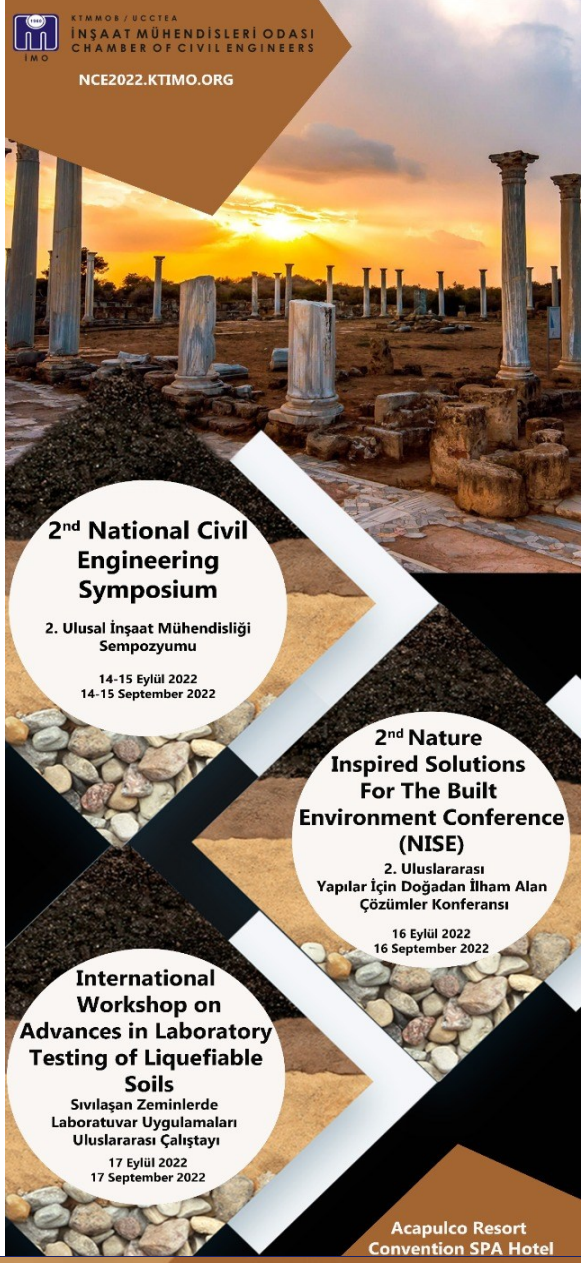
Using Sawdust in Sustainable Concrete Production

Asst. Prof. Dr. Ömer DAMDELEN
odamdelen@ciu.edu.tr

CYPRUS INTERNATIONAL UNIVERSITY



Sawdust

woodworking results in large amount of a by-product called sawdust or “saw ash” when the particle size is smaller (<4mm).

Which is a powdery waste material that occurs as a result of

- drilling,
- cutting or
- sanding different wooden parts.
- It is also sometimes generated naturally by woodpeckers and carpenter ants that dwell on wood.

Dangers of sawdust waste

- The amounts of sawdust produced every year is alarming if left unmanaged, especially in its untreated form it has negative consequences on both the environment and the human health.
- Becomes a disturbance to activities at the woodwork mills.
- When disposed-of on or in land by burning or landfilling it causes earth and air pollution causing a threat to both the human and wildlife as well as the well-being of the agricultural produce.
- when it is disposed in water, it causes water pollution and becomes a risk of endangering the under-water ecosystems

Properties of SAWDUST

Sawdust Chemical Properties	
Specific Gravity (g/cm3)	1.47
Density (Kg/m3)	325
Water Absorption (%)	98.9
Finess Modulus	2.17
Sawdust Physical Properties	
CaO	9.8
SO2	0.41
MnO	0.01
MgO	6.3
SiO2	67.9
Al2O3	5.1
Fe2O3	3.17
K2O	0.09
Loss on Ignition (LOI)	3.82

Aim of the Research

1. **Examine the influence of wood waste material – sawdust on;**

❖ *Mechanical properties of the concrete mixes.*

a. density, b. compressive, c. flexural, d. splitting strength, f. modulus of elasticity

❖ *Thermal properties of the concrete mixes.*

a. thermal transmittance – U value and b. thermal resistance – R value.

2. **Study their influence and effect on the properties of concrete to ensure that the result can still be used in construction in one form or another.**

3. **Achieve sustainability of construction**

4. the reuse of waste material, all in hope of preserving the environment.

The Concrete Mixes used in the Experiments

Three concrete mixes were prepared with different percentages of replacement by sawdust by weight with five samples of each mix;

- (SW1) a reference mix with zero replacement by sawdust
- (SW2) with 30% of replacement by sawdust
- (SW3) with 40% replacement by sawdust
- (SW4) with 50% replacement by sawdust

The Concrete Mixes

Mix No.	Description
SW1	100% PC + 100% CA + 100% FA + 100% W
SW2	100% PC + 100% CA + 70% FA + 30% SW+ 100% W
SW3	100% PC + 100% CA + 60% FA + 40% SW+ 100% W
SW4	100% PC + 100% CA + 50% FA + 50% SW + 100% W

FA: Fine aggregate, CA: Coarse Aggregate, SW: Sawdust, PC: Portland cement, W: Water

Tests Conducted

- ***Compressive strength*** – sample size cube (150x150x150 mm was tested at 28 day.
- ***Splitting Tensile Strength*** –Test is used on 150x300 mm cylindrical samples to measure splitting tensile strength at 28 day.
- ***Modulus of Elasticity*** - Cylindrical concrete specimens measuring 75 mm in diameter and 150 mm high, three for each mixture, were prepared to determine the modulus of elasticity.
- ***Density*** - The testing method was applied cube sample (100x100x10m0 mm) accurately determined using a Buoyancy Balance were tested at day 28.
- ***Thermal Conductivity*** - A steady-state principle hot plate equipment was applied as part of the research. The test applied 100x500x500mm samples to measure thermal conductivity The equipment was checked by PC automatically. The sample were tested at day 28 applying guarded hot plate.

Results-Effect on Mechanical Properties

- The increase in the sawdust percentage through the mixes resulted in a decrease in the density of the concrete samples compared to the reference mix.
- demonstrating an inversely proportional relationship.
- The same was observed in the values of the compressive, flexural and splitting tensile strength of the samples.
- The increase in the sawdust content led to a decrease in the values of all of the three samples implying a similar inversely proportional relationship.

Results-Effect on Mechanical Properties

- The modulus of elasticity decreased as well with each 10% increase in the sawdust content.
- The values of all the mechanical properties remained sufficient and conforming to the standards of lightweight concrete structures.

Results-Effect on Thermal Properties

- The values of the thermal conductivity and U-value of the mixes had an inversely proportional relationship with the percentage of the replacement of the fine aggregates with sawdust.

- The R-values of the mixes on the opposite side has a directly proportional relationship as they had increased with the increase in the percentage of sawdust.

Results-Statistical Considerations

- comparing mechanical and thermal properties of concrete between different SW contents using statistics.
- Results obtained from One-Way ANOVA tests with Bonferroni corrections found a reduction in all the mechanical properties as well as the thermal performance when compared to SW1.

Conclusion

- The decrease in the density leads to a lower weight concrete as a lighter option for construction.
- The decrease in the mechanical properties is still enough for lightweight construction options.
- The decrease in the thermal conductivity and the U-values in the sawdust concrete and the increase in the R-value showed its suitability for use in energy efficient structures and insulation systems.

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Thank you for giving attention ☺