Cement Replacement With Waste Brick Powder In Paving Blocks

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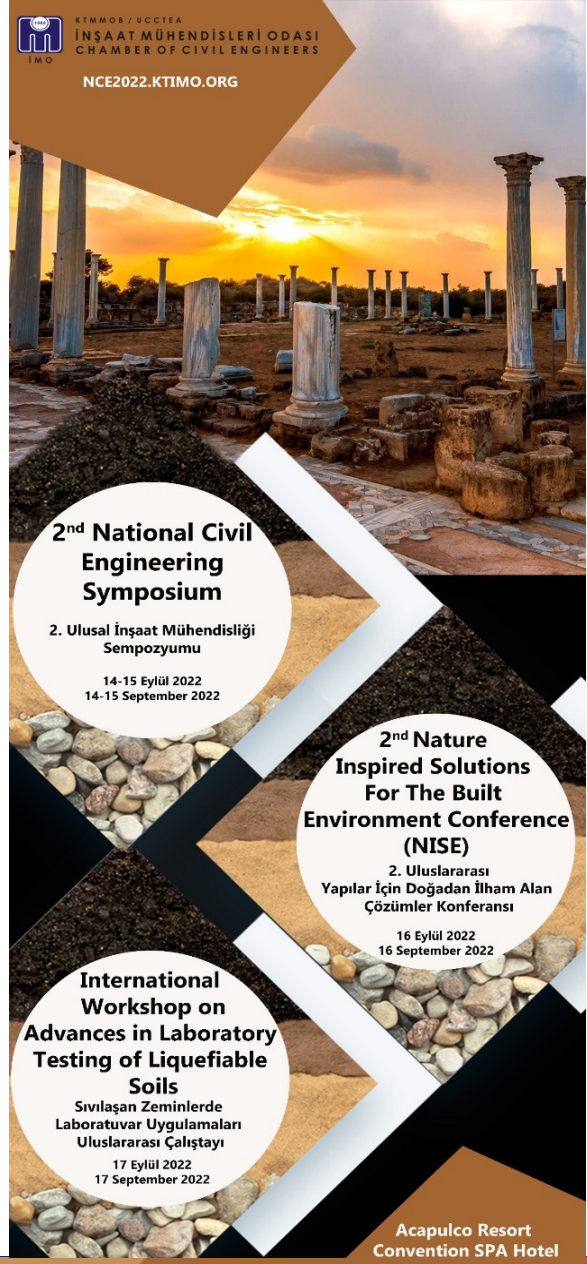
Nicosia 2022



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Introduction

- Concrete is a fundamental material for airport runways, highways, and streets. Concrete pavements are used for general paving needs such as driveways, parking lots and playgrounds.
- Deciding which cement-based materials are best to employ depends on the project. Soil-Cement, Cement-Modified Soils (CMS), Cement-Treated Base, Full-Depth Reclamation (FDR) are among options available

Waste Clay Brick (WCB)

- Fired clay brick is considered a supplementary cementitious material due to the burning process.
- North Cyprus has two major production companies for fired clay brick and the estimated waste is approximately 950 kg/day.

Figure 1. clay brick

Concrete Paving Block

- Concrete block paving provides a hard surface which is aesthetically pleasing, comfortable to walk on, trafficable, extremely durable and easy to maintain.
- Paving blocks are fully engineered products, manufactured in factory conditions, ensuring consistency and accuracy.
- Laid with an edge restraint over a granular bedding course, individual blocks interlock to act compositely which can distribute large point loads evenly.(5)

- They are suitable for pedestrian areas, driveways, or heavily trafficked areas such as container ports r and aircraft hard-standing.
- Proprietary drainage channels may be incorporated.
- Designers can use changes in the color, texture and shape to distinguish roads from footways, parking bays and public space from private space.
- Concrete block paving can be put into use immediately after laying and requires only minimal maintenance.
- Mechanical installation techniques allow large areas to be laid with a minimum of manpower, saving both time and energy.(4)

Types of Paving Block

- Paving Slabs
- Porcelain Paving
- Walling
- Concrete Paving
- Block Paving(3,5)

Paving Slabs

Figure 2. paving slab (1)

Figure 3. paving slab (1)

Porcelain Paving

Figure 4. Porcelain Paving (1)

Figure 5. Porcelain Paving (1)

Walling

Figure 6. walling (1)

Figure 7. walling (1)

Block Paving

Figure 8. block paving (1)

Figure 9. block paving (1)

Concrete Paving

Figure 10. concrete paving (1)

Figure 11. concrete paving (1)

Benefits of concrete paving

- Performance
- Application
- Reconditioning
- Reinstatement and recycling
- Aesthetics(2,3,5)

Materials and Methods

- WCB were collected from one of the production companies.
- WCB were crushed using jaw crusher to the size of sand.
- Los Angeles machine was used to ground the WCB further to powder form passing 150 micron sieve. The process shown in figure 12.
- Chemical composition of WCB was determined by XRF analysis.
- Mid course and fine aggregate with sieve analysis shown in figure 13.

Materials and Methods (Cont.)

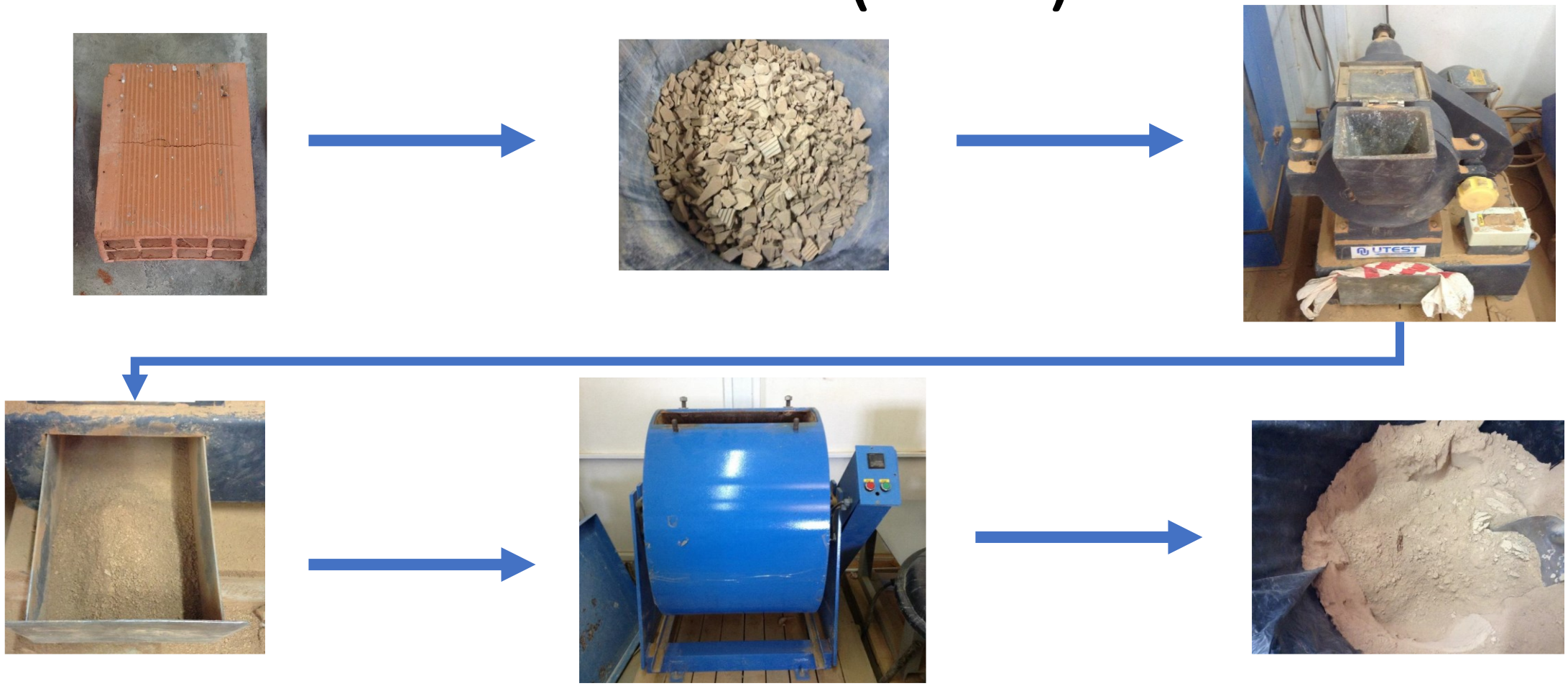

Figure 12 WCB Powder preparation process

Materials and Methods (Cont.)

Table 1 WCB Chemical Composition

Oxides	Wt.%
SiO2	44%
Al2O3	13%
Fe2O3	7%
CaO	9.87%
MgO	8.75%
CO2	9.31%
B2O3	2.38%
Other	5.21%

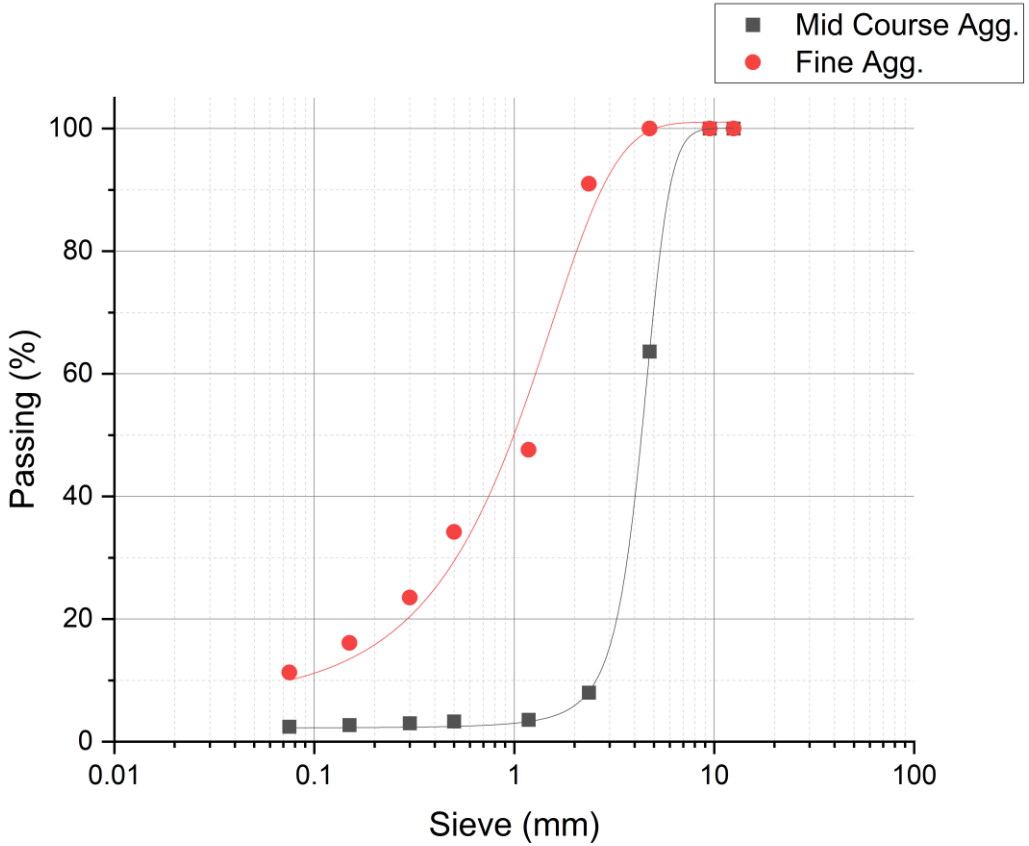

Figure 13 Sieve analysis of the aggregates

Materials and Methods (Cont.)

- Samples are mixed according to table 2, until homogenous mixture attained
- 10 cm cube mold was used to cast the samples.
- Each sample cast in two layers followed by vibration 3 to 5 second and compaction using dead weight 0f 30 kg.
- Samples demolded after 24 hrs. and water sprayed once. As shown in figure 14.
- Samples left in curing room until the date of test.
- Compressive strength and bulk density at age 7^{th} and 28^{th} day were measured.

Materials and Methods (Cont.)

Table 2 Mix proportions

Mix	Mid Coarse Agg (%)	Fine Agg (%)	Cement (%)	Clay brick Powder (% cement)	Water/Binder ratio
Control Mix (C00)	17.87%	71.80%	10.33%	0%	0.635
C5B	17.87%	71.80%	9.81%	5%	0.635
C10B	17.87%	71.80%	9.29%	10%	0.635
C15B	17.87%	71.80%	8.78%	15%	0.635
C20B	17.87%	71.80%	8.26%	20%	0.635
C25B	17.87%	71.80%	7.74%	25%	0.635

Results and Discussion

C00

C5B

C10B

C15B

C20B

C25B

Figure 14 samples with different WCB content

Results and Discussion (Cont.)

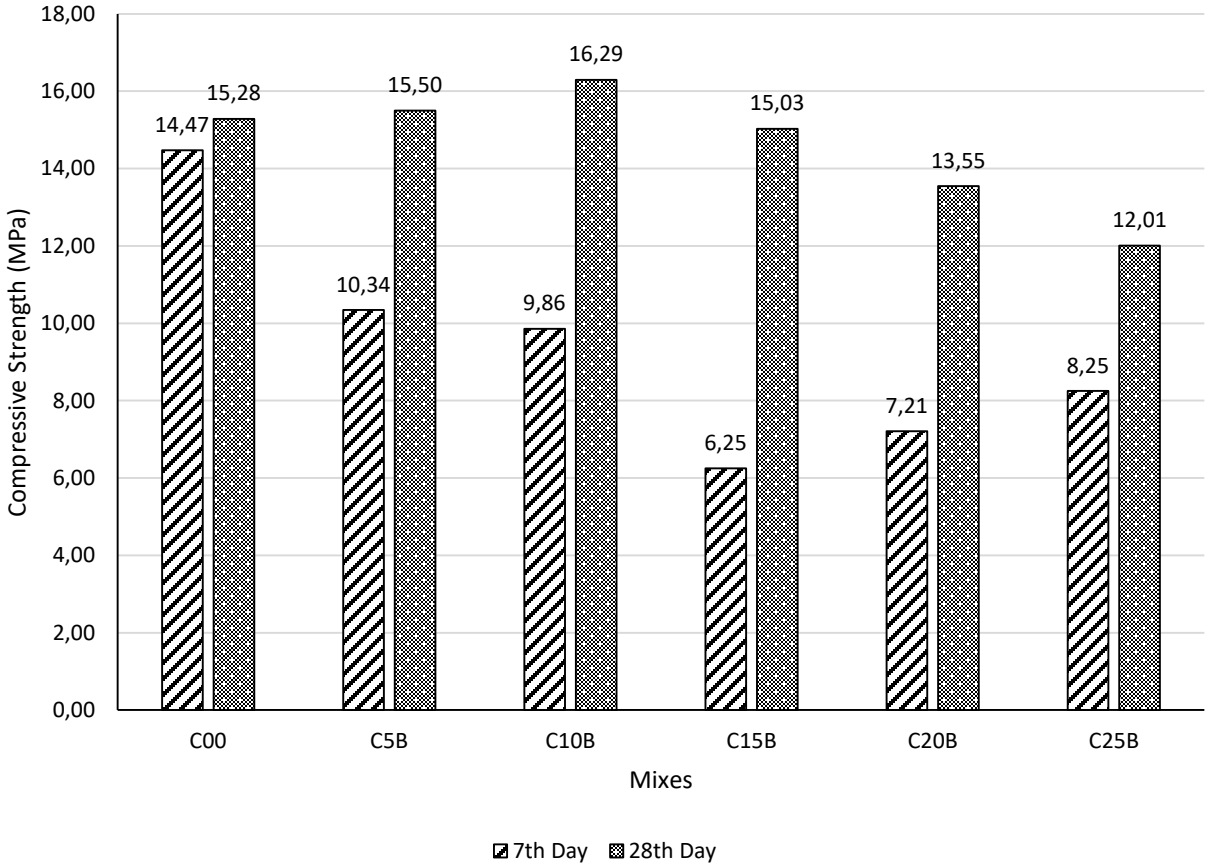

Figure 15 Result of Compressive Strength

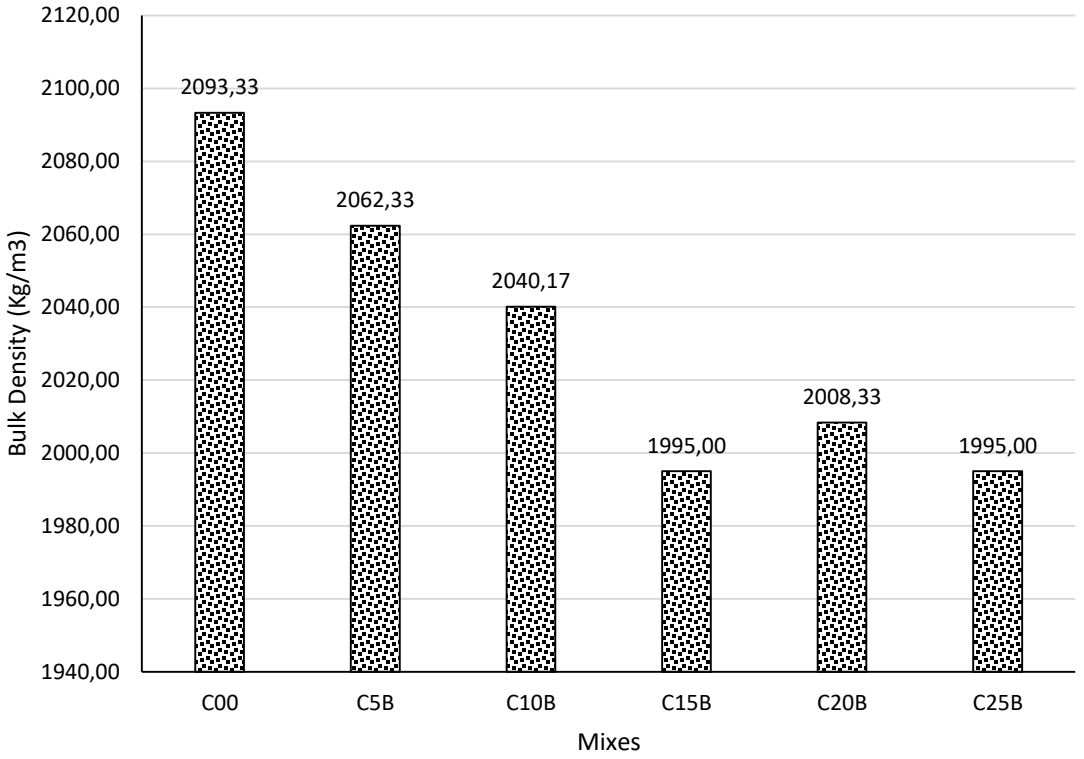

Figure 16 Result of Bulk Density

Conclusion and Recommendation

- The test results showed a decrease in density when using WCB at all percentages.
- At 10% WCB, the 28th-day compressive strength increased by 6.6% compared to the control mix.

- Total immersion curing could be considered to see if there is a increase in strength
- Analysis on the micro structural interaction can be investigated on.

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Thank you!