous and thus reduces the permeability caused by capillarity. Portland cement [7] was used in this study and all kinds of physical-mechanical tests and chemical analysis results about this cement were performed in the quality control laboratory. The basic physical and chemical properties of Portland cement are indicated and shown in Table 1.

In the case of water, concrete mixing water is the increased amount of water required for the chemical reaction of cement to reach the appropriate consistency. The amount of moisture in the aggregate structure is not sufficient to reach the desired consistency during mixing, but after a certain period, it becomes useful for the chemical reaction. The presence of a large amount of foreign matter in the water used in concrete production can affect the rate and amount of hydration products. It is important that the water to be used in concrete production is clean and does not hurt the concrete [15]. Şanlıurfa drinking water was used in the concrete mixture.

For this purpose, a series of samples were collected from the Seferoğlu and Yetimoğlu quarries and subjected to various standard tests to assess their suitability for concrete production. The main tests are represented as follows:

2.1. Aggregate Specifications

In this section, the specification of the aggregate was evaluated based on the sieve analysis and Losangeles test. The results presented are based on the ASTM C -1260.

2.1.1. Sieve Analysis

This test determines the particle size distribution of the aggregates. A well-graded aggregate will have a range of particle sizes, which contributes to better packing and reduces the amount of cement paste needed in the concrete mix, ultimately improving the concrete's strength and durability.

Table 1: Basic physical and chemical properties of Portland cement.

Appearance	Gray or white granular powder	**Relative Density (Specific Gravity) (g/cm^3)**	2.75 – 3.20
Smell	None	**Apparent Density (g/cm^3)**	0.9 – 1.5
PH (in water) 20 °C	9-14	**Viscosity cPs 25 °C**	No implementation.
Boiling Point (°C) 760 mmHg	No implementation.	**Vapor Pressure hPa 20°C**	No implementation.
Melting Point (°C)	>1200 ºC	**Explosion Hazard**	The product is not explosive.
Flash Point (°C) 760 m	No implementation.	**Oxidation Properties**	No implementation.
Spontaneous Flammability Temperature (°C)	No implementation.	**Average grain size (micron)**	1-30
Decomposition Temperature (°C)	No implementation.	**Water solubility (%)**	0.1 – 1.5

In concrete samples, limestone-based crushed sand (0-4 mm) taken from quarries constitutes 10%, 15% and 20% of the aggregates. After the sieve analyses, 0 – 5 mm fine sand, 5 – 15 mm gravel and 15 – 25 mm gravel samples were taken from certain parts of the aggregate pile. The samples were reduced to approximately 10 kg by the quartering method, then the material was taken and stored for aggregate tests. The sieve analysis results are represented in Table 2 and related figures are presented in Figures 4 and 5.

The sieve analysis showed that the aggregates from both Seferoğlu and Yetimoğlu quarries have a well-graded particle size distribution, which is conducive to producing high-quality concrete. The proper gradation ensures that the concrete mix has fewer voids, resulting in stronger and more durable concrete.

2.1.2. Los Angeles Abrasion Test

This test evaluates the resistance of the aggregates to wear and tear. Aggregates that perform well in this test are less likely to degrade over time, ensuring the longevity of the concrete structures in which they are used. Determination and usability of organic matter of the aggregates based on the color as well as accelerated mortar bar method limit values are represented in Tables 3 and 4 and related test figures are presented in Figures 6 and 7.

Table 2: Sieve Analysis Experiment Results

Sieve Size (mm)	**Seferoğlu** (Percentage %)	**Yetimoğlu** (Percentage %)
31.5	98.8	100
22	98.8	100
16	83.8	82.2
12	68.8	66.5
8	57.8	58
4	46.6	45.3
2	29.4	25
1	20.4	20.2
0.5	13.9	12
0.25	9.1	8

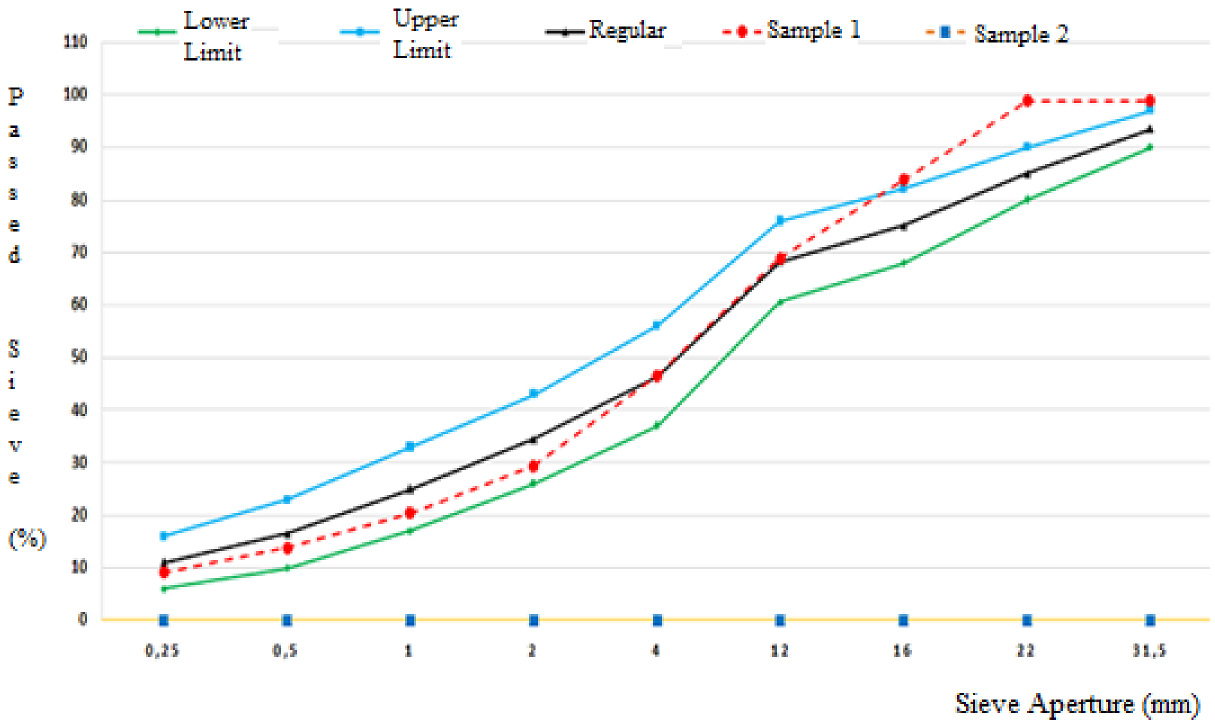


Figure 4: Sieve analysis of Yetimoğlu quarry.

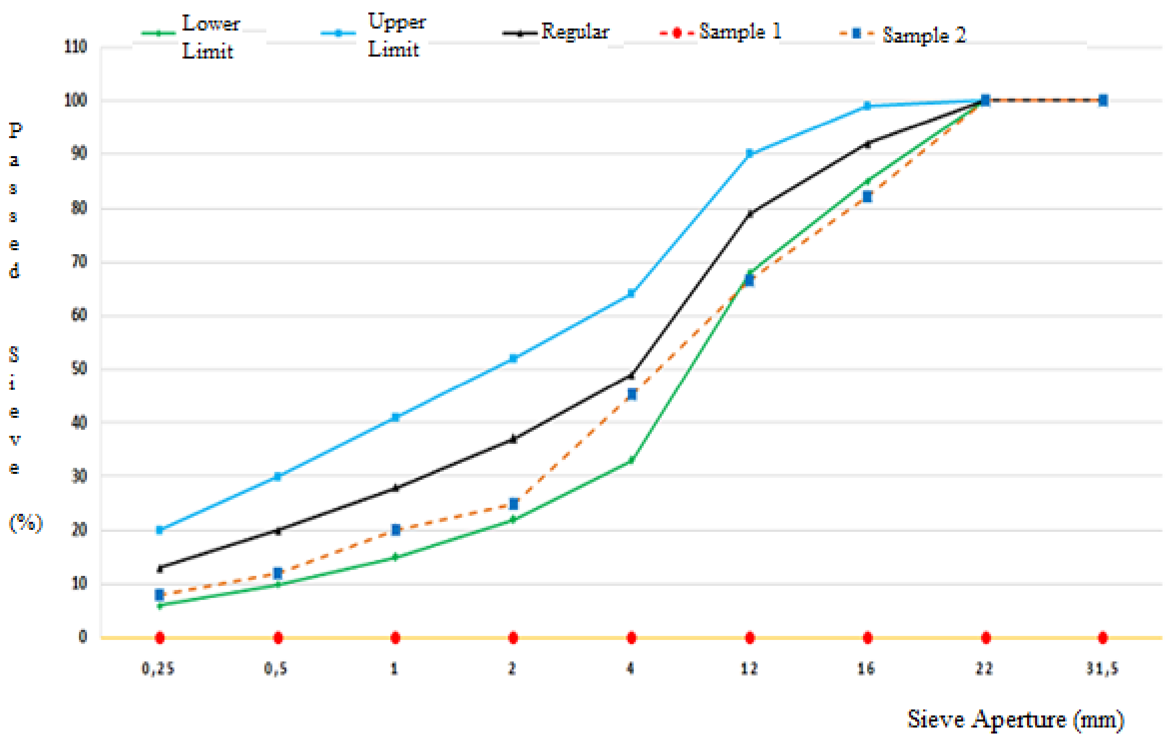


Figure 5: Sieve analysis of Seferoğlu quarry.

Figure 6: Los Angeles test.

Figure 7: Los Angeles test- Evaluation.

Table 3: Determination and usability of organic matter based on the color of the solution [16].

Color Type	Organic Matter Determination	Aggregate Utilization Condition
Slightly Yellow	None/Very Little	Suitable for Concrete Production
Dark Yellow	Available in Small Quantities	Suitable for Use
Red	Exist	Suitable for Minimal Tasks
Brown	Many Exist	Not Suitable for Use

Table 4: Accelerated mortar bar method limit values (ASTM C -1260).

Height change (%)	< 0.3	0.3-0.2	>0.2
Alkali silica reaction measured after 14 days by the length change method	Harmless	Controlled zone	Potentially Harmful

2.2. Fresh Concrete Properties

Considering the strength of aggregates in the concrete compression test will be compared in this study, the mixes were prepared according to the C30/37 concrete class mixture value by keeping the W/C ratio constant in the concrete mix calculation. The amounts of materials used in concrete mix calculation are represented in Tables 5 and 6.

Table 5: Concrete Mix Quantities for Seferoğlu Quarry.

Material Name	Amounts (g)
Aggregate	25520
Sand	18290
Cement	7560
Water	3780

Table 6: Concrete Mix Quantities for Yetimoğlu Quarry.

Material Name	Amounts (g)
Aggregate	24650
Sand	19150
Cement	7560
Water	3780

TS EN 12350-1 was employed to test fresh concrete that was filled into the mold (15*15*15 cm) in three layers of equal thickness. Each layer is inflated 25 times with a compaction bar during filling. The compaction bar blows should be distributed equally over the surface area of each layer. The compacted thickness of each layer should be approximately 1/3 of the mold height. Figure 8. shows the visual of the completion of the filling process for the slump test.

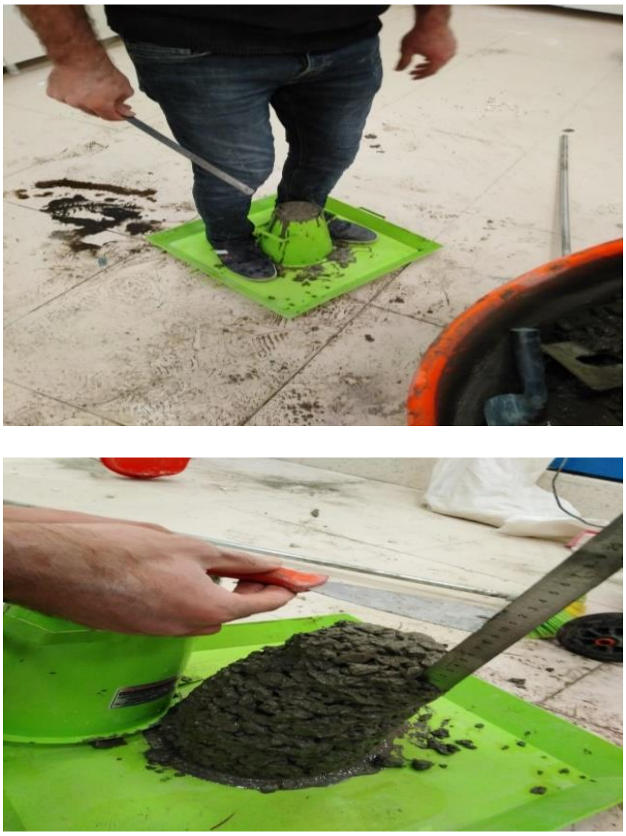


Figure 8: Slamp Test.

TS EN 12350-1 and TS EN 12380-1 standards were employed before placing fresh concrete into the mold; the inside of the mold should be checked and cleaned if necessary. The samples are removed from unlubricated molds carefully to prevent any damage that may occur through the removing the samples in Figures 9 and 10.

Figure 9: Fresh concrete samples.

Figure 10: Concrete samples placed in the curing pool.

2.3. Hardened concrete properties

This section will focus on the preparation of samples for general tests in terms of ultrasonic test, capability and compressive strength test.

2.3.1. The behavior of concrete exposed to high temperatures

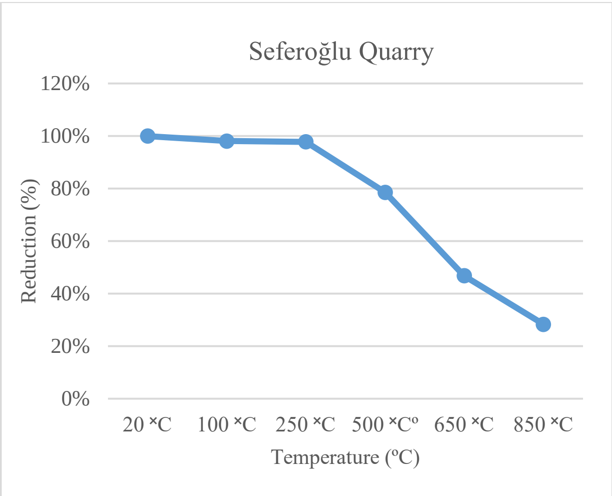
To examine the behavior of the specimens subjected to high temperature the specimens were tested after cooling in air. At the end of the 7, 14 and 28-day curing periods, the produced samples were exposed to high temperatures. They were exposed to the target temperature (100, 250, 500, 650 and 850). After being exposed to high temperatures, the samples taken from the oven were used as a cooling method in the air. All samples exposed to high temperatures in the study were tested after cooling in air. When concrete is exposed to high temperatures, its strength decreases due to large cracks formed in the material. Although concrete is a non-flammable material, it can experience large fractures due to heat. Concrete is resistant to heat, but if the concrete loses too much strength, the structure can collapse.

To better observe the change in strength after heat treatment of concrete at different temperatures, the strength of the sample after heating was expressed as a percentage of the strength before heating (20 °C). In general, a certain decrease in compressive strength was detected with increasing temperature. When the concrete was exposed to a temperature of 100 °C, a decrease in compressive strength was observed. The reason for the decrease may be the expansion of moisture in the voids in the concrete and the formation of cracks on the concrete surface. It is thought that the expansion in the concrete begins due to the pressure applied by the water in the voids. The expansions and cracks that occur are thought to cause the compressive strength of the concrete to decrease.

When the temperature of the concrete reaches 500 °C, the aggregates in it begin to expand. Cracks may form in the concrete with these expansions. These cracks combine with water cracks and cause the cracks to grow. As a result, the compressive strength of the concrete decreases and the aggregates in the concrete begin to crack at temperatures of 500-850 °C. As it expands, all the cracks merge to form large cracks and seriously deform the concrete. At this temperature, the cement and aggregate materials in the concrete are now deteriorating and it is thought that their strength has decreased. Table 7 shows the compressive strength results of the samples exposed to different temperatures. To predict the behavior of the concrete compressive strength, artificial neural network models have been used in the literature and the results demonstrate the appropriate accuracy [17,18]. Figure 11 shows the reduction of compressive strength as a result of the increase in temperature.

Table 7: The results of concrete compressive strength at different temperatures

	Concrete compressive strength at a specific temperature					
Sample	20 ºC	100 ºC	250 ºC	500 ºC	650 ºC	850 ºC
Seferoğlu	100%	98.10%	97.78%	78.60%	46.80%	28.30%
	47.91 MPa	47 MPa	46.85 MPa	37.5 MPa	23.19 MPa	13.5 MPa
Yetimoğlu	100%	98.50%	97.89%	78.20%	47.10%	28.50%
	50.17 MPa	49.42 MPa	49.11 MPa	39.23 MPa	23.63 MPa	14.3 MPa



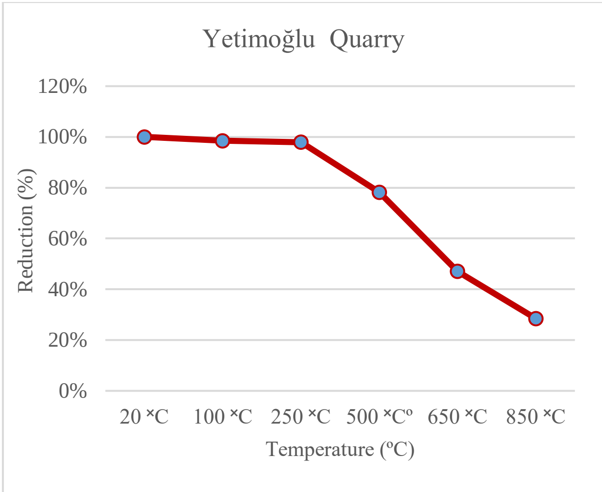


Figure 11: The reduction of compressive strength as a result of the increase in temperature.

Table 8: Capillarity and permeability test results.

Quarry	**Seferoğlu**		**Yetimoğlu**	
Minutes	K (Capillary water absorption coefficient 10^{-5}) cm^2/s		K (Capillary water absorption coefficient 10^{-5}) cm^2/s	
5	25.4	25.7	25.5	25.3
10	27.3	27.5	27	27.1
20	29.5	29.7	28.7	29.1
30	31	31.1	30.4	31.7
60	32.7	33.4	32.3	32.5
240	37.3	37.6	37.1	38.3
1440	41.1	42.4	40.8	41.4

2.2.2. Capillarity and Permeability Tests

These tests measure the water absorption and permeability of the aggregates. Aggregates with low permeability reduce the risk of water penetration into the concrete, which can lead to issues such as freeze-thaw damage and reduced durability. ASTM C 1585 standard was used to determine the capillary water absorption of concrete. For the test, 15x15x15 cm cubes of concrete produced with samples taken from two different quarries were prepared and kept in a water cure for 28 days (standard time) and then kept in an oven at 100ºC for 24 hours to dry. The cubes were then left to cool in the laboratory. After the cubes were cooled, the side that would come into contact with water was made waterproof with tape. A material sample was weighed and then placed in a device made of metal supports. The sample was immersed in 2 mm of water and the weight was measured at intervals of 0, 5, 10, 20, 30, 60, 240 and 1440 minutes. The capillarity coefficient was calculated as cm/min and the amount of water absorbed by the sample was taken into account. Table 8 shows the results of the capillary water permeability test for two different quarries and related figures are presented in Figures 12 and 13.

2.2.3 Ultrasonic Test

Ultrasonic sound speed test is a non-destructive test method that can be used on very thick samples and has high accuracy in detecting small defects. It can be used to detect defects and flaws, examine the internal structure of an element, determine whether an element is reinforced and even measure the thickness of a sample. Ultrasonic wave speed can be done on a single surface and results are obtained quickly. It is difficult to examine samples with very small or irregular surfaces. Also, it is not possible to detect defects or additional reinforcement close to the outer surface of the concrete. A professional person with proper knowledge and experience is needed to understand and interpret the results of the test. Ultrasonic wave speed is used to determine the physical and mechanical properties of concrete. In denser environments, the wave speed moves faster and some engineers and scientists have considered using the ultrasonic sound speed method to evaluate the speed and quality of materials. The ultrasonic sound speed method can be used on wood and concrete and even to check damages such as cracks and voids in the material. The speed of the wave passing through the material is also used to determine the quality of the material. The ultrasonic speed in concrete is affected by the elastic properties of the material. It can measure changes in the elastic properties of the medium in concrete. Shear waves travel at a constant speed through all samples and if this speed is known, the path traveled by the wave can be calculated by using the round-trip time and the size of the sample [19]. The schematic diagram of the circuit of the test device used to measure the ultrasonic sound speed is shown in Figure 14 and the results are represented in Table 9.

Figure 12: Seferoğlu capillarity percentage-time graph.

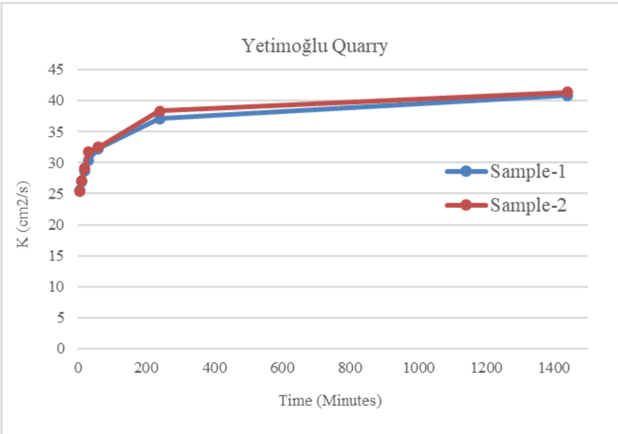


Figure 13: Yetimoğlu capillarity percentage-time graph.

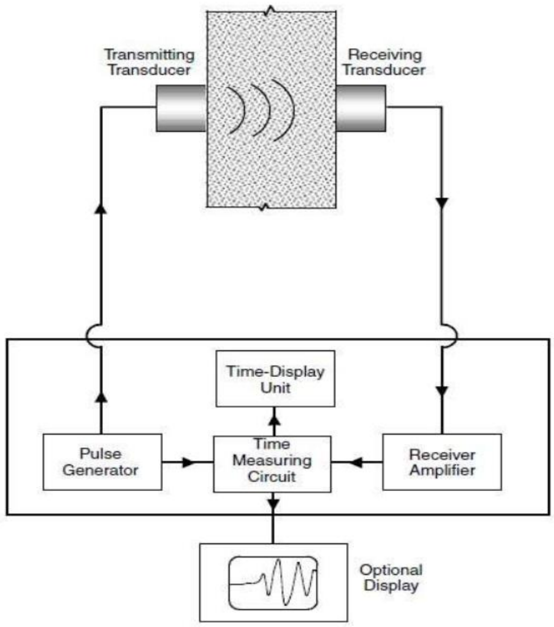


Figure 14: Schematic diagram of ultrasonic sound speed test [19].

Table 9: Relationship between ultrasonic sound and concrete quality.

Ultrasonic Sound Velocity	Concrete Quality
>4.5	Excellent
3.5-4.5	Good
3-3.5	Moderate
2-3	Weak
>2	Very Weak

The ultrasonic sound speed test was conducted according to TS EN 12504-4. The reflection devices were used on the parts contacting the cube samples to connect the receiver and transmitter sections. The wave propagation time received from the device indicator was divided by the sample size to determine the measured sample's propagation speed and it is represented in Table 10.

Table 10: Ultrasonic test results

Quarry	Concrete Class	Unit Weight (g/cm^2)	Utrasonic Wave Velocity Average
Seferoğlu	C35/45	2441	4.85
Yetimoğlu	C35/45	2489	4.89

2.2.4. Compressive Strength Tests

Concrete cubes made with the Şanlıurfa aggregates were tested for compressive strength at 7 and 28 days (Figure 15). These tests provide insights into the potential long-term performance of the concrete. The results from these tests were compared against the requirements of Turkish standards to determine the aggregates' suitability for concrete production. The unit weight and water absorption rates of hardened concrete are determined according to ASTM C567. The samples were dried in the oven to a constant weight of 105±5C0. After the samples were weighed on the scale, they were kept in water for 48 hours to fill the voids with water. Then, the saturated dry surface samples were weighed in water and their weights in water were determined and the unit weights and water absorption rates of the concrete were calculated according to ASTM C567 / C5 67M-19. The unit weight of the concrete was calculated according to the obtained data. Concrete compressive strength is one of the main parameters during an earthquake and has been investigated with different conditions in the literature [20-23].

Figure 15: Standard concrete compressive test.

The loading speed of the compressive strength tests of 3 cube samples for each quarry with dimensions of

15x15x15 cm for 7 days and then 28 days is fixed as 1.0 MPa/sec for cube samples. This test is used to give an idea about the amount of load that the unit area of concrete samples of certain ages. Compressive strength is made according to TS EN 12380-3 and the mixture of concrete samples of different ages is taken as basis. Excess water on the surface is dried before the test sample is placed in the test machine. The test sample made according to TS EN 12380-3 is then placed in the testing machine. No other accessory was used between the test sample and the loading head of the testing machine, in addition to the gap adjustment block and additional plate. Cubic samples should be placed in such a way that the load application direction is perpendicular to the pouring direction. The sample should be placed in the middle of the lower loading head. The cube specimen shall be placed at the center of a cylindrical specimen of the specified size or diameter with an accuracy of 1%. The load was placed on the specimen without impact repetition with a constant loading rate deviation of 1.0 MPa/s (N/mm2.s) from the selected speed. It shall be applied at a constant speed not exceeding 10% until the maximum load is reached. In manually controlled testing machines, the tendency of the loading rate to decrease when the specimen is approaching the fracture stage is adjusted by using the load adjustment valve. The largest load read from the screen is recorded. The tendency of the loading rate to increase is adjusted by the machine. The compressive strength was specified by rounding to the nearest 0.5 MPa (N/mm2). The results of the 7 and 28-day compressive strength tests are represented in Table 11 and related figures are presented in Figures 16 and 17.

Table 11: The results of the 7 and 28-day compressive strength test.

Quarry	**Seferoğlu Madencilik**			**Yetimoğlu Taş Ocağı**		
Days	**Day 7.**	**Day 28.**	**Increase Amount (%)**	**Day 7.**	**Day 28.**	**Increase Amount (%)**
MPa	42.65	47.91	12,33	44.25	52.37	18,35
MPa	43.18	48.36	12,00	45.52	50.17	10,21
MPa	41.93	46.61	11,16	45.01	49.69	10,39
Average MPa	42.59	47.63	11,83	44.93	50.74	12,93

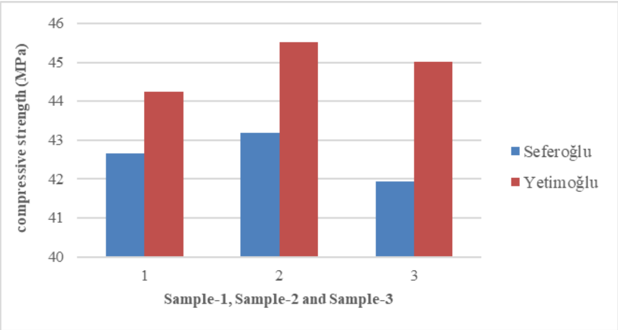


Figure 16: 7-Day compressive strength results.

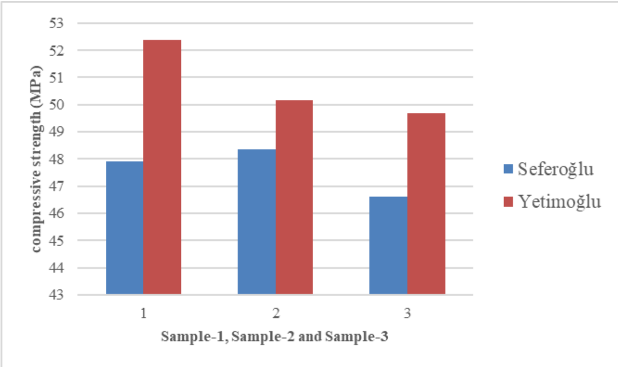


Figure 17: 28-Day compressive strength results.

2.2.5. Resistance to Freezing and Organic Impurities Test

The experiment with Magnesium Sulphate ($MgSO_4$) solution is carried out to determine the freezing damage of aggregates. A mass loss of 1.4% was detected in the sample taken from Yetimoğlu mining and 1.6% in the sample taken from Seferoğlu mining. When the obtained values were evaluated according to the TS 706 EN 12620 standard for concrete aggregates, the analyzed aggregates were in the MS18 category. Aggregates in this category can be used in all weather conditions. The results of the experiment were conducted by giving the initial weight and the weight at the end of the experiment. Natural gravel and sand or aggregates obtained by crushing usually contain some frost-sensitive grains after being naturally sorted. In regions where frost does not generally occur, such features can be ignored. For this purpose, the freezing resistance test has been done for both inquiries and the results are reported in Table 12.

Table 12: Results of freezing resistance test.

Sample Name	Starting Weights (gr)	End of Experiment Weights (gr)	Freezing Loss (%)
Seferoğlu	500	493	1.4
Yetimoğlu	500	492	1.6

The presence of organic matter in concrete components is undesirable as it will affect the hardening of the concrete. The method used to test aggregates is based on the color change that occurs when the alkali mixture reacts with the organic matter in the 0-5 mm part of the aggregate. The darker the color of the liquid, the more organic matter is present in the aggregate. A large color change in the solution may indicate too much organic matter in the aggregate. A small color change indicates too little organic matter in the sand. However, the test is not used to determine definitively whether or not the aggregate contains organic matter, as other factors may be responsible for the color change. The results of organic impurities tests are represented in Table 13.

Table 13: Result of organic impurities test.

Quarry	Color Situation	Determination of Gorganic Matter	Aggregate Utilisation Condition
Seferoğlu	Colorless	None/ Very Little	Can be used in the Concrete Production
Yetimoğlu	Colorless	None/ Very Little	Can be used in the Concrete Production

2.2.6. Alkali Silica Test

According to ASTM 1260-07, the alkali silica reaction values of the aggregates taken from the quarries with the accelerated mortar bar method were determined to be below the 0.1% expansion length limit of the bars waiting in NaOH solution for 0-5 mm grade samples at the end of 14 days. These results showed that there is no negative effect on concrete production if the aggregates obtained from both quarries are used with appropriate composition. Seferoğlu and Yetimoğlu query alkali silica test results are represented as 3.7 and 14 days in Tables 14 and 15 respectively.

Table 14: Seferoğlu quarry alkali silica test results

Seferoğlu Samples	Size of Samples	Average Expansion Percentage of Mortar Bars		
		Day 3.	Day.7.	Day 14.
Sample-1	0-5 mm	0.003	0.007	0.011
Sample-2	0-5 mm	0.004	0.007	0.013
Sample-3	0-5 mm	0.004	0.008	0.014
AM ± SD		0.004 ± 0.001	0.007 ± 0.001	0.013 ± 0.002

Table 15: Yetimoğlu quarry alkali silica test results.

		Average Expansion Percentage of Mortar Bars		
Yetimoğlu Samples	**Size of Samples**	Day 3.	Day.7.	Day 14.
Sample-1	0-5 mm	0.005	0.009	0.015
Sample-2	0-5 mm	0.004	0.008	0.014
Sample-3	0-5 mm	0.004	0.007	0.014
AM ± SD		0.005 ± 0.001	0.008 ± 0.001	0.014 ± 0.002

3. Results and Discussion

In this study, aggregate samples taken from Seferoğlu and Yetimoğlu quarry and used in concrete production in Şanlıurfa province were examined to determine the physical properties of aggregates taken from the quarry. Los Angeles, sieve analysis, organic matter determination, alkali-silica reaction, resistance to freezing, slump, high-temperature test, capillary water permeability, ultrasonic sound speed measurement and compressive strength test were performed on the samples.

The findings of this study suggest that the Şanlıurfa aggregates are well-suited for use in concrete production. The aggregates' physical properties align with the requirements of Turkish standards, making them a viable option for local construction projects. By using locally sourced aggregates, concrete producers in Şanlıurfa can reduce their reliance on imported materials, leading to cost savings and promoting sustainability in the construction industry. The abrasion tests were performed for each type of aggregate used in the experiments to determine the Los Angeles abrasion values of the aggregates. Aggregates that perform well in this test are less likely to degrade over time, ensuring the longevity of the concrete structures in which they are used. Additionally, the study highlights the importance of continuous quality control and testing in the production of concrete to ensure that the materials used consistently meet the necessary standards. In the resistance test against freezing and thawing with magnesium sulfate ($MgSO_4$) solution, a mass loss of 1.4% was detected in the sample taken from Yetimoğlu mining and 1.6% in the sample taken from Seferoğlu mining. According to the determination of the organic matter in the aggregate samples from the quarries, it was observed that the solution liquid in which the aggregate samples were located was "colorless" after 24 hours. This situation was determined as "none" or "very little" when the organic matter determination was taken into account.

In general, a certain decrease in compressive strength was detected with increasing temperature. The reason for this is that concrete has a high compressive strength at temperatures up to 100 degrees. As the temperature increases, the concrete expands and its strength decreases, which causes an increase in the breaking strength. As the temperature increases, the cracks widen and serious damage occurs in the concrete. The cube compressive strengths of the produced concrete were measured as the lowest value of 41.93 Mpa and the highest value of 45.52 Mpa for 7 days. The lowest compressive strength value for 28 days was 46.61 Mpa, while the highest was measured as 52.37 Mpa. Although the samples taken from the two quarries were limestone, the difference in strength between them was due to the data obtained as a result of the experiments and the different concrete mixture calculations made for each quarry. Most of the facilities where Şanlıurfa currently produces ready-mixed concrete are located close to the Haliliye district and its surroundings. All of these facilities are preferred due to their proximity to economic production. The average ultrasonic transition times of the aggregates were calculated as 4.85 km/s for Seferoğlu mining and 4.89 km/s for Yetimoğlu mining. It is always desired that the concrete is well compressed and that the voids inside are few when poured into the mold. When this is achieved, the strength of the concrete increases, while its permeability decreases.

Generally, the previous studies point out the need to manage quarry and ornamental stone industry by-products to minimize the environmental impact. Using these waste materials as construction materials appears to be a viable solution to the problem of waste accumulation. The same as the current study, the former studies showed that most of the researchers used quarry dust as a filler for producing concrete mixtures. One of the key problems that had to be addressed by the researchers during the experimental procedure was the required amount of water that had to be added to the designed mixtures.

In the Alkali-Silica Reaction test, it was determined that the expansion length limit of the rods waiting in the NaOH solution of 0-5 mm grade samples after 14 days was below 0.1%. This obtained value shows us that if the aggregate samples taken from both quarries are used with the appropriate composition, it does not hurt concrete production.

The construction sector is developing rapidly in Şanlıurfa region. Therefore, the speed of building construction is high, so it is necessary to pay attention to the fact that the aggregate tests are carried out in sufficient order and precision. The layered structure of the quarry, the production method and the particle size of the material all affect the properties of the material. It should also be remembered that quality control in production is an important engineering requirement.

4. Conclusions

The conclusions derived regarding the experimental investigations conducted on the aggregate samples taken from Seferoğlu and Yetimoğlu quarry and used in concrete production in Şanlıurfa province are summarized below:

- ASTM standards have been employed to evaluate the performance of aggregate from Şanlıurfa province based on Los Angeles, sieve analysis, organic matter determination, alkali-silica reaction, resistance to freezing, slump, high-temperature, capillary water permeability, ultrasonic sound speed measurement and compressive strength tests. The study concludes that aggregates obtained from Şanlıurfa province are suitable for use in concrete production.
- These local materials meet the necessary standards for producing high-quality concrete that can be used in a variety of construction applications.
- The results underscore the potential economic benefits of using local resources, as well as the importance of continued quality control processes in the production of construction materials.
- The construction sector is developing rapidly in the Şanlıurfa region; therefore, it is necessary to pay attention to the fact that aggregate tests are carried out in sufficient order and with sufficient precision. The layered structure of the quarry, the production method and the particle size of the material all affect the properties of the material.
- The standard cube compressive strengths of the produced concrete were obtained as the lowest value of 41.93 MPa and the highest value of 45.52 Mpa for 7 days and the lowest compressive strength value for 28 days was 46.61 MPa, while the highest was measured as 52.37 MPa.
- The samples taken from the two quarries were limestone and the difference in strength between them was due to the data obtained as a result of the different concrete mixture calculations made for each quarry.

Furthermore, as shown in Figure 6, 32% of respondents were undecided about the influence of the product/production process's environmental impacts on their furniture purchasing decision. 50% of the study participants stated that they consider the environmental impact of furniture products and their production processes while shopping for new furniture. In contrast, only 18% declared the environmental impact of the furniture products and production processes as non-influential. The results of this study were parallel with those of previous literature and indicated a growing preference for environmentally friendly production processes and products [3, 7, 8, 13, 14].

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Authors' Contrtibution

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The Declaration of Conflict of Interest/Common Interest

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The Declaration of Ethics Committee Approval

This study does not require ethics committee permission or any special permission.

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