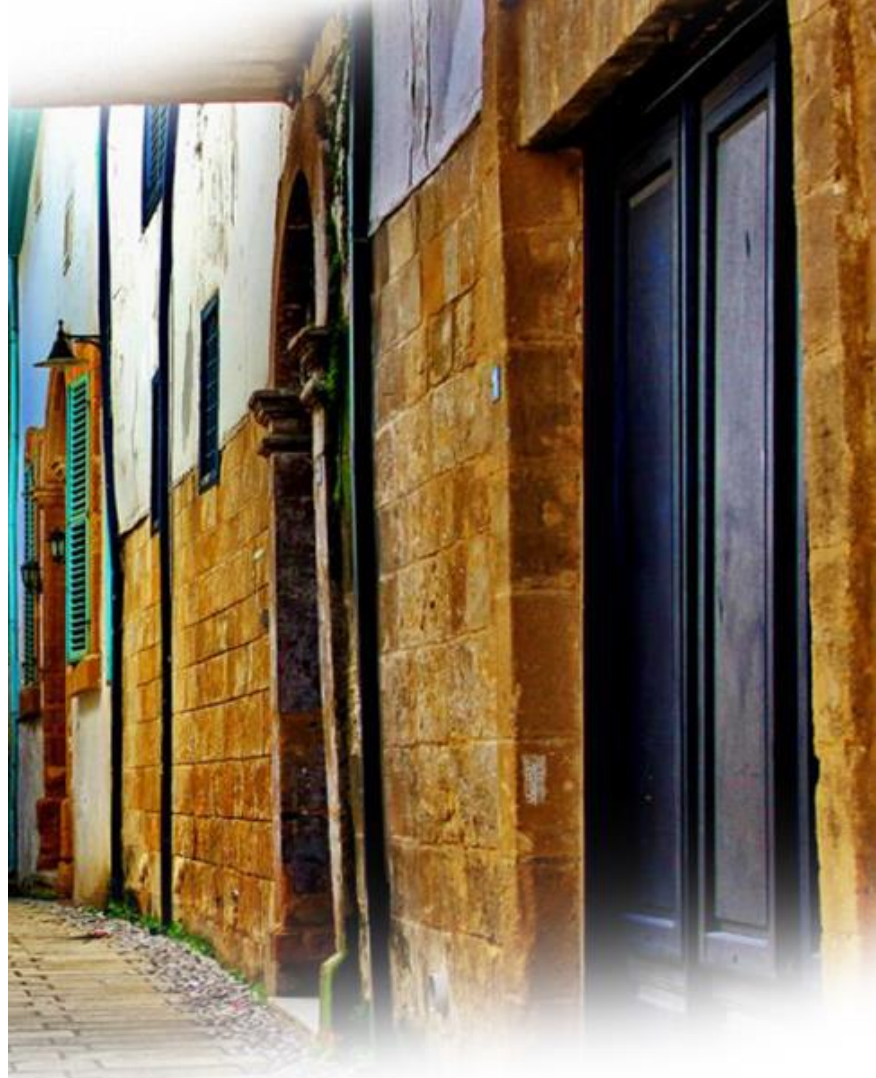
Use of industrial and poultry wastes in concrete sector
Endüstriyel ve kümes hayvanı atıklarının beton sektöründe kullanımı

Assoc. Prof. Dr. Ertuğ Aydın
Doç. Dr. Ertuğ Aydın

Material/Malzeme
European University of Lefke/Lefke Avrupa Üniversitesi



Current Situation

- World population ≈ 8 billion
- Annual cement consumption≈ 4.6 billion tons worldwide
- Expected to increase by about 6 billion by the year 2050
- The concrete sector responsible for huge amount of CO_2
- Concrete is one of the most widely used materials, with world utilization approaching 25 Gt per annum

Sustainability

- Global warming is a recognized phenomenon
- Reducing carbon emissions is an important issue in the construction sector.
- It is mandatory to minimize environmental impact and carbon footprint by incorporating the use of wastes, such as, bottom ash, or marble powder, in building construction

Development in Construction Industry

- The term sustainability, first introduced in the Brundtland Report in the 1980s
- Offers the use of alternative supplementary cementitious materials in concrete construction
- Cement can either partially replace various wastes or be used during the manufacturing stage of the cement to attain sustainability goals

Sustainability

- Interest in the sustainably built environment and green technology has been increasing worldwide
- There is a growing interest in a sustainably built environment, and green technologies are gaining worldwide attention

Marble powder and Bottom Ash Wastes

- 30-35% of waste is produced during the marble cutting
- Bottom ash wastes are generated burning coal used for firing bricks.
- This waste, like other wastes, causes serious storage problems as well as environmental damage.

Eggshells

- In US 150 000 tones of eggshell produced annualy
- Rich in calcium carbonate
- As is known, eggshell refers to poultry wastes that accumulate in landfills and pollute the environment.
- This type of waste is becoming popular in concrete production that can partially replace cement
- Few scientific studies were studied the possibility of utilization of eggshell in concrete performance

Application Areas

- BA is additionally used in embankments, waste stabilization, municipal solid waste (MSW) management, and road base/sub-base, and as an ingredient in cement manufacturing.
- Some high-strength concrete (HSC), fiber-reinforced, and self-compacting BA applications have been reported

Aim of Study

- The present study is aimed to investigate the use of waste materials, as cement substitutions, to produce environmentally friendly and cost-effective building materials.
- Composites were designed to produce ecological and economical products. Utilization of waste materials in construction sector is the way to achieve sustainable building.

Mixture proportions

➡ **Phase 1**

Marble dust 20-25 %

Bottom ash 20-25%

Cement 75-80%

Another set of mixture group composed of 25%Marble dust+25 bottom ash, 50% cement. 30%MD+30%BA, 40% cement also prepared.

Mixture proportions

- **Phase 2**

- The second phase involved the inclusion of eggshell at 0.5%, 1%, 1.5%, and 2% in cement paste.

Methodology

- The composites were prepared in a Hobart-type mixture with a 2-liter capacity
- The water-cement ratio was 0.40 throughout the investigation.
- The replacement percentages are by mass of cement.

Laboratory Tests

- Fresh Unit Weight
- Mini slump
- Flow Table
- Dry Unit Mass
- Water Absorption
- Porosity
- Apparent Specific Gravity

Compressive Strength

Flexural Strength

Sodium Sulfate Test

Sea water resistance

Composites

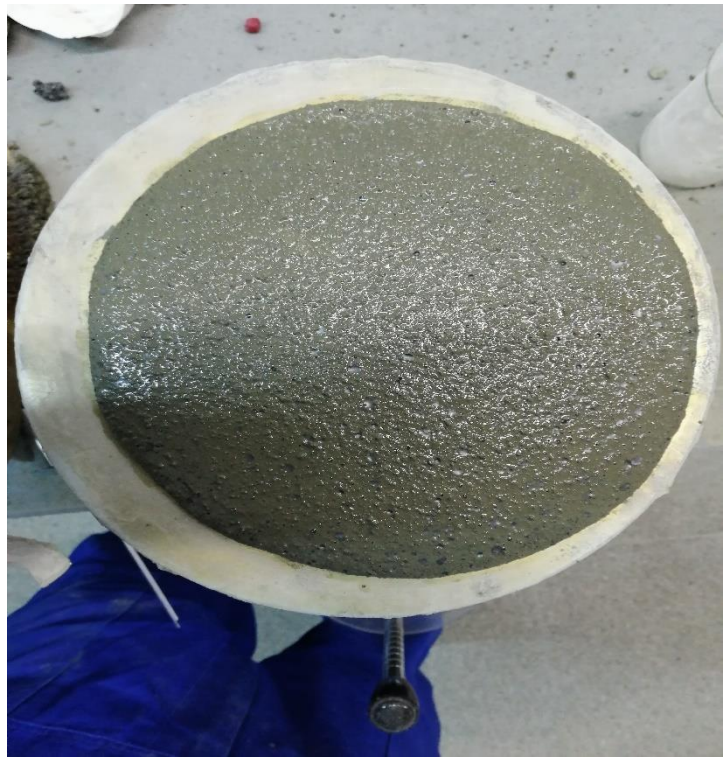
- The laboratory produced cement paste composed of
- Bottom ash
- Marble dust
- Eggshell
- Cement

- Bottom ash was obtained from Levent brick factory plant-Lefkosa
- Marble dust was obtained from Stonite marble factory-Lefkosa
- Eggshell was obtained from local bakery (Arkadaş Pastanesi/Lefke local bread bakery)
- CEM I cement

Sample size

- 40 mm x 40 mm x 160 mm prisms
- 50 mm cubic samples

Laboratory work

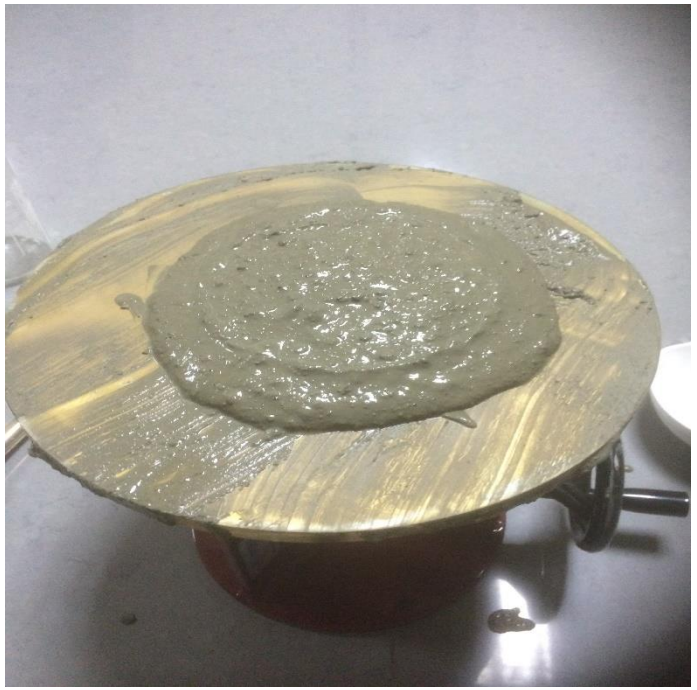


Bottom ash cement paste composites

Marble dust cement paste composites

Eggshells

Workability of Eggshell cement paste composites

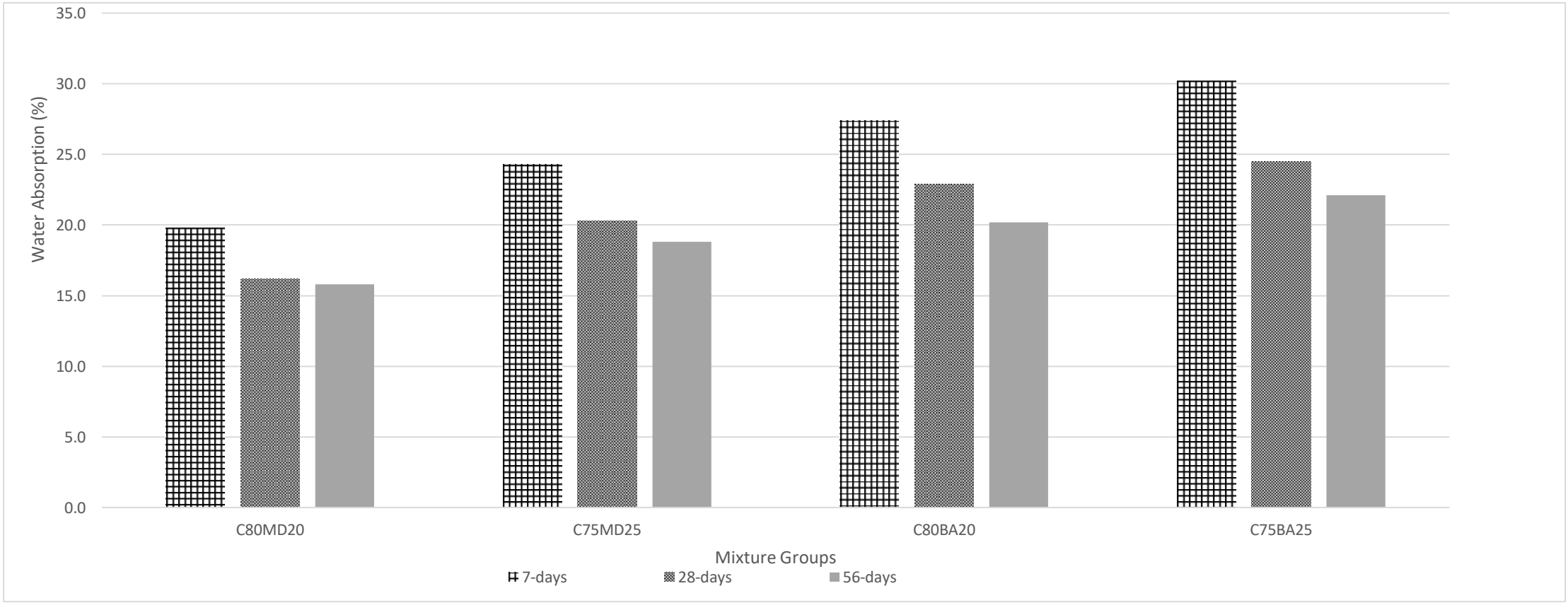


Casting of Cement Paste Composites

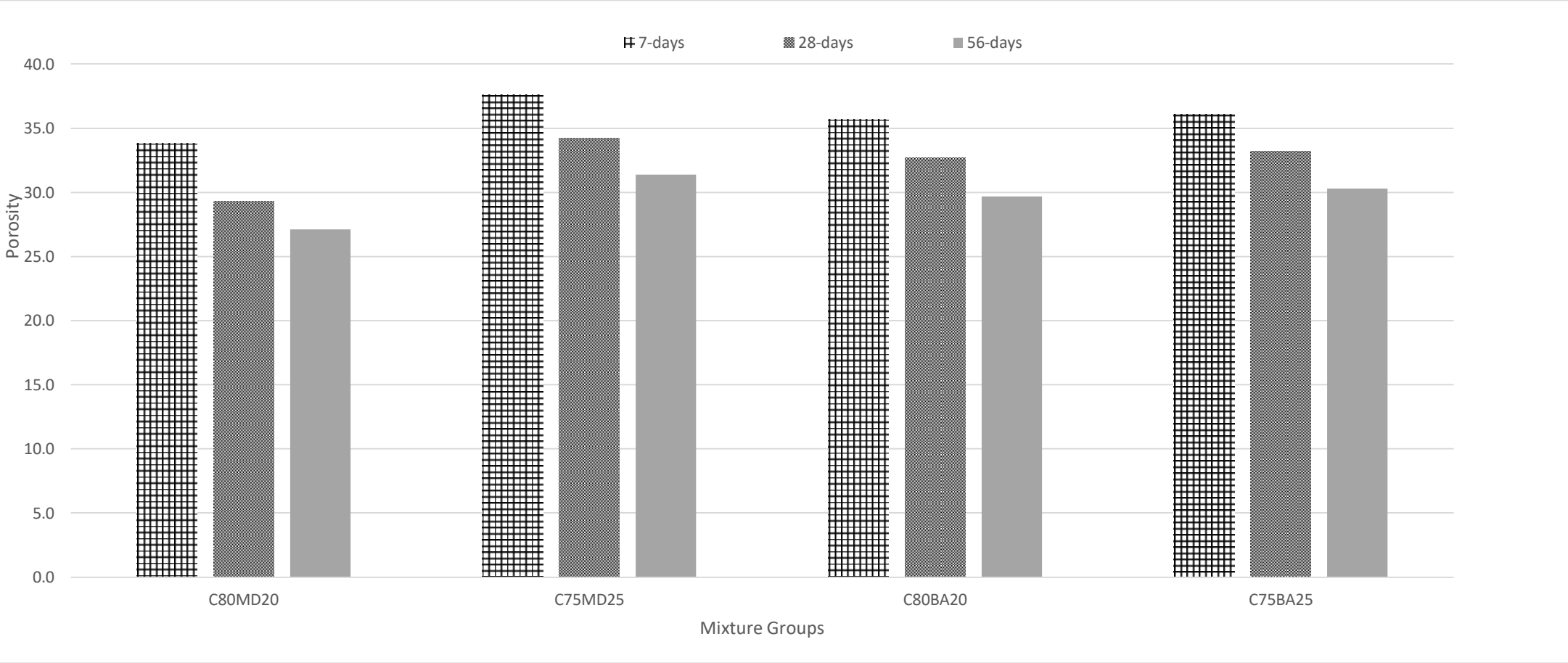
Laboratory Produced Eggshell Composites

Laboratory produced eggshells

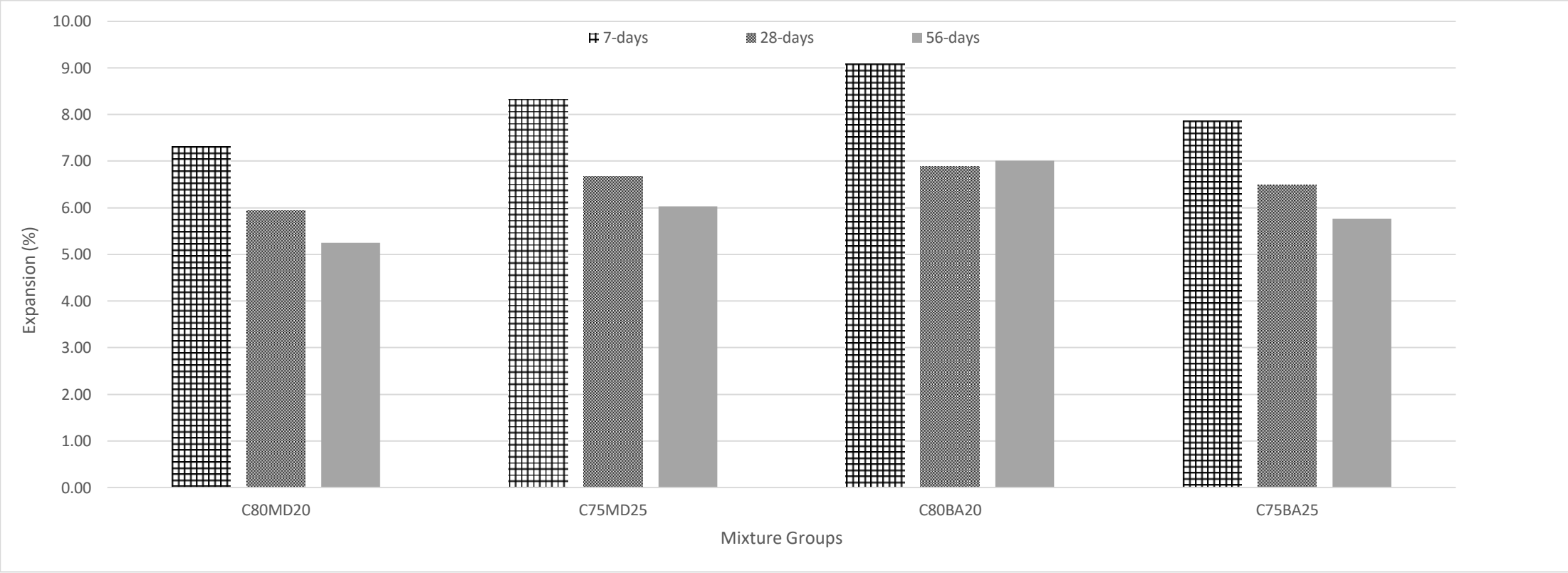
Water Absorption



Porosity


7-days
28-days
56-days
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Porosity
C80MD20
C75MD25
C80BA20
C75BA25
Mixture Groups

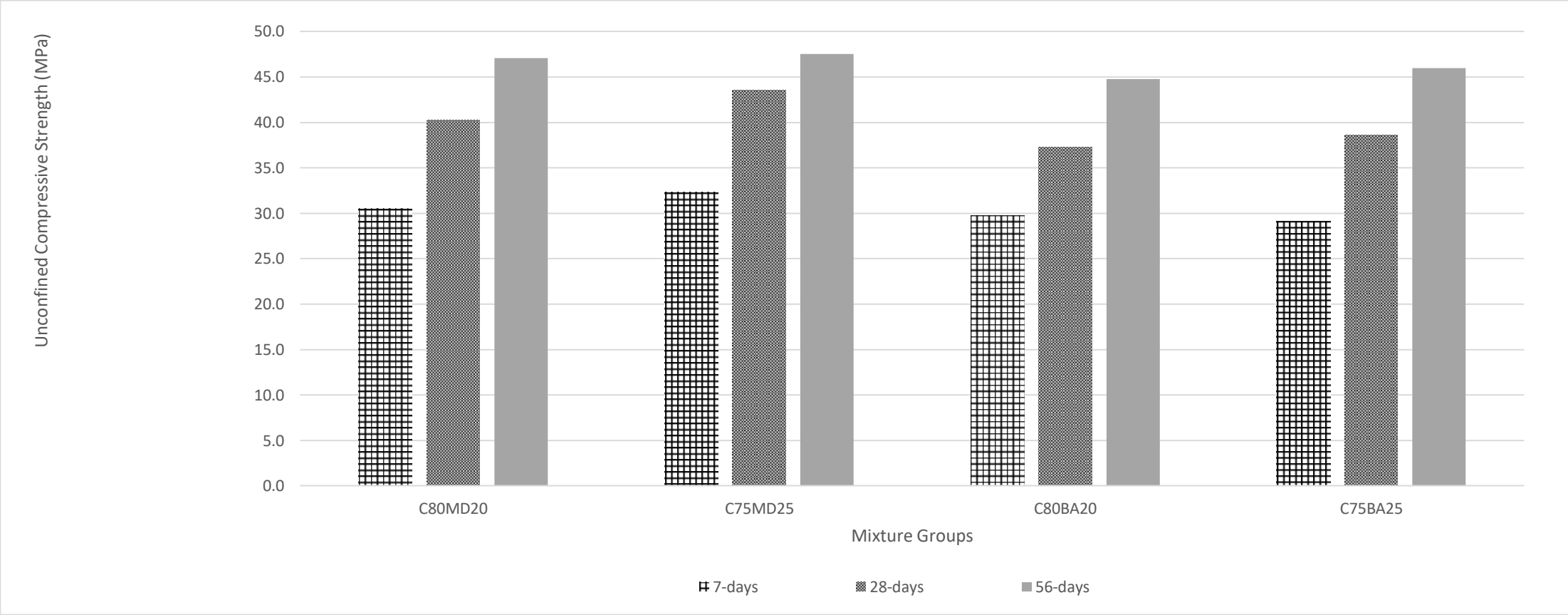
Sea water resistance



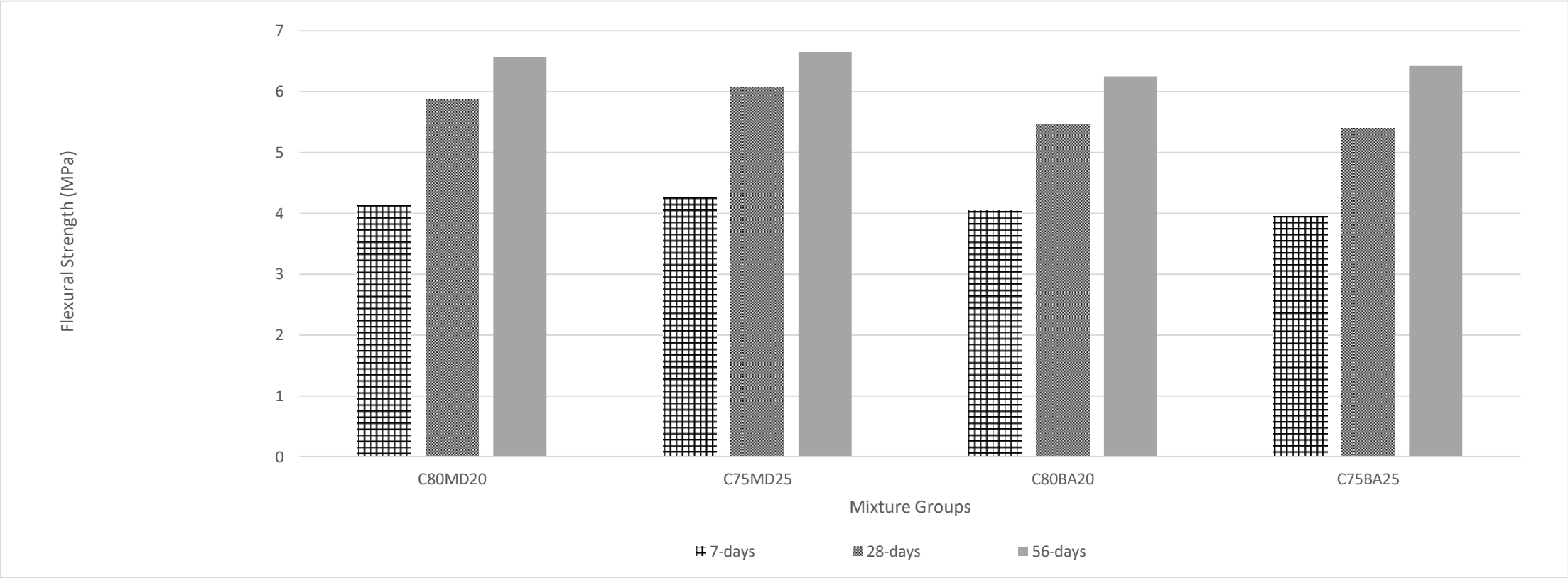
Outcome of the study

- In phase 1, the reduction in workability was reported in all groups.
- In Phase 2, slump and flow values slightly increased because the eggshell was involved in cement paste

Compressive strength



Flexural Strength



Outcome of the study

- DUM values ranging from 1333 kg/m3 to 1420 kg/m3 for phase 1

Outcome of the study

- The highest Water absorption (WA) value was reported in Group 3 and the lowest WA value was reported in Group 4. That group contains the highest amount of bottom ash (BA).
- BA absorbs high amount of water, consequently reducing the cohesiveness of paste to reach the desired flow properties. Bottom ash also contains more pores than marble and cement.

Outcome of the study

- The compressive strength values tended to decrease as the bottom ash content increased. It is reported that compressive strength of bottom ash cement paste increases beyond 7 days

Sulphate Resistance

- As the percentage of the bottom ash increased, the weight loss of the composites increased subsequently. Conversely, as the marble powder percentage increased, the weight loss of the samples decreased.

Conclusions

- Such products could be considered lightweight and could be good candidates for vairous civil engineering applications. Compressive strength requirements for lightweight materials ranges from 1.40 MPa to 17.20 MPa)

Conclusions

- final product can be considered as a lightweight material and could be used in the lightweight aggregate production and insulation materials.
- They can be used in general construction for pedestrian and light traffic paving brick

Conclusions

- Optimization of bottom ash and marble powder showed that a combination of 30% bottom ash and 20% marble powder has better matrix properties. Eggshell addition of up to 1.5% decreased the porosity values. Beyond this level, the porosity values tended to increase.

Conclusions

- Bottom ash mix groups showed better performance in porosity compared to marble powder mixture groups. The addition of eggshell of up to 1.5% had a positive effect on porosity. Above this point, porosity values increased for both ages. Staple wire addition increased the porosity values for both ages.

Acknowledgement

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