



## The Impact of Current and Community-Relating Changes on the World, Especially the Turkish Marble Industry

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To cite this article: Derya BERRAK, PhD, Science, Volume 4, No. 11-1, 2022, p. 25 – 48. - 0099-0001-2211-0102.

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ISSN: 2667-9515

Barcode: 977266795001

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"" • Current Science Multidisciplinary Academic Journal with Review Panel is a monthly multidisciplinary academic"" ("Scientific Studies - Current Science Georgia") ("CURRENT SCIENCE") ("CURRENT SCIENCE") ("Scientific Studies - Current Science Georgia") ("Scientific Studies - Current Science Georgia")

journal with a multi-science peer-review." ("Scientific Studies - Current Science Georgia") ("Scientific Studies - Current Science Georgia")

• The magazine is published monthly.

""The magazine will be at the subscriber's address in the first week of the month."" ("Scientific Studies - Current Science Georgia") ("CURRENT SCIENCE") ("CURRENT SCIENCE") ("Scientific Studies - Current Science Georgia") ("Scientific Studies - Current Science Georgia") ("Scientific Studies - Current Science Georgia")

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have been reported in the marble industry in Turkey, corrective actions have been proposed in the marble industry to reduce the damage to workers' health and the environment as well as to strengthen the economic aspects. The result of these actions was a 7% improvement in the productive efficiency of the marble process. A technique for studying air, soil and water pollution issues as a result of stone and marble activities in China is presented, laying the foundations for developing a clean production plan in this context. These difficulties have arisen from the activities. The problems plaguing the marble industry in Mexico are characterized by low productive performance, lack of management and organizational structures, excessive amounts of waste from raw materials, and adverse social and environmental impacts. In this industrial context, actions towards sustainability need to be part of the corporate strategy of the industrial sector to achieve the goals of improving the quality of life, reducing and ultimately eliminating poverty and minimizing the environmental impact it causes.

**Keywords:** *Turkish Marble Sector, Issues Affecting the Turkish Marble Sector, Current and Social Issues in Turkey and the World Marble Sector, and Especially the Impacts on the Turkish Marble Sector*

## 1. Introduction

The 2030 Agenda for Sustainable Development advocates for action plans to eradicate poverty, protect the environment and reduce climate change challenges. Titled "Industry, Innovation and Infrastructures", the Goal is one of the 17 goals outlined in the 2030 Agenda. This goal means producing and implementing actions that will significantly reduce carbon dioxide emissions and the amount of waste generated in its processes, while making the industry more productive. The method proposed by the Business Council for Sustainable Development (BS) (2002) forms the basis of this research. The framework consists of a diagnostic study of the context and challenges faced by the Mexican marble industry in the social, political, economic, cultural, environmental, research and development dimensions. In conclusion, this article contributes to a three-helix comprehensive management approach for the integration of capital forms reported in the Mining,

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Minerals and Sustainable Development (MMSD) project of 2006 and the Multidimensional Model proposed by the government to transform the marble industry sector by the following sustainability principles. It is essential to bring the strengths of business, school and society into synergy.

## 2. Strengths of the Marble Industry

Integration of the strengths of the marble industry in the international arena with a comprehensive management approach consisting of three helixes, namely government, business and school, makes it possible to report internationally reported experience and information on marble industry processes in the international arena. This is in line with local experience in locations where this comprehensive triple-helix management (THM) approach is replicated. This comprehensive management approach includes government, business and educational institutions. Considering this purpose, some of the aims that this article aims to achieve are as follows:

*Synthesizing research papers written on the marble industry and published in international research journals between 2014 and 2021 and accumulating knowledge to help address issues in this mining industry makes the government-business-school approach a useful tool for researchers to use when addressing issues in the marble industry value chain. recommend it as an intervention guide.*

## 3. Components and Procedures

This exploratory and descriptive research integrates the socio-economic and environmental dynamics of the marble industry reported in scientific papers from 2014 to 2022 with the aim of relating the dimensional elements of a sustainable company. This model applies to characterize the technical, productive and environmental context of the Mexican marble industry and is supported by documents from other countries. Compared to its other foreign counterparts, the technical, productive and environmental background of the Mexican marble industry can be well described using this model. Primary information for this study was collected in situ at three

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different marble companies in Tepexi de Rodriguez-Puebla, Mexico, using five different hedonic-level Likert scale questionnaires. These studies confirmed aspects of marble extraction and processing processes reported by both international and national studies. Marbles (dimensional stone) and cut stone in general are not yet protected by an acceptable mining legislation that would protect and aid them in growth and industrialization in many countries, including Turkey. Turkey is one of these nations.

#### 4. Marble and Turkey in General

In general, Turkey can supply a large potential resource for marble, stone, onyx (onyx marble), travertine, granite and similar materials. These materials are typically of high quality and have the potential to dominate markets around the world. Currently, quarry mining conditions are mostly quite simple and at an early stage of the crafting process. When mechanization is present it simply consists of pneumatic hammers and as a result only roughly 30-35% of the total material used is used for block production.

Many extensively explored sites are either not ran due to a lack of budgetary allocation or are subject to occasional exploitation only for road paving blocks, tombstones and mosaic work. This is possible even though modern engineering can offer excellent equipment to achieve the maximum production of a quarry with a minimum amount of material waste . Regarding the marble industry, only a few of those visited are adequately equipped. In many production facilities, both the working mechanisms and the materials themselves are insufficient. For example, benches that make homogeneous cuts by using coarse calcareous sand instead of fine-grained silica sand as the material for the cutting bed can be included in the subject. All this contributes to the prohibitive cost of production, although the actual cost of labor appears to be quite modest on average. Mosaic work, which works with marble grains of varied sizes, is an example of the secondary sector based on marble. In fact, the use of mosaic in construction represents 80-90% of material use for pavement, pavement, cladding, stairs and other similar applications at the locations analyzed. Although it is superior to mosaic in both quality and appearance, building painters have not yet

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begun to consider the use of "Palladiana". This material consists of pieces of marble that vary in type and possibly color and are bonded together to form an artificial breccia. In addition, the square meter price of "Palladiana" is five times more than the price of the mosaic.

To explore future growth opportunities, the next step is to consider the many sub-sectors that make up the marble industry. The following observations were made in the existing quarry management:

1. *The working system is insufficient as it is still in the craft phase.*
2. *Mechanization is limited or absent and*
3. *Equipment consists of pneumatic hammers only, when available.*

There are currently only four spiral wire devices that can be used in marble cutting in Turkey. The white, black veined, crystalline limestone cropping out in Sakarya Sapanca is a highly studied place. Others are in Belevi Köy (Selçuk-İzmir) (not working yet); in Süpüren (Eskişehir); and Akhisar (Turkish-made equipment). The challenge of mechanizing mining and industrializing quarrying is vast and naturally involves not only economic considerations but also planning and technology. Thanks to the development of newer technologies, a wide variety of machines are available for use in the marble mining industry.

Equipment selection should be made considering a wide variety of factors, the most important of which are:

- a. *The required amount of production*
- b. *lithological material type,*
- c. *The structure of the material,*
- d. *The structure of the outcrops and how they are arranged,*
- e. *The demand and cost of markets in other countries; and f. properties and cost of similar materials produced in other countries.*

Broadly speaking, we cannot trust any piece of machinery that does not supply a constructive solution to the problems outlined above. Such problems can shift from one outcrop to another, from one environment to another, and sometimes even from one quarry to another within the same



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outcrop. In the light of these evaluations, it is not financially possible to do business with insufficient or obsolete machinery in a country like Turkey where the marble industry is in the development stage. To better understand the possibilities of opening markets in foreign importing countries by seeing not only the national production, but also the equipment of foreign manufacturers and exporting countries, future programs need to consider modern and adequate machinery when planning.

Only with this method will Turkey be able to compete with other countries that produce and export goods. These countries have completed all the planning stages and are currently conducting both production and export activities at full ability. Labor qualification is an issue that needs to be addressed directly in quarries, and one way to do this is by training workers on how to run mechanical equipment. The findings of the research conducted in the quarries showed that there were competent quarry experts familiar with the marble working process. From a more macro perspective, there is an urgent need for management as well as proper equipment. In other words, there is a problem with the regulation of stocks, or rather, an error in the mining program. Considering this, marble quarrying, like any mining operation, requires a mining project, so work can be scheduled over a period. Throughout the progress of the quarrying, up to the manufacture of the blocks must be seen, and a marble specialist should always be present to conduct the ongoing investigations at the quarry site. A business and production project needs to be brought together. It is essential to recommend the choice of new production points and suitable slaughter areas.

All this will be done on a weekly, fortnightly, monthly or yearly schedule, taking into account the challenges posed by financial and logistical considerations. About the use of the apparatus, the MTA Institute must prepare a test chart summarizing the apparatus, their operating characteristics and output. These tables should also highlight the type of materials and equipment most likely to be used effectively. In collecting the experimental data described above, it makes sense that the MTA Institute could receive help from the ability and experience that governments of other nations have gained in this field. In general, we are of the opinion that any quarry supervisor can run even the most modern machinery after going through a training phase of two to six months and being supervised by highly trained industry professionals. In general, industrial establishments using

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materials from marble quarries such as Ankara, Afyon and Marmara Island are adequately equipped for real production. This is true regardless of the specific location of the industrial concern.

#### 4. Defects or Lack of Equipment

If we can talk about the flaws or the lack of equipment, then both can be due to the same working methods. For example, it is possible to see that the "charge" in the weaving loom is usually produced with materials that vary according to the degree of hardness. This naturally has a negative impact on the output of the loom and reduces the time the equipment can run effectively. Most companies use unsuitable sand for cutting marble (usually composed of coarse calcareous granules).

The result is a sizable part of the waste generated from all the cut material. The low quality of the blocks has a natural effect on this waste rate. Currently, there is only one factory in the vicinity of Gemlik (Bursa Vil.) that processes materials such as granite, gneiss and diabase and other rocks of similar composition. More factories, especially for the domestic market, can be set up around the places where there are marble reserves and equipped with modern technology. These factories will be for the domestic market. These industries are needed to work full time, that is, twenty-four hours a day, by the norms in the countries of the European Union and the United States. In particular, the industrial exploitation of hard stones such as granite and overhanging rocks should be encouraged. These resources are especially useful in construction. Currently, the marble industry only extracts the Gemlik diabase, which is an overhanging rock. Granite is not mined, and the only other use of other intrusive rocks is in the construction of pavers. Characteristics of the Turkish Marble Industry Turkey's natural marble products are gaining popularity in various parts of the world, and because of Turkey's international reputation and prestige in the commercial field, they gain significant trust from importers compared to other international marble products. This paves the way for the Turkish marble industry to become a unique brand.



## 5. World Market

There is a wide variety of marbles on the world market in terms of quality grades, colors and styles that are ideal for the various requirements of the market. The costs of Turkish marble are comparable to Italian marble and other European marble varieties. It is the subject of ability in the artisanship often associated with Turkish artifacts, as well as ability in the manufacture of marble, including the production of washbasins, pools, many decorations and numerous accessories.

## 6. Turkey's Most Important Marble Producers

Marble firms and factories in Turkey can be found in all the country's most famous marble towns, which are also home to many natural marble mines. Muğla, Mersin and Adıyaman districts in Turkey are the districts that contribute the most to the marble sector. These three cities are home to more than 4% of the world's marble deposits and constitute 15% of the marble reserves in Turkey. The following Turkish marble businesses are among the most well-known businesses in the country. Rinx Marble, produced from natural stone in Şahinler, is used in marble production and export as well as marble production in Turkey.

According to the information given above, the prices of several types of Turkish marble vary according to the type of marble and the characteristics of the slab. Marble goods needed for marble exports from Turkey can be bought directly from Turkish domestic producers. This is also the case in the export of marble. It is important to prepare some documents including invoices, certificates of origin and other documents for the shipment from Turkey. This should be done after deciding what items are needed and reaching an agreement with the shipping business. Shipping is usually managed by the freight forwarder, as shipping companies can arrange these on your behalf. Mersin and Antalya are the two most important ports of Turkey in the export of marble from Turkey's many marble quarries. Whether in the form of raw marble (block) or ready-to-assemble marble, marble products from Turkey are exported to many countries in the world, especially China, India, Thailand and Middle East countries. Examples exist such as Saudi Arabia, Kuwait, Lebanon and other African countries such as Libya and Algeria . It is possible to come across these marble

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products in both forms. The bazaars in Turkey are brimming with local marbles, and the country also hosts a series of exhibitions each year to highlight its local produce. These shows can serve as a convenient venue to order. In addition to being able to import directly from Turkey's leading marble companies, you also have the option of importing products through an agency or company that prepares Turkish marble purchase requests. Importing goods from Turkey for distribution to the rest of the world is a service offered by Tebadul International Trade with its expert staff.

Some important companies offer marble transportation and import services to their customers from Turkey as a part of the full range of services they offer for marble imports from Turkey. These services are available for customers traveling all over the world. Below is a list of the services we offer:

*Providing the highest quality and most exclusive varieties of marble, commercial cooperation agreements with marble quarries and production facilities and the most competitive pricing according to the parameters specified for the Turkish marble products sold, checking the completion of the works related to the completed contracts and keeping an eye on the contracts themselves. To provide important shipments for businesses and private customers, to provide transportation between Turkey and any point in the world with all related services and coordination support.*

Turkey is home to some of the most modern marble quarries in the world that can produce high quality marble and aim to meet the needs of markets all over the world. Many companies in the global market produce a wide range of natural stones under various brands to meet consumer demand. Turkish marble suppliers have a lot of experience in this sector, as marble has been mined in the Anatolian Peninsula for thousands of years. The island of Marmara, home to some of the oldest known marble quarries, is said to be where the term "marble" originated. Marble suppliers in Turkey are dependent on the country's large inventory of marble production facilities.

For example, the Afyon quarry is a well-known place all over the world. It is a known fact that the natural stones extracted from these quarries are of extremely high quality. For this reason, goods from these quarries are highly sought after by architects and builders all over the world. Marble

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Mines in Turkey There is a treasure to be found in Turkey's marble quarries scattered across the nation. This resource handles contributing more than one billion dollars to the Turkish economy. For example, Afyon and Antalya have become famous tourism destinations in recent years due to Turkey's important marble quarries. These quarries produce such high-quality marble that they are often visited by people from all over the world. Turkey's marble quarries are working hard to double their production to meet the needs of both today's market and the market of the future. Marble from Turkey is of the highest quality and is in high demand in markets all over the world.

## 7. What Are the Many Marble Types Found in Turkey?

Marble suppliers in Turkey have a large inventory with a wide range of products. The value of these natural stones can vary depending on several factors such as color, shape and type. People especially have a strong preference for Turkish gray marbles. These natural stones can be used in conjunction with other stone types to create a wide variety of patterns and designs. Clients can create contrast and harmony using a wide variety of tonal combinations that include both light and dark tones. Customers also have the option to choose complementary hues such as beige marbles, which are readily available on the Turkish stone market. Finished products supplied by natural stone suppliers have found use in a variety of industries. These remarkable stones are ideal for use as flooring and for cladding gardens, balconies and other architectural features. These items can also be used to make several types of furniture. The furniture industry is home to a wide variety of products decorated with marble in various shapes. There are many wonderful examples of sinks and toilets used in unusual ways in public restrooms. In addition, these stones are suitable for use as countertops in kitchens.

## 8. Where is Turkey in the Global Marble Quarries Market?

Turkey attaches immense importance to the exploitation of marble mines as it has become a leading producer and exporter of marble in a variety of forms, including in its raw form, cut into



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frames or finished product for wall and floor tiles. After China and Italy, the third largest marble exporter is Turkey with sales to more than 120 countries. Turkey is generally accepted as an important natural stone producer since the emergence of production techniques in the natural stone industry. This material is used in a wide variety of applications. According to the General Directorate of Mining Affairs of Turkey, Turkey is the place where 36% of the world's marble reserves are found. This is an important part of the total. The southeastern region of the United States is home to a considerable number of marble quarries. Since ancient times, there has been a steady growth trend in both the production and use of natural stone. Natural stone production is intricately linked to various businesses around the world, primarily construction. Natural stone, in the form of building and facing stone, was chosen because of its unique qualities in terms of color and design, as well as its physical and mechanical properties.

In 2018, international stone material trade was 83.4 million tons, each ton of which was bought at a price of 290 USD. This corresponds to a total of 25 billion USD. In the last decade, almost all countries, with the exception of Italy and Spain, have seen a growth in the total amount of processed products, with the exception of Italy and Spain. The value of stone material exported to other countries in 2018 was USD 13.67 billion (Carli, 2019). As the demand for this commodity continues to increase, the amount of natural stone produced is constantly increasing. Natural stone waste is produced because of block efficiency, natural discontinuities, color differences, natural defects, color and design demands from customers at every stage of natural stone production, starting from the quarries. (“Natural stone waste generation from the perspective of natural stone ...”) Natural stone waste can be produced in any process involving natural stone production. The same principle applies to the waste produced for sizing in marble processing factories.

This waste is caused by edge residues, natural discontinuities in natural stones, manufacturing errors and customer requests. Turkey has consistently kept its position in the top three in the world natural stone market in terms of both reserves and total production volume. According to the data of the Republic of Turkey Ministry of Commerce (2018), Turkey met 17.3% of the world stone trade demand in 2018. There are approximately 1717 stone quarries authorized by the state, over 2000 small and large-scale marble producers and approximately 9000 small-scale enterprises in

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Turkey. <sup>1</sup>According to the data provided by the Istanbul Minerals and Metals Exporters' Association (İMİB), the total amount of natural stone produced in Turkey in 2018 was approximately . <sup>2</sup>According to Kacr (2017), Turkey gets about 10% of its total marble supply from the Bilecik area, where it plays a key role in the worldwide natural stone market.

The production of natural stone quarries in Turkey varies between 0.5% and 15% on average (Sarışık, 2010). Especially due to the North Anatolian Fault Zone, there is a lot of fracture in the primary natural stone formation. This results in loss and waste throughout the entire production process. If the quarry yield in a marble quarry is only 10%, the remaining 90% of the stone produced is wasted. It is a challenge not only to figure out how to recycle old things, but also to figure out where to put them. Considering environmental considerations, one of the most important challenges is to supply adequate storage for waste from natural stone production (Shadrunkova et al. 2019).

Marble and waste rock pieces are generally thrown into unused areas, agricultural areas or landfills (Özçelik, 2016). Ecologically sound and sustainable planning studies for natural stone quarries are extremely important for these very reasons. Careddu and Siotto (2011) evaluated environmental issues such as noise, vibration, smoke and dust caused by natural stone production in the Orosei region of eastern Sardinia. Careddu and Siotto's research was published in the journal Environmental Research Letters. In addition, they made recommendations on how to reduce the damage these elements do to the ecosystem. It is essential to understand the processes that lead to waste generation in the natural stone industry, to discover new industries that can reuse wastes, and most importantly, to decide the ratio of industrial waste to total waste (Careddu and Marras, 2015). It is important to find the many purposes for which this can be applied. However, it is also especially important to decide how sensitive the defined use may be to the waste produced by the marble producers.

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<sup>1</sup> Republic of Turkey Ministry of Energy and Natural Resources Publication, 2019

<sup>2</sup> Istanbul Minerals and Metals Exporters' Association, 2018, 2019



## 5. On Social Impacts

Deciding the typical amount of garbage produced by a marble processing plant is vital before discussing the ways in which the waste can be reused and the types of businesses that can reuse it. The first step to reusing waste natural stone to create a more sustainable environment is to understand every step of the process in which garbage is produced. Natural stone production facilities do not produce garbage even in a single category (Karaca et al . 2012). Therefore, litter can show a wide variety of properties. For this reason, it is extremely important to have a solid understanding of the properties of waste natural stone. The features that will be outlined later within the scope of the investigation will create waste in proportion to the amount of production. Production equipment, the surface properties of the stone and the operations performed on it can all cause this waste to have markedly different qualities. A customer's needs will decide the nature of production and the qualities of the litter. Quantification of waste and determination of its physical and chemical properties are of the highest importance. In the published research, it is possible to come across many studies on the use of natural stone scraps in various sectors. The construction industry, the paper industry, the food industry, and the pharmaceutical industry are some of the industries that can use stone scraps significantly. As part of their research, Rai et al. (2011) investigated the usability of marble powder and granule in mortar or concrete.

Mixing ratios were defined as 5%, 10%, 15% and 20%, respectively. It has been discovered that substituting fine aggregate with marble trash results in a proportionally stronger compressive strength with each use. This is true even when the marble waste is of a thinner consistency. The researchers emphasized that the flexural strength of the mixture increased in proportion to the amount of waste marble it had. In addition, marble dust can be found in applications such as mortar and concrete (Corinaldesi et al., 2010). In this research, by analyzing the chemical and physical properties of marble dust, it has been tried to decide whether the dust formed because of cutting and shaping the marble can be used in the production of mortar and concrete.

## 9. Consequences of Effects

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According to the results of the research, when powdered marble is used instead of sand for 10% of the mixture, best compressive strength is obtained. The findings of this study, together with the findings of many earlier research studies, show that effective results can be achieved in mortar and concrete by using marble powder instead of sand. Another study highlights the effect of marble dust on the mechanical properties of concrete. In this study, 0%, 25%, 50% and 100% sieved samples from 0.25 mm sieves were used and it was concluded that each ratio has a beneficial effect on the compressive strength values (Demirel, 2010). Another study (Topçu et al., 2009) shows that marble scrap dust can be used as a filler in self-compacting concrete. This study focuses on the fact that the amount of marble waste produced in Turkey has increased exponentially. The findings of the study led the researchers to the conclusion that a maximum and best amount of 200 kg/m<sup>3</sup> of marble dust should be included in the self-compacting concrete to achieve the best possible performance for both fresh and hardened concrete forms. In addition, a significant amount of research has been done on the use of marble rubble in asphalt. This is because it is a known fact that aggregates are more than 95% of the weight of asphalt pavement material. Researchers from various institutions have studied the possibility of using waste marble from marble production as a substitute for aggregates, which are needed in significant quantities. Akbulut and Gürer investigated the use of marble and andesite quarry wastes on the city asphalt between Afyonkarahisar and İscehisar within the scope of their research in Afyonkarahisar, Turkey. They performed tests known as Los Angeles abrasion, aggregate impact value, freeze and thaw, flake index, and Marshall stability flow on litter samples. As a result, they realized that litter could be used as asphalt pavement binder layers for light to medium density areas (Akbulut and Gürer, 2007). Studies on the use of discarded marble as aggregate in concrete or as a substitute for sand can be found in published research on the subject. Researchers Almeida and colleagues (2007) tried using natural stone slurry instead of fine aggregate in concrete compositions. They concluded that the slurry made of natural stone could be used as fine aggregate or microfill in concrete mixes. In their research, they examined mixtures with or without natural stone slurry.

## 10. Impact Value of Waste Products

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They underline that the compressive strength, splitting tensile strength and modulus of elasticity values produce superior results in mixtures where natural stone slurry is used. This is consistent with the findings obtained. Similar types of experiments were conducted using natural stone slurry. In their research on ways to reduce costs associated with self-compacting concrete, Ghezal and Khayat (2002) highlight the fact that replacing 100 kg/m<sup>3</sup> of cement with finely ground limestone filler improves deformability and stability without affecting one-day compressive strength. The use of waste products obtained from natural stone not only in the construction sector but also in other areas has been the focus of research for a long time. In contrast to larger chunks of solid waste, sludge samples are typically used in this type of investigation. Ahmed et al. (2013), the sludge was ground so small that it could pass through a sieve with a 10-micron aperture. The researchers combined the grinding sludge with processed rice husk, another type of waste, and natural rubber for use. Based on the findings of their research, they concluded that the mixture improved all physical and mechanical properties.

(Bilgin et al. 2012) conducted a research on the possible use of marble dust waste for the brick industry. Natural stone rubble is used in construction for assorted reasons. After combining the waste materials with industrial brick mortar in varying proportions (ranging from 0% to 80% by weight), the mechanical properties of the brick obtained because of this process were investigated. According to the findings of this research, increasing the proportion of marble dust additive has a positive effect on the resistance of industrial bricks to physical, chemical and mechanical damage.

## 11. On Recent Developments and Impacts

According to industry members, the recent coronavirus epidemic has had profound consequences on the production and export sectors of the Turkish marble industry, while block marble shipments to an East Asian country have already decreased by fifty percent. Turkish Marble, Natural Stone

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and Machinery Manufacturers Association (TUMMER) said that China is the world's largest block marble importer; therefore, the introduction of the virus significantly impacts the business.

The findings point to the production of pollutants that are then dumped into the water bodies, the dust emission from cutting operations, the existence of occupational hazards, the generation of environmental noise and harm to the health of people in Palestine. Similar situations have been reported in the marble industry in Turkey, corrective actions have been proposed in the marble industry to reduce the damage to workers' health and the environment as well as to strengthen the economic aspects. The result of these actions was a 7% improvement in the productive efficiency of the marble process. A technique for studying air, soil and water pollution issues as a result of stone and marble activities in China is presented, laying the foundations for developing a clean production plan in this context.

These difficulties have arisen from the activities. The problems plaguing the marble industry in Mexico are characterized by low productive performance, lack of management and organizational structures, excessive amounts of waste from raw materials, and adverse social and environmental impacts. Two representative marble usage areas in Mexico:

### *Comarca Lagunera and Mixteca Poblana*

In this industrial context, actions towards sustainability need to be part of the corporate strategy of the industrial sector to achieve the goals of improving the quality of life, reducing and ultimately eliminating poverty and minimizing the environmental impact it causes.

Goal 9, titled "Industry, Innovation and Infrastructures", is one of the 17 goals outlined in the 2030 Agenda. This goal means producing and implementing actions that will significantly reduce carbon dioxide emissions and the amount of waste generated in its processes, while making the industry more productive. The method proposed by the Business Council for Sustainable Development (BS) (2002) forms the basis of this research. The framework consists of a diagnostic study of the context and challenges faced by the Mexican marble industry in the social, political, economic, cultural, environmental, research and development dimensions.

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## 12. Sustainable Development (MMSD) Project

The 2006 Mining, Minerals and Sustainable Development (MMSD) project contributes to a three-helix comprehensive management approach for integrating the forms of capital reported in the proposed Multidimensional Model. The integration of the strengths of the marble industry in the international arena under a comprehensive management approach consisting of three helices (government, business and school) allows to align internationally reported experience and knowledge of marble industry processes with local experience. (“Sustainability | Free Full-Text | A Triple-Helix Intervention Approach ...”) In other words, the integration of the strengths of the marble industry in the international arena under a comprehensive management approach consisting of three helices - government, business and school - is comprehensive management. The state-business-school model can serve as a useful intervention guide so that academics can effectively intervene and solve problems in the marble sector value chain. This model applies to characterize the technical, productive and environmental context of the Mexican marble industry and is supported by documents from other countries. It is necessary to use a THI method to manage the processes of the marble industry to become an economically, socially and environmentally sustainable company. The findings obtained from the studies conducted within the framework of the literature and on-site are applied. The academic literature has reported that models have been developed that adopt a four- or five-helix approach, emphasizing the knowledge of society, to create synergies between economy, society and democracy. Despite this, the industry in Mexico is still in development. As a result, it is believed that in this development process, the mining industry, and more specifically the marble industry, should be guided in such a way that the use, production and transformation of products are sustainable in order to “develop itself”. Italy, Spain, Portugal, Turkey and Greece are the five countries with the largest mineral reserves in the world. Turkey is the most productive producer among these countries, accounting for 39% of the total, followed by Italy with 16% and Greece with 7%. In this industry, Palestine, Turkey and Pakistan have identified problems such as the inability to ensure a sustainable waste management from the extraction, conversion, transport and distribution of marble and the demand for large quantities of

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marble. Among these problems is the inability to achieve a sustainable waste management arising from the extraction, transformation, transportation and distribution of marble. The high demand for this resource has a negative impact on the communities in which this industry runs because of the discharge of contaminated water. This water is characterized by a high content of 95% calcium carbonate and the remaining 5% consists of chemicals such as calcium sulfide, chromium, zinc and iron used in marble cutting and finishing. On the other hand, the low level of professionalization of employees in this sector is another cause for concern. In addition, insufficient conditions in the ventilation and lighting of the facilities put the workers in this sector at risk in terms of their health in the medium and long term. In this context, the lack of good practices in the management and operation of quarries, the absence of formally set up environmental controls, companies with changing structures and organizations, negative externalities to public health and repulsive production systems are the factors affecting the integration of all these.

### 13. Conclusion

In essence, the waste produced by the marble industry consists of laminated marble pieces and sludge formed during the cutting of marble. This waste has caused obvious environmental damage, which includes altering the landscape and having an impact on flora and fauna, in addition to the pollution caused by the emission of marble dust in the air causing respiratory diseases. Given that these events have been reported in international articles, the authors suggest conducting environmental performance assessments and looking for useful and marketable alternative economies. This is because these events have been reported in international articles. Other examples include the rare earth minerals bastnaesite and xenotime, sphene and tourmaline. When it comes to Pakistan's natural resources, the province of Balochistan is by far the most abundant. The state of Punjab has the second largest rock salt deposits in the world, while the state of Khyber Pakhtunkhwa (KPK) is the richest in terms of gemstone resources. Recent exploration in Sindh has revealed large coal reserves in the region. (Omair et al., 2015; Mansoor and Nadeem, 2012).

Processing marble for its many end-uses generates a significant amount of waste that can occur in

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quarries or processing plants. The processing of marble causes about thirty percent of the material to be lost due to its irregular form or smaller size. The amount of waste in semi-processed slabs varies between 2% and 5%. Generally, there are two types of waste generated during the processing of natural stones, and they are solid waste and semi-liquid slurry. Natural fine aggregates such as sand used in concrete directly affect the environment and can cause soil and riverbed erosion. Sand mining in India has become a problem for the environment as a direct result of the obvious cost of illegal mining in India taking over the country's ecosystem and environment. Illegal mining activities have altered the flow of rivers, lowered water levels and had an inexplicable effect on living things; however, the addition of GGBS contributes to an even greater environmental optimization of the mix design. A comparative environmental assessment of the impact of FA showed that environmental benefits can be obtained from replacing some of the cement with FA in the 'non-allocation' and 'economic allocation' situation rather than in the 'collective allocation' situation. For Turkey, the situation requires more attention. For many comparable results to gain a more scientific quality, more academic articles should be supported in the literature.

## 14. References

- Afonso, O.; Monteiro, S.; Thompson, M. A growth model for the quadruple helix. *J Bus. econ. manag.* 2012, 13, 849–865. [CrossRef]
- Awad, AH; Abdel-Ghany, AW; Al-Wahab, AAA; El-Gamasy, R.; Abdellatif, MH The influence of adding marble and granite dust on the mechanical and physical properties of PP composites. *J. Therm. Anal. calorim.* 2020, 140, 2615–2623. [CrossRef]
- Bares, L. PORTINNOVA: Un estudio de caso de un modelo de la cuadruple helice. *Rev. Contrib. A Las Cienc. Soc.* 2018, 10. Available online: <https://www.eumed.net/rev/cccss/2018/03/modelo-cuadruple-helice.html> (accessed on 4 February 2020).

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Bares, L. PORTINNOVA: Un estudio de caso de un modelo de la cuadruple helice. Rev. Contrib. A Las Cienc. Soc. 2018, 10. Available online: <https://www.eumed.net/rev/cccss/2018/03/modelo-cuadruple-helice.html> (accessed on 4 February 2020).

Cobo-Ceacero, CJ; Cotes-Palomino, MT; Martínez-García, C.; Moreno-Maroto, JM; Uceda-Rodríguez, M. Use of marble sludge waste in the manufacture of eco-friendly materials: Applying the principles of the Circular Economy. *environ. sci. Pollut pic.* 2019, 26, 35399–35410. [CrossRef]

Cobo-Ceacero, CJ; Cotes-Palomino, MT; Martínez-García, C.; Moreno-Maroto, JM; Uceda-Rodríguez, M. Use of marble sludge waste in the manufacture of eco-friendly materials: Applying the principles of the Circular Economy. *environ. sci. Pollut pic.* 2019, 26, 35399–35410. [Google Scholar] [CrossRef]

Constr. build. mater. (2017)

"Figueroa, RFA Desarrollo de un Plan de Mejoramiento Para la Reducción de Fallas en el Proceso de Fabricación de Materia Derivada del Mármol y Granito en la Industria Ornamental; Universidad de San Carlo Guatemala: Guatemala City, Guatemala, 2019." ("Sustainability | Free Full-Text | A Triple-Helix Intervention Approach ...") ("Sustainability | Free Full-Text | A Triple-Helix Intervention Approach ...") [Google Scholar]

Fiş AM, Wasti AS (2010) A New Organizational Dimension: Firmness-Flexibility. Proceedings of the 18th National Congress of Management and Organization (pp. 611–618), Edited by Çukurova University 20–22May Gelfand MJ, Nishii LH, Raver JL (2006) On the nature and importance of cultural tightness and looseness. *J Appl Psychol* 91:1225–1244 Gelfand MJ, Raver JL, Nishii L, Leslie LM, Lun J, Lim BC et al (2010) The difference between "tight" and "loose" societies revisited: ecological, socio-political, and societal correlates of tightness-

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looseness in modern nations. Working paper Gelfand MJ, Raver JL, Nishii L, Leslie LM, Lun J, Lim BC et al (2011) Differences between tight and loose cultures: a 33-nation study. *Science* 332(6033):1100–1104 Morishima M (1995) The Japanese human resource management system: a learning bureaucracy. In: Moore and LF, Jennings PD (ed) *Human resource management on the Pacific Rim: institutions, practices, and attitudes*. de Gruyter, New York (pp 119–150) Nunnally JC (1978) *Psychometric theory* (2nd ed) McGraw-Hill, New York Pelto PJ (1968) The difference between 'tight' and 'loose' societies. *Transaction* 5:37–40 Semercioz F, Hassan M, Aldemir Z (2011) An empirical study on the role of interpersonal and institutional trust in organizational innovativeness. *Int Bus Res* 4(2):125–136 Toh SM, Leonardelli GJ (2012) Cultural constraints on the emergence of women as leaders. *J World Bus* 47:604–61

G. Marras et al. Characterization method for re-using marble slurry in industrial applications *Energy Procedia* (2017)

G. Marras et al. Sustainable reuse of marble sludge in tire mixtures *Resour. Pol.* (2018)

G. Tozsin et al. The effects of marble waste on soil properties and hazelnut yield *J. Clean. prod.* (2014)

H. Hebhoub et al. Use of waste marble aggregates in concrete *Constr. build.* ("Effects of waste glass and waste marble on mechanical and ... - Nature") ("Effects of waste glass and waste marble on mechanical and ... - Nature") *Mater.* (2011)

HY Aruntas et al. Use of waste marble dust as an additive in cement production *Mater. Des.* (2010)

*L'Industria Mineraria. Serie II - anno XVII, Rome. no. 4, Aprile 1966, p. 168.*

M. Singh et al. An investigation on effect of partial replacement of cement by waste marble slurry

ME Cinar et al. Characterization of composite produced from waste PET

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- and marble dust Construct. build. mater. (2018)
- MJ Munir et al. Thermally efficient fired clay bricks incorporating waste marble sludge: an industrial-scale study J. Clean. prod. (2018)
- Mineral Facts and Problems. Bulletin no. 630-1965. Bureau of Mines, Washington, pp. 875-893.
- N. Careddu et al. Promoting ecological sustainable planning for natural stone quarrying. The case of the Orosei Marble Producing Area in Eastern Sardinia Resour . (“The crisis of granite and the success of marble: errors and market ...”) (“The crisis of granite and the success of marble: errors and market ...”) Pol. (2011)
- N. Careddu et al. Raw materials associated with extractive industry: an overview Resour. Pol. (2018)
- N. Careddu et al. Recovery of sawdust resulting from marble processing plants for future uses in high value-added products J. Clean. (“Preliminary investigations on stone cutting sludge processing for a ...”)
- (“Preliminary investigations on stone cutting sludge processing for a ...”) Prod. (2014)
- Pappu, A.; Chaturvedi, R.; Tyagi, P. Sustainable approach towards utilizing Makrana marble waste for making water resistant green composite materials. SN Appl. sci. 2020, 2, 347. [CrossRef]
- Pappu, A.; Chaturvedi, R.; Tyagi, P. Sustainable approach towards utilizing Makrana marble waste for making water resistant green composite materials. SN Appl. sci. 2020, 2, 347. [Google Scholar] [CrossRef][Green Version]
- Relazione dell' Assemblca Generale Ordinaria dell 'Indústria Marmifera Italiana. Rome, ed. arte
- V. Corinaldesi et al. Characterization of marble powder for its use in mortar and concrete Construct. build. mater. (2010)

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