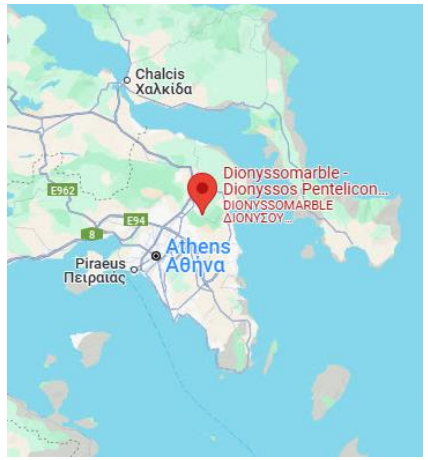
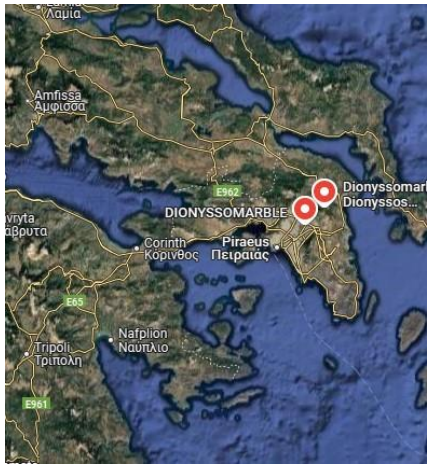
Penteli

Environmental Management

of Marble Powder





CRM: Magnesium

Overview | CRMs (Mg, Mn) | Location

VE | History | VEs Map

Disclaimer

CRM: Manganese

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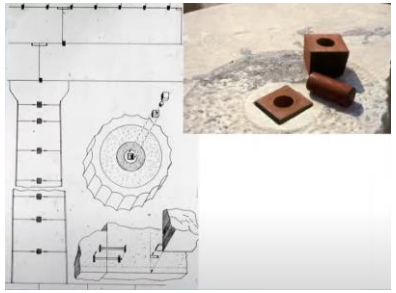
History of Pentelic Marble

The high quality of Pentelic Marble was well-known in the 6th B.C. Century.
The Ancient Hellenistic period from 6th – 3rd B.C. Century was historically named "Gold Century"
Parthenon is the most famous cradle of civilization. It is constructed with carved-out Pentelic Marble.

The Sarcophagus of Alexander the Great is carved out with the Pentelic Marble



True Lies

It is wrongly declared that the construction of the Parthenon took many years, and many slaves died before its finalization due to the time of Pentelic marble delivery from Penteli to the Acropolis.
The point is that the columns of the Parthenon are structured by separated sculptured marbles placed one over the other. Internally, a metallic rounded column offers a high level of stability to the whole construction.

By-Product containing CRMs (Mg, Mn)
Marble Powder Collection & Utilization

Dionyssomarble AEVE extracts the Pentelic Marble as the primary product. However, in terms of the Circular Economy and respecting the policy of 4Rs (reduce the produced waste, recover & recycle beneficial materials contained in waste, reuse waste) as declared in the Green Deal, an innovative environmental management system is implemented to utilize the marble powder that contains CRMs (Mg and Mn), as building material, especially by the concrete industry.

After the primary extraction of the Pentelic Marble (shown in the first two panoramas), the primary product is transferred to the factory to be cut into pieces or polished. The marble cutting is done wet to collect the released powder. The aqueous marble powder could be transferred to the concrete industry units to produce Portland limestone cement.

Applying this environmental management system, the company utilizes the produced waste, which contains CRMs (Mg, Mn), and offers high compressive strength to the produced concrete mix. The proportion of the required CRMs (Mg, Mn) in the Portland limestone cement mix falls within specific limits 0,02-2%, as their concentration in the marble powder. Therefore, the waste produced from cutting marble is directly reused after its collection.

Marble Powder Reuse | **Marble Powder Info**

By-Product Marble Powder
Collection & Utilization

Utilization of CRMs (MgO&MnO), contained into the Pentelic Marble Powder, in limestone Cement Production for Construction Works

Sources:

https://doi.org/10.1016/j.optlaseng.2010.10.005

https://doi.org/10.1016/S0958-9465(01)00089-0

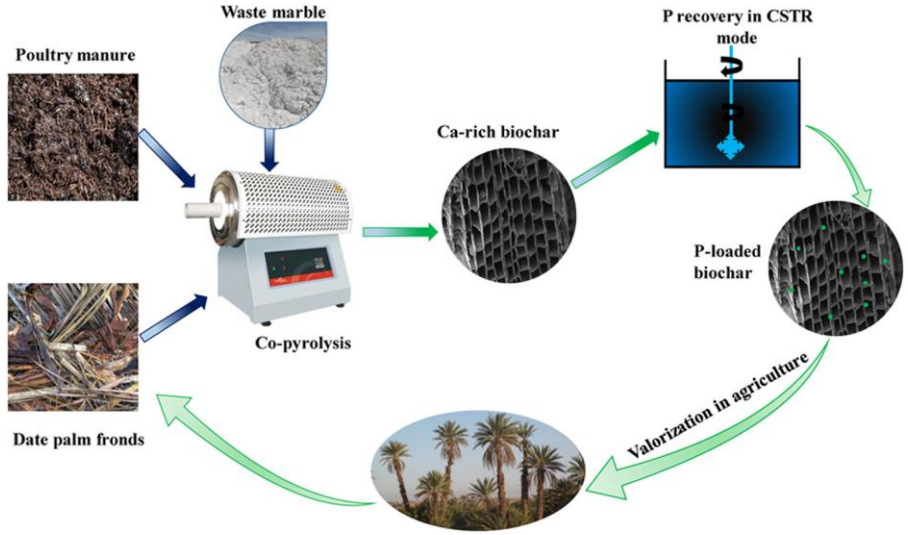
Generally, by-product of Marble Dust-Marble Powder can be reused in separate industrial applications.

The most common reuse corresponds to the structural materials, such as cement and bricks

General Utilization of Marble Powder in the Construction of Reactors Used in the Synthesis of Novel Calcium-rich Biochar-Phosphorus Recovery

Source:

https://doi.org/10.1016/j.jenvman.2023.119926



By-Product
Marble Powder

Utilization of Pentelic Marble Powder As Structural Material
Marble Powder, produced from cutting Pentelic Marble, is utilized in the cement industry as a structural raw material.

Main Elements contained in the Pentelic Marble Powder	Source: Hellenic Survey of Geology and Mineral Exploration (H.S.G.M.E.) (*Click to see the Elemental Analysis)
Element	**Concentration (%)**
(SiO_2)	2,95
(MgO)	**1,3**
(MnO)	**0,05**
(Al_2O_3)	1,6
(Fe_2O_3)	0,3
(CaO)	50,9
Other	**42,9**

It contains 0.02-2% Magnesium and Manganese.
*Generally, the size of the Powder rapids the chemical binding, and its content in metalloids increases the compressive strength of the cement mix. According to ASTM C114, when the contained percentages of MgO and MnO in the marble powder meet the required permissible limitations for concrete mix, the specific marble powder is utilized in cement farina production. Otherwise, if the %ratios of contained MgO & MnO exceed this limitation, the powder could be utilized to produce bricks after ignition.

A typical elemental analysis of Cement mix containing Marble Powder is shown below (Source: https://doi.org/10.1016/j.jclepro.2018.01.267)

CRMs
Magnesium (Mg), Manganese (Mn)
Click to see Criticality Assessment of Mg, Mn

Supply Risk: Risk Grade of the material resources
Economic Importance: Grade of the material's price value to the market
Criticality: Grade of material's impact on the Market

CRM	Supply Risk SR	Economic Importance EI	Criticality CR
Magnesium (Mg)	4.1	6.7	27.47
Ranges for SR, EI, CR	0-5	0-9	0-45
Impact on SR, EI, CR (%) (Numerical Value of the CRM) ÷(Maximum Threshold)	$(SR)_{CRM} \div (SR)_{Max}$ 8 2%	$(EI)_{CRM} \div (EI)_{Max}$ 74.4%	$(CR)_{CRM} \div (CR)_{Max}$ 61%

CRM	Supply Risk SR	Economic Importance EI	Criticality CR
Manganese (Mn)	1.2	7	8.4
Ranges for SR, EI, CR	0-5	0-9	0-45
Impact on SR, EI, CR (%) (Numerical Value of the CRM) ÷(Maximum Threshold)	$(SR)_{CRM} \div (SR)_{Max}$ 2 4%	$(EI)_{CRM} \div (EI)_{Max}$ 77.7%	$(CR)_{CRM} \div (CR)_{Max}$ 18.6%

Source: European Commission: Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, Grohol, M. and Veeh, C., *Study on the critical raw materials for the EU 2023 – Final report*, Publications Office of the European Union, 2023, **https://data.europa.eu/doi/10.2873/725585**

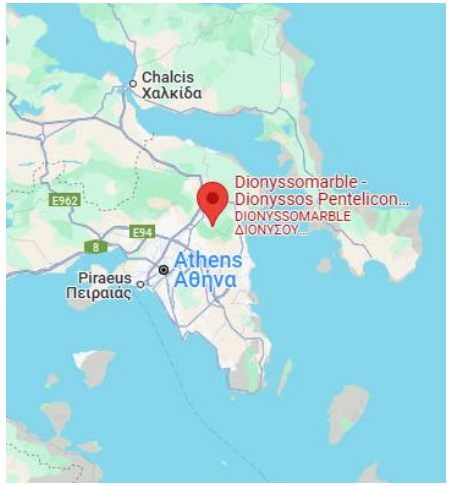
Criticality Matrix

Criticality Matrix		Supply Risk (SR)				
		1	2	3	4	5
(CR)=(EI)*(SR)						
Economic Importance (EI)	1	1	2	3	4	5
	2	2	4	6	8 **(Mn=8.4)**	10
	3	3	6	9	12	15
	4	4	8 **(Mn=8.4)**	12	16	20
	5	5	10	15	20	25
	6	6	12	18	24	30
	7	7	14	21	28	35
	8	8 **(Mn=8.4)**	16	24	32	40
	9	9	18	27 **(Mg=27.47)**	36	45

- The **Criticality Matrix** displays a quantitative assessment of the Criticality grade for each examined raw material, based on the information contained in the European Study on CRMs, as shown below on this slide.
- The **Supply Risk (SR)** and **Economic Importance (EI)** refer to variable parameters that depends on the entire resources of raw materials and their configured price values according to their demand, respectively. i.e. the SR of a raw material could fluctuate within a period. Therefore, depending on the global resources data and industrial needs, the corresponding Study for CRMs could be updated, including the existing SR and EI indices for raw materials.
- The **Criticality (CR)** is configured by the multiplication of EI and SR grades. The CR index shows the criticality grade of each examined raw material.

Source: European Commission: Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, Grohol, M. and Veeh, C., *Study on the critical raw materials for the EU 2023 – Final report*, Publications Office of the European Union, 2023, **https://data.europa.eu/doi/10.2873/725585**

Map of the Virtual Excursion



DionyssoMarble AEVE Factory

Latitude:38°09’66.1”N_Longtitude:23°90’38.3”E

Disclaimer

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