

# Use of marble crushed sand in cementitious materials

*Effrosyni Christodoulou<sup>1</sup>, Maria Amenta<sup>2</sup>, Zoi S. Metaxa<sup>2</sup>, Dimitrios Papaevaggelou<sup>1</sup>, Stavros K. Kourkoulis<sup>3</sup>, Athanasios Ekmektsis<sup>1</sup>, and Athanasios C. Mitropoulos<sup>2</sup>*

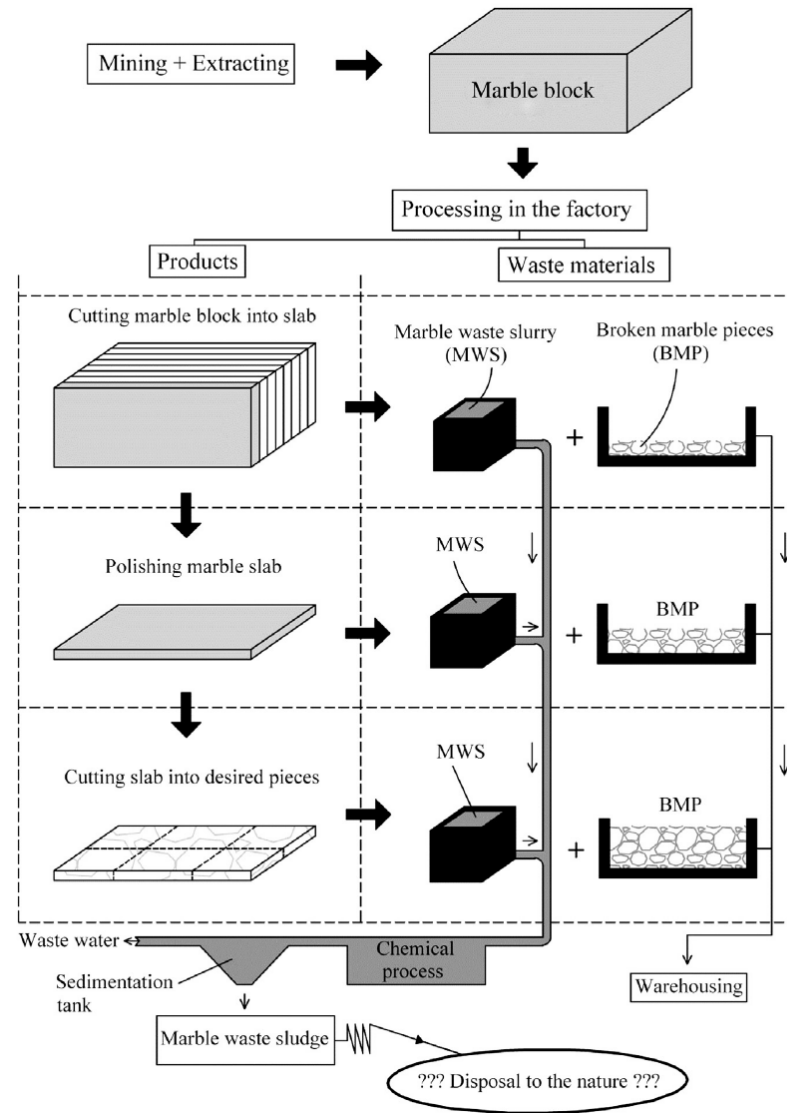
<sup>1</sup>Alexandros SA, 53 Mix. Karaoli str, 67100, Xanthi, Greece

<sup>2</sup>International Hellenic University, School of Sciences, Department of Chemistry, Hephaestus Laboratory, St. Luke 654 04, Kavala, Greece

<sup>3</sup>National Technical University of Athens, Department of Mechanics, Laboratory of Testing and Materials, 9 Heroes Polytechniou Str., 15780 Athens, Greece



# Marble waste



Marble slurry deposited in nature



- Marble slurry
- Broken marble pieces

# Benefits from utilizing marble waste in construction industry

- ❖ reduce the CO<sub>2</sub> emissions
- ❖ lessen the usage of raw materials that are in great demand
- ❖ reduce the consumption of fuels and power
- ❖ offer economic advantages to cement industries
- ❖ increase the consumption of a waste material which otherwise would be dumped

## In this study:

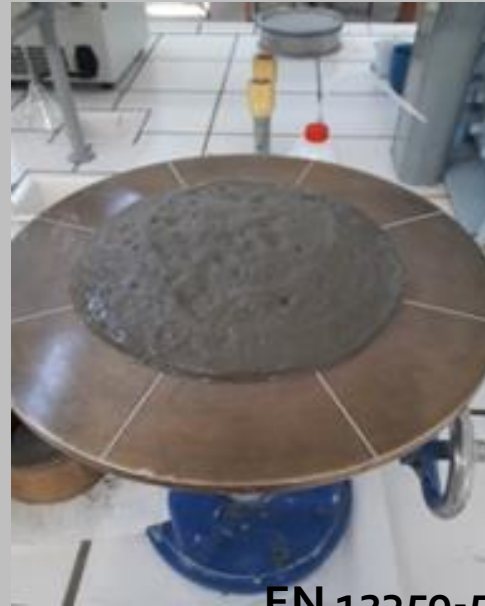
Investigate the effect of partial **substitution of natural aggregates with waste marble crashed sand** on the **rheological properties of mortars**

Investigate the effect of **waste marble crashed sand granulometry**

# Rheological properties of fresh mixtures



EN 196-12



EN 12350-5



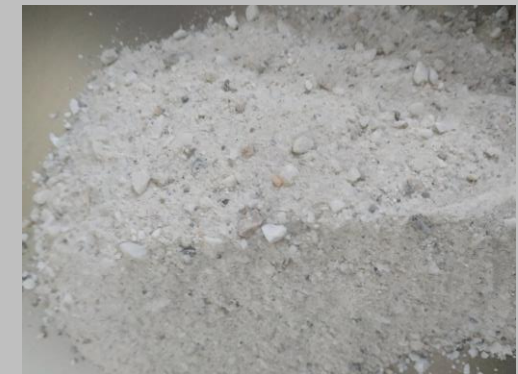
EN 196-3:2005

# Effect of Granulometry



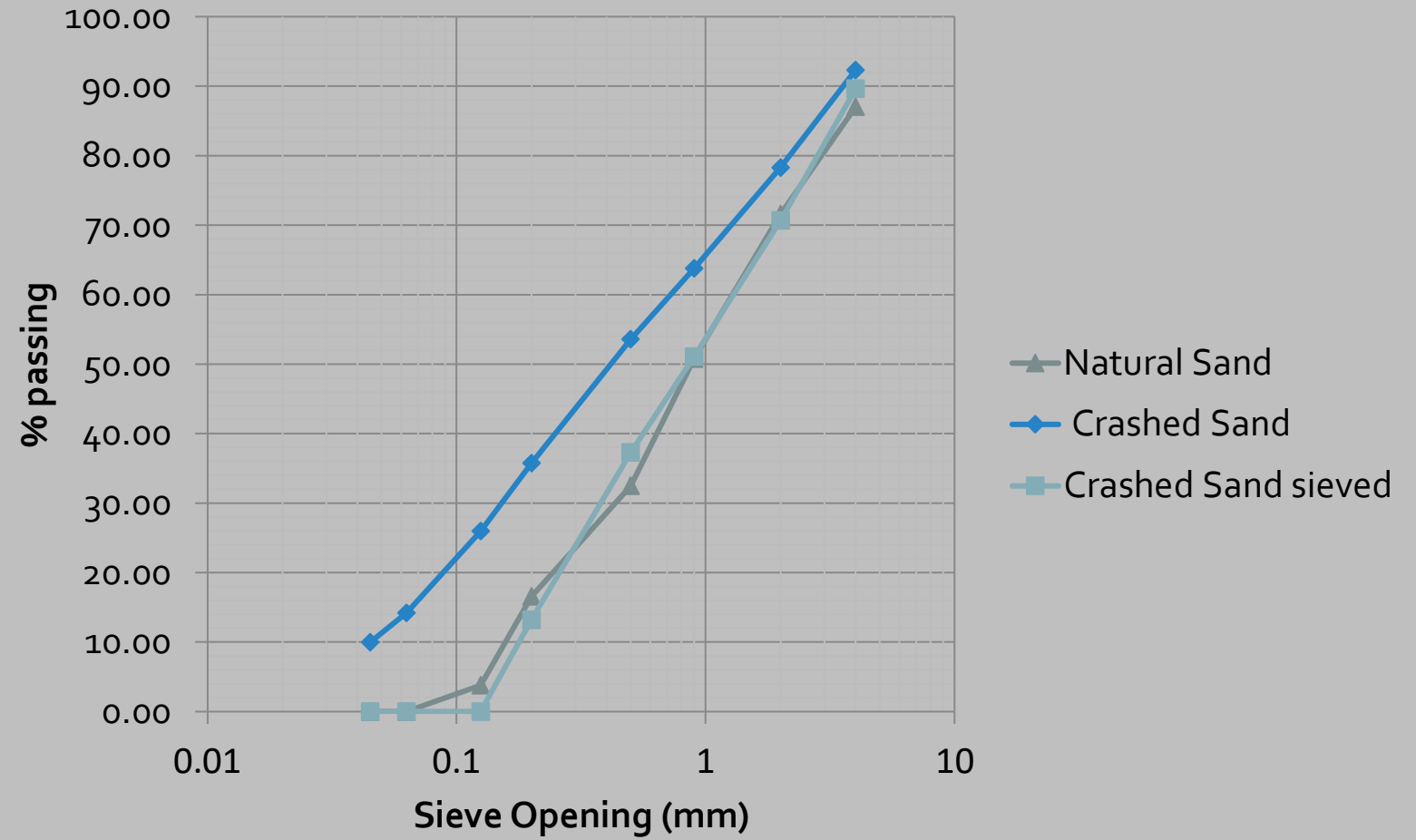
EN 933-1:2012

- Crashed sand (C)
- Crashed sand Sieved (CS) to remove the finer fractions ( $<125\ \mu\text{m}$ )



# Effect of Granulometry

## Granulometry

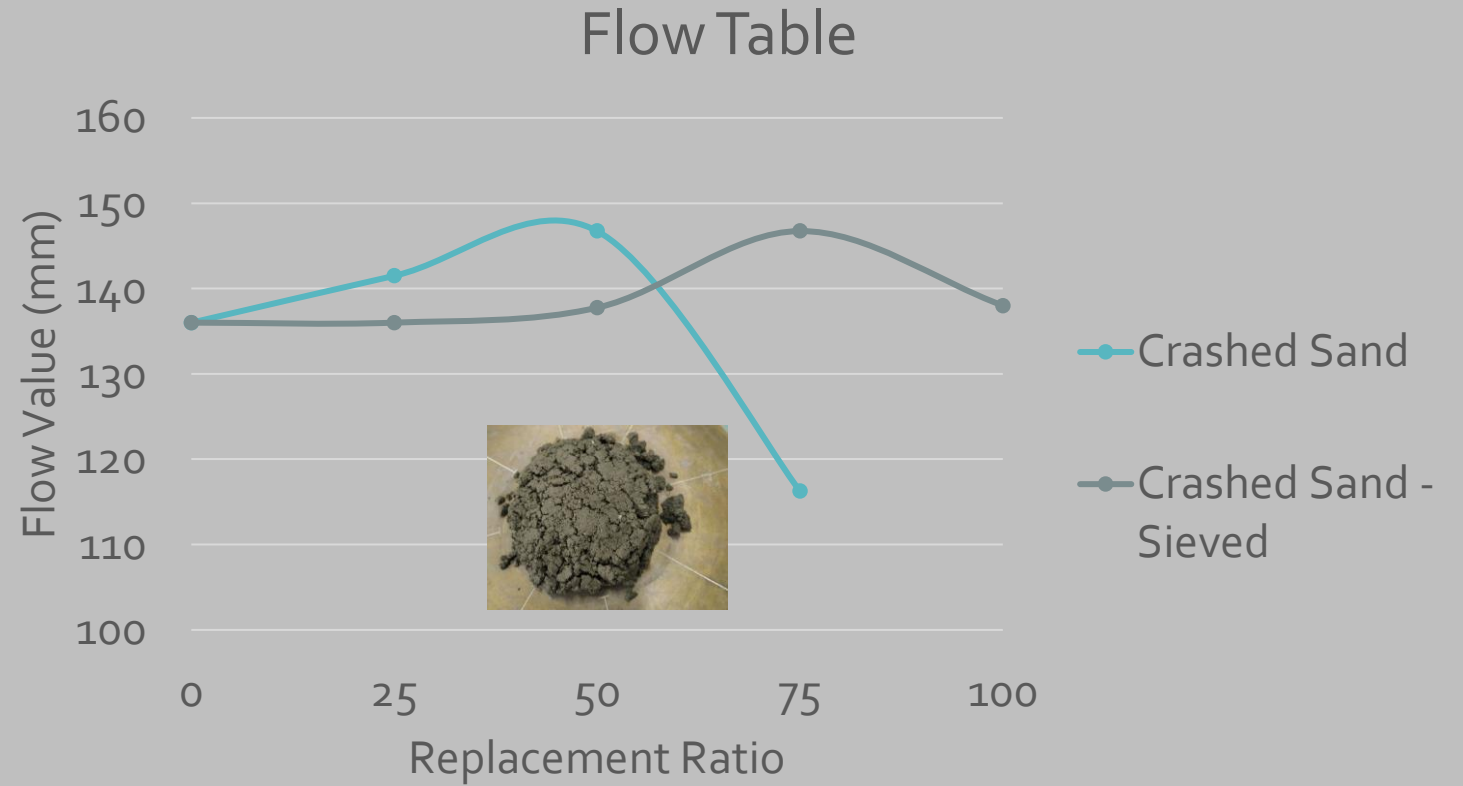






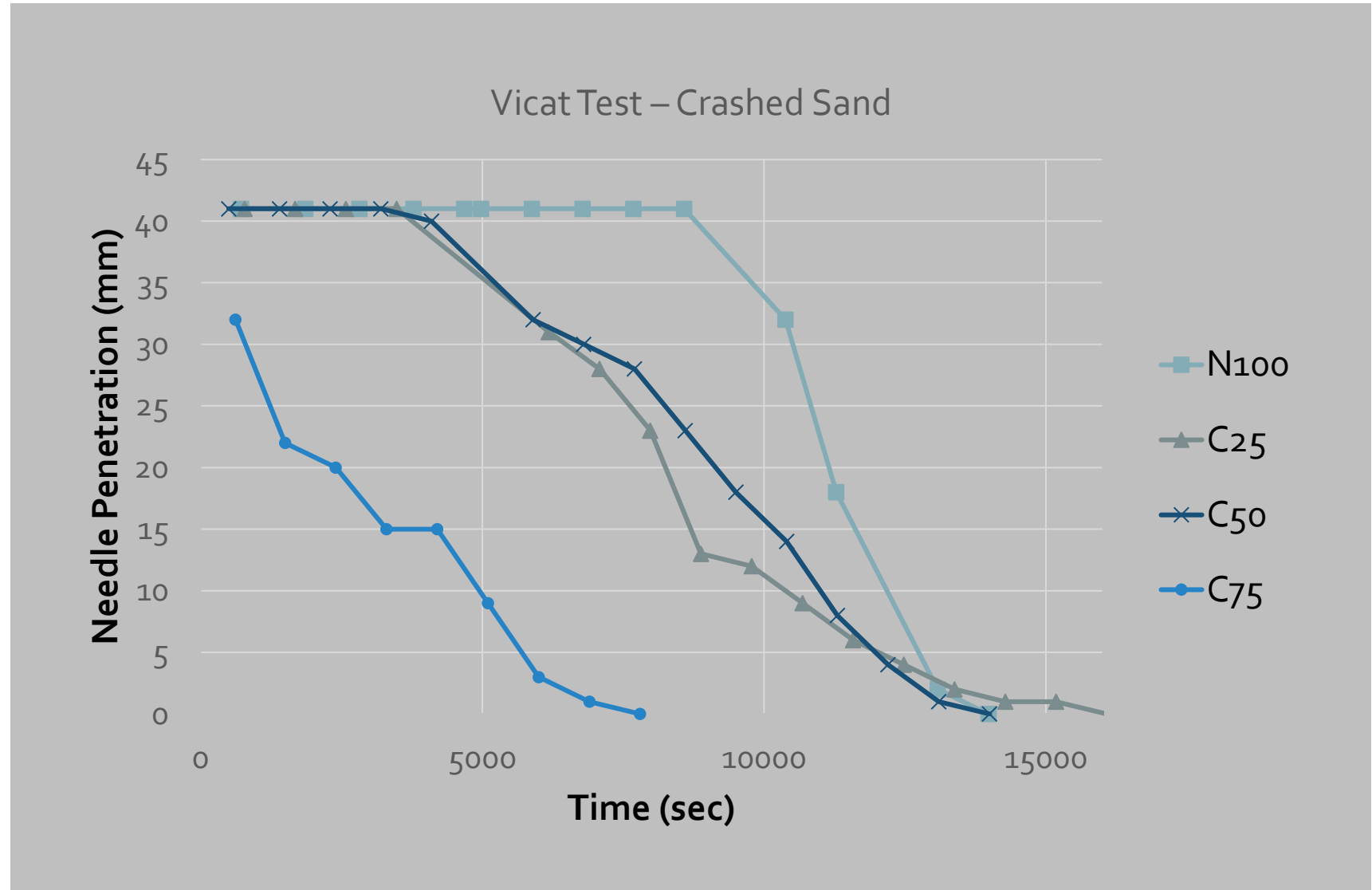
# Results

## Flow Table



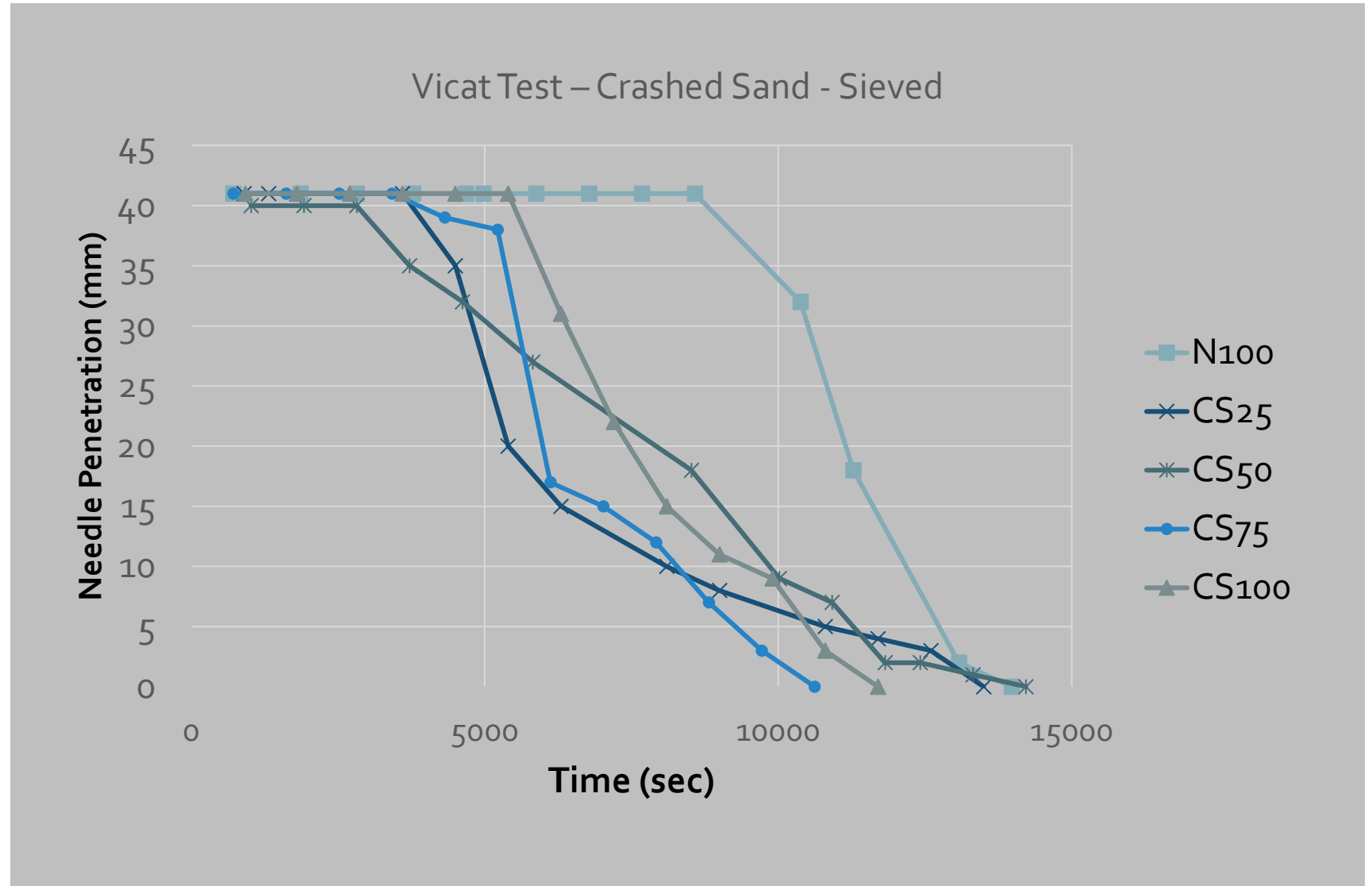
# Results

## Vicat Test



# Results

## Vicat Test



# Conclusions

- ❖ The replacement of natural sand by crashed marble aggregates up to 50% leads to the improvement of the fresh mortar properties
- ❖ Further addition of crashed sand leads to a severe reduction of workability
- ❖ When sieved crashed sand was used the replacement ratio could be raised up to 100% without any depreciation of the fresh mixture workability
- ❖ The main disadvantage shown by Vicat testing is the earlier setting time measured when crushed aggregates are used and should be accounted for in practical applications

Thank you  
for your  
attention!

The authors acknowledge the financial support of the EU (European Social Fund-ESF) and Greek national funds through the Program:

**"Investment innovation plans for research and development for companies in the quarrying sector"**

