Valorisation of waste marble powder as additive of epoxy polymers for the protection of commercial marbles

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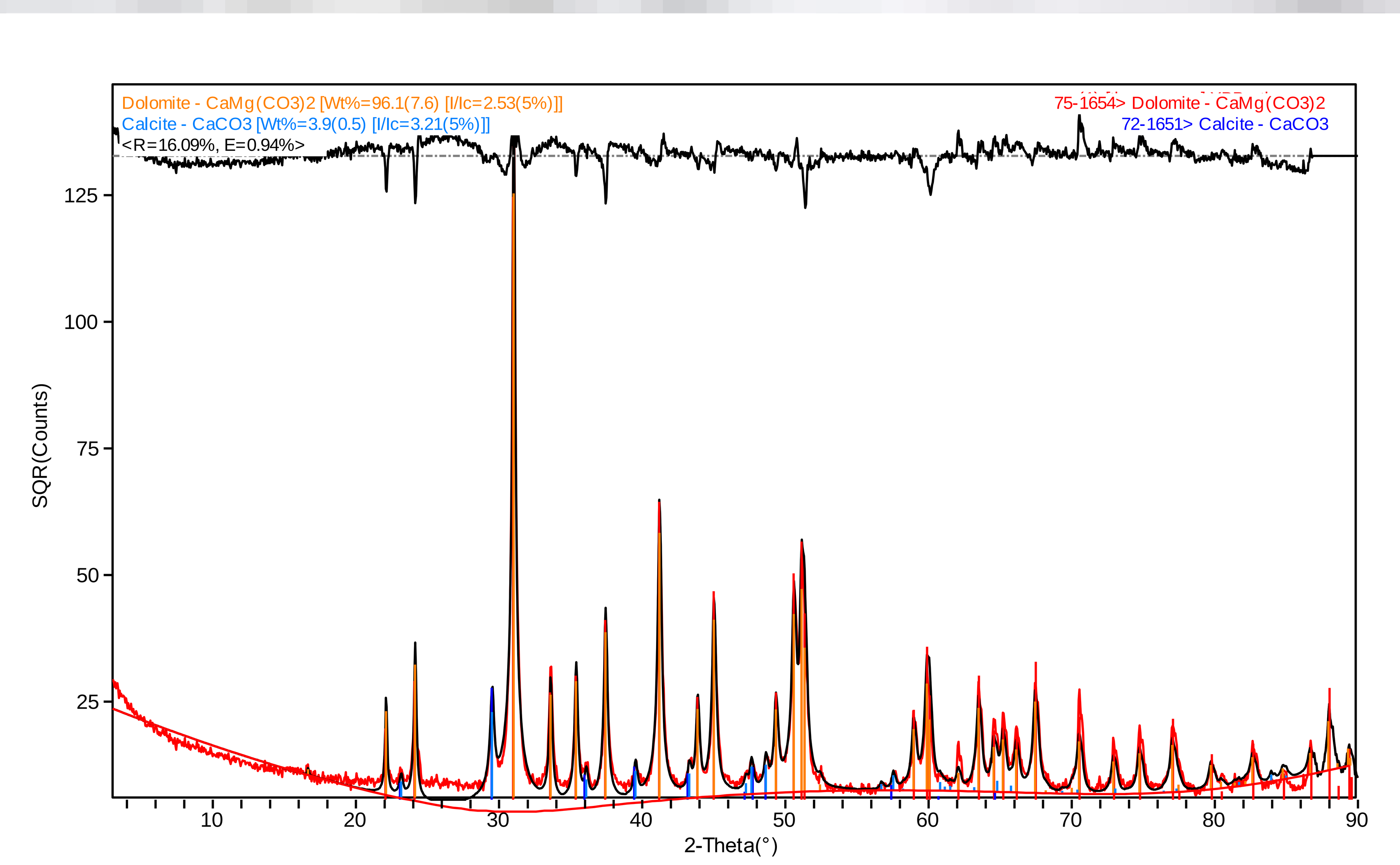
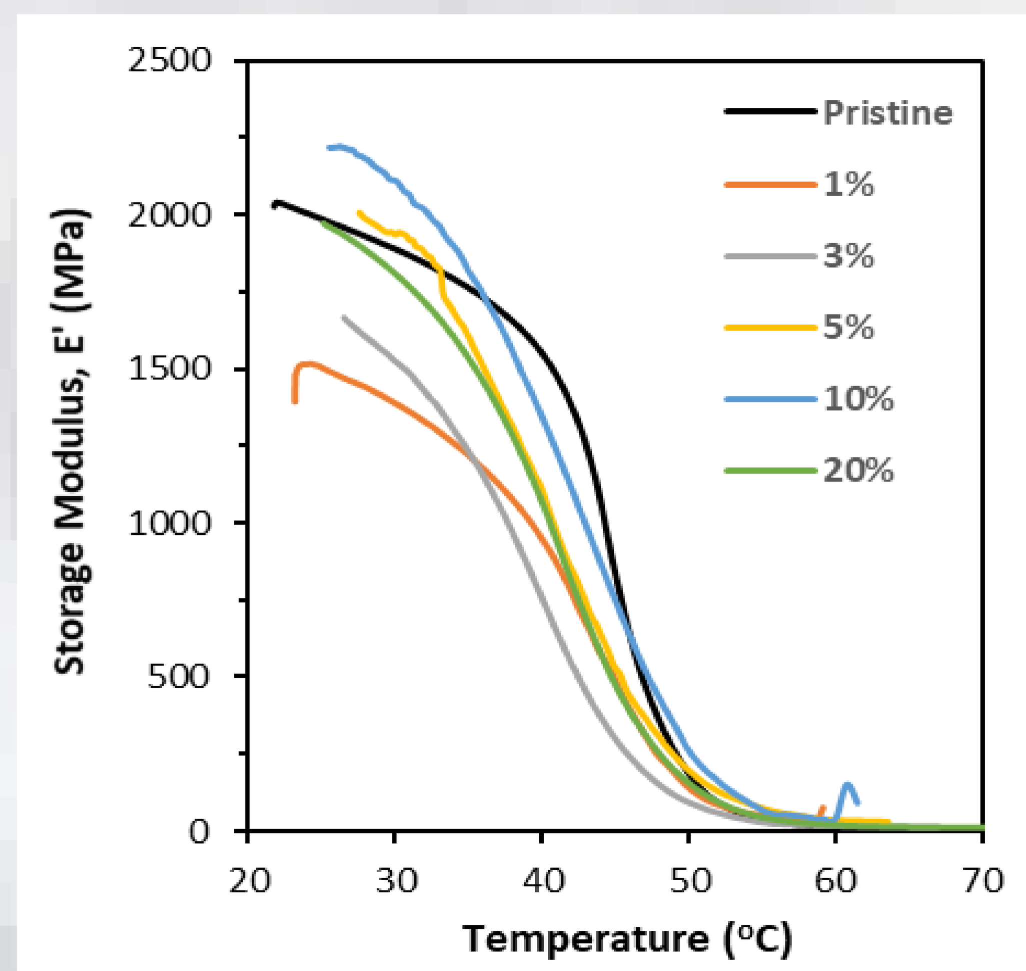
Introduction

- Marble has been used since antiquity as a building material, with a range of uses that extends from small structures to grand monuments that exist for centuries.
- Despite the particularly good properties of marble, there are some difficulties that must be addressed during the stages of processing and application of the material. The most important of these difficulties are the vulnerability to environmental corrosion, the damages during processing and transportation, and the management of the waste marble powder (WMP).
- WMP is a by-product of marble cutting and polishing processes, that cannot be stored and should be utilized in other sectors.
- To prevent marble damaging during processing and transporting, the use of protective agents has been implemented, which are either impregnated into the marbles to increase the consistency of the structure or used as coatings for corrosion protection. A common class of marble protecting agents is crosslinked epoxy resins.
- The **aim the present work** is to study the potential use of WMP as an epoxy polymer additive and the production of a composite resin with improved marble protection action compared to the respective neat epoxy polymer. The benefits of an approach like this are manifold, as WMP, a by-product of marble industry, will be used to improve the properties of the final commercial products of the same industry. This way economic losses can be reduced, and environmental pollution can be prevented.

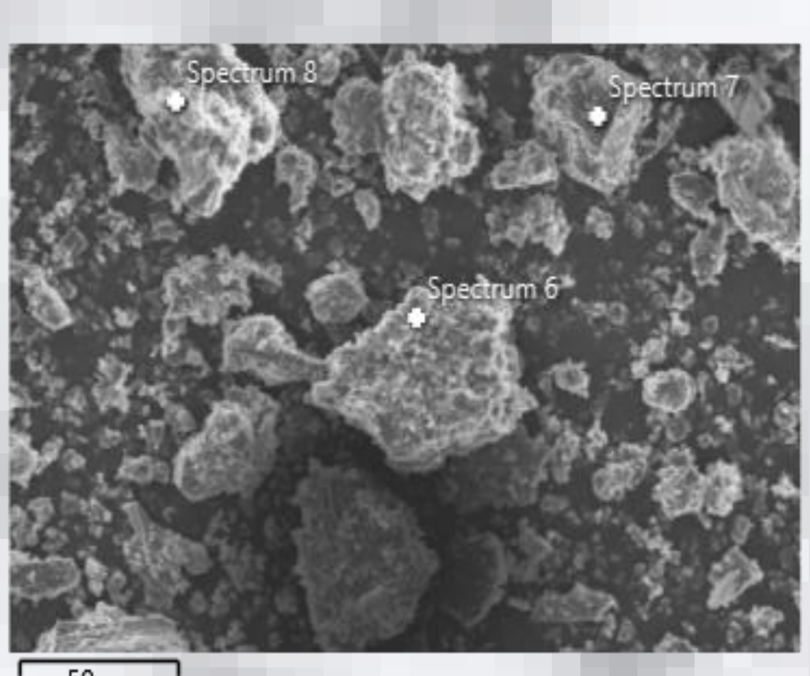
Results & Discussion



XRD spectrum of Thasos WMP



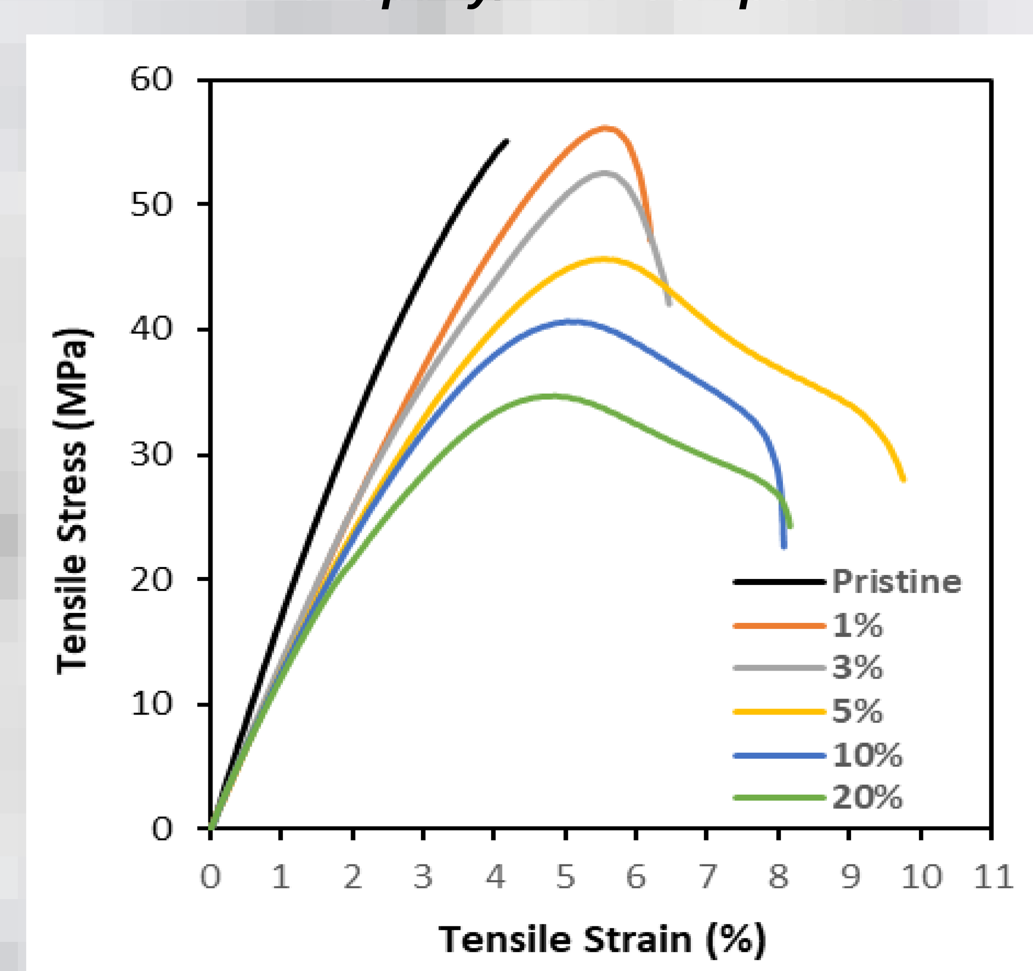
DMA of epoxy/WMP composites



SEM image of Thasos WMP

Elemental analysis of Thasos WMP

Spectrum Label	Weight %		
	Spectrum 6	Spectrum 7	Spectrum 8
O	29	0	62
Mg	12	20	14
Ca	59	80	24
Total	100	100	100



Tensile strength of epoxy/WMP composites

Conclusions

- The identification and quantification of phases via XRD revealed that Thasos marble consists of 96.1 % dolomite and 3.9 % calcite.
- SEM revealed that the WMP consists of particle agglomerates with variable size (up to ca. 100 μm), while the primary particles are of irregular shape and significantly smaller size.
- The elemental analysis results of WMP are characteristic of dolomite and calcite structure
- As it was shown from the DMA curves, the thermomechanical properties of epoxy/WMP composites increase with increasing WMP loading up to 10 wt. % and then decrease.
- The stress-strain curves of epoxy/WMP composites revealed that by increasing the WMP loading up to 20 wt. % the strength of the composites decreases monotonically, and the flexibility decreases.

SafeMarble

Project code : T2EDK-02205

European Union
European Regional Development Fund

HELLENIC REPUBLIC
MINISTRY OF DEVELOPMENT AND INVESTMENTS
SPECIAL SECRETARIAT FOR ERDF & CF PROGRAMMES
MANAGING AUTHORITY OF EPAnEK

EPAnEK 2014-2020
OPERATIONAL PROGRAMME
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ENTREPRENEURSHIP
INNOVATION

ΕΣΠΑ 2014-2020
ανάπτυξη - εργασία - αλληλεγγύη
Partnership Agreement 2014 - 2020

Co-financed by Greece and the European Union