Enhancing Properties of The Sulfur Concrete Using Polymers

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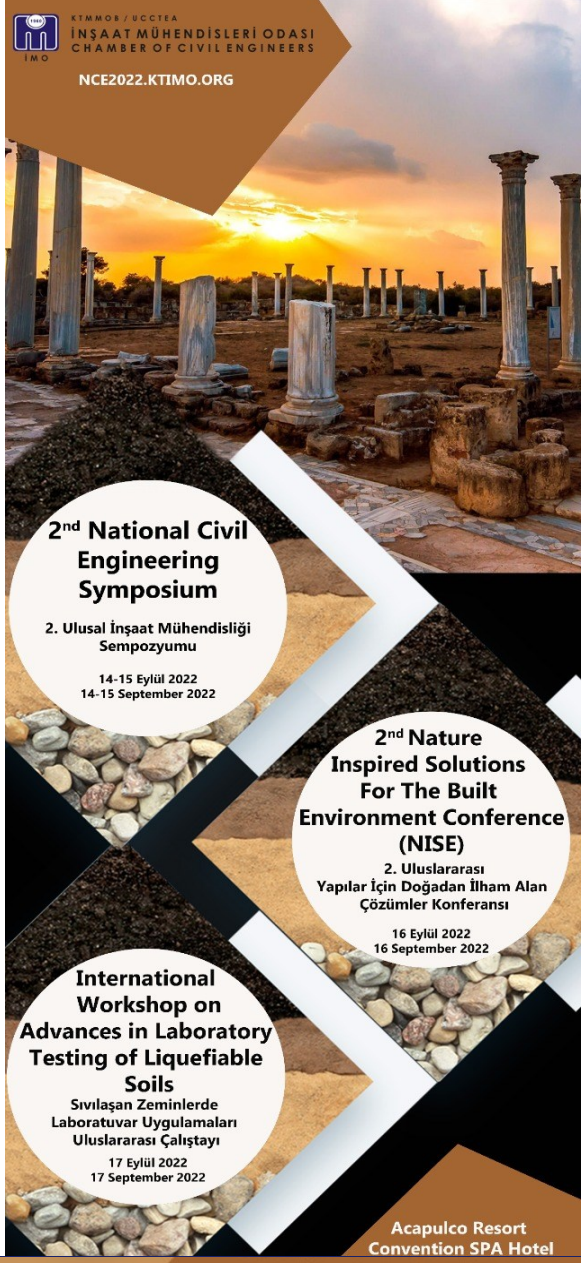

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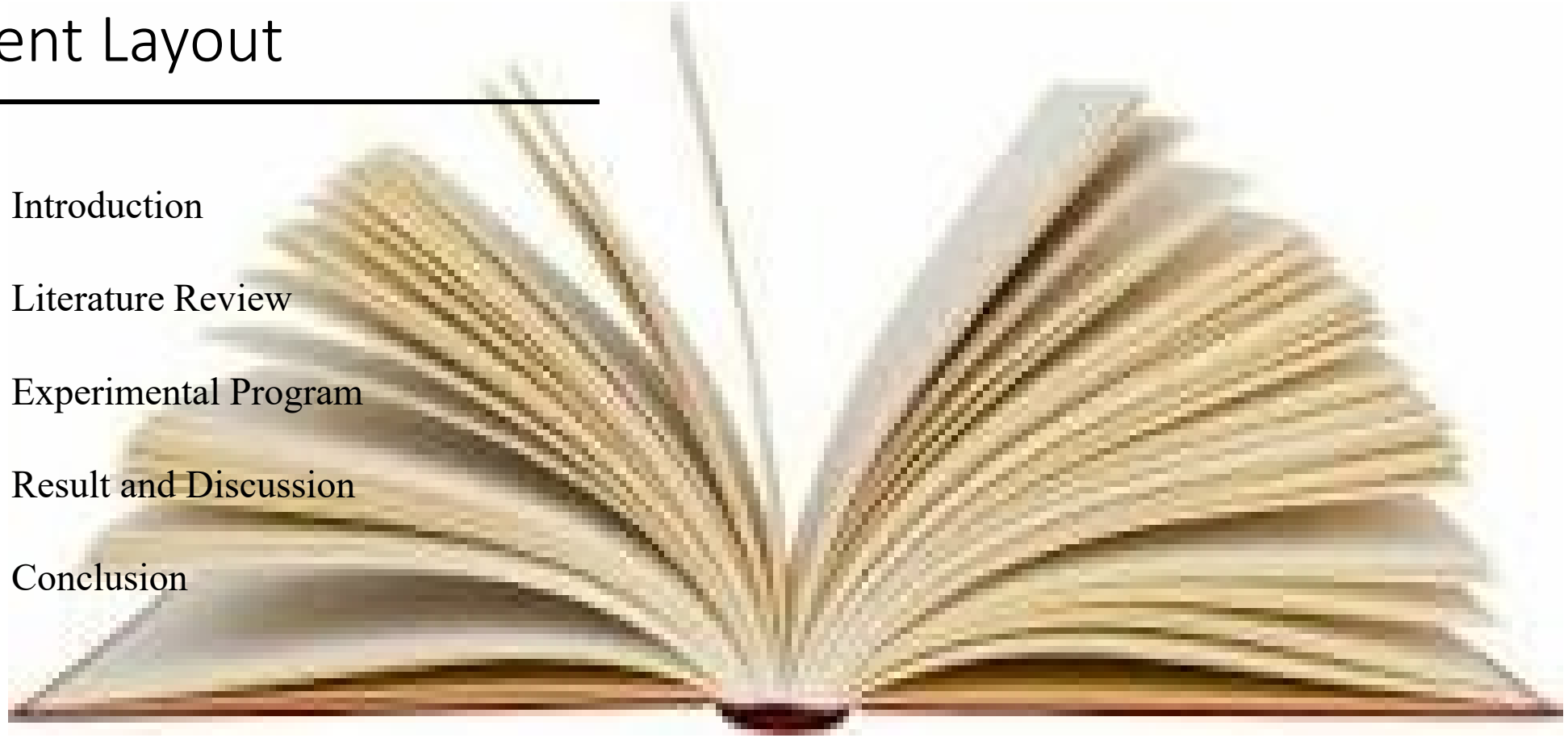

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Introduction

- Sulfur concrete opens a new path in construction due to its higher resistance toward harsh environment specially in acidic environments.
- Sulfur is abundant → **low cost** ($40/ton)

No Portland Cement!

No Water!

Sulfur concrete contents:

Sulfur

Aggregates

Modifier

Literature Review

Elemental sulfur concrete suffers from the unstable molecular structure in long term (Gutarowska et al., 2019).

Therefore, the long-term reliability of these material remains questionable. To address this problem, modifiers are introduced to the sulfur concrete.

As an example, dicyclopentadiene, cyclopentadiene or combinations of these, as well as olefin polysulfide additives, has been used as modifier (M. el Gamal et al., (2017) and M. el Gamal et al., (2021)).

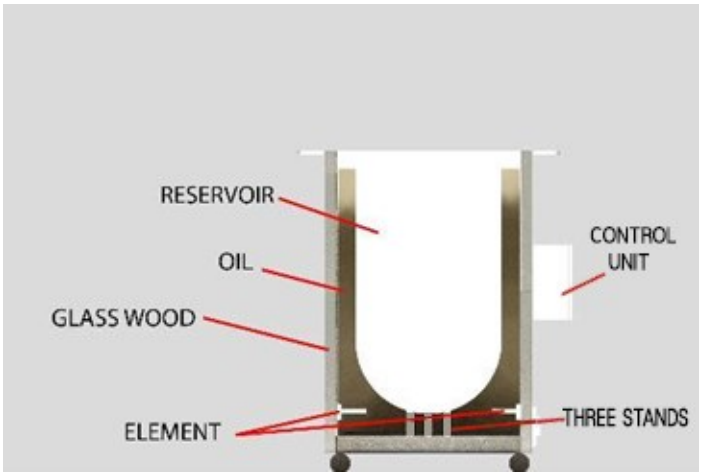
Experimental Program: Fabrication of a new machine

Materials:

- Sulfur
- Aggregates
- High-Density Polyethylene (HDPE)
- Linear Low-Density Polyethylene (LLDPE)

Sulfur Concrete Specimen Preparation:

i. Sulfur is poured into reservoir when the temperature of oil reaches **~150 °C**
ii. The modifier (HDPE or LLDPE) is added gradually
iii. Pre-heated coarse and fine aggregates are added gradually
iv. The prepared mixture is poured in molds to produce the specimens



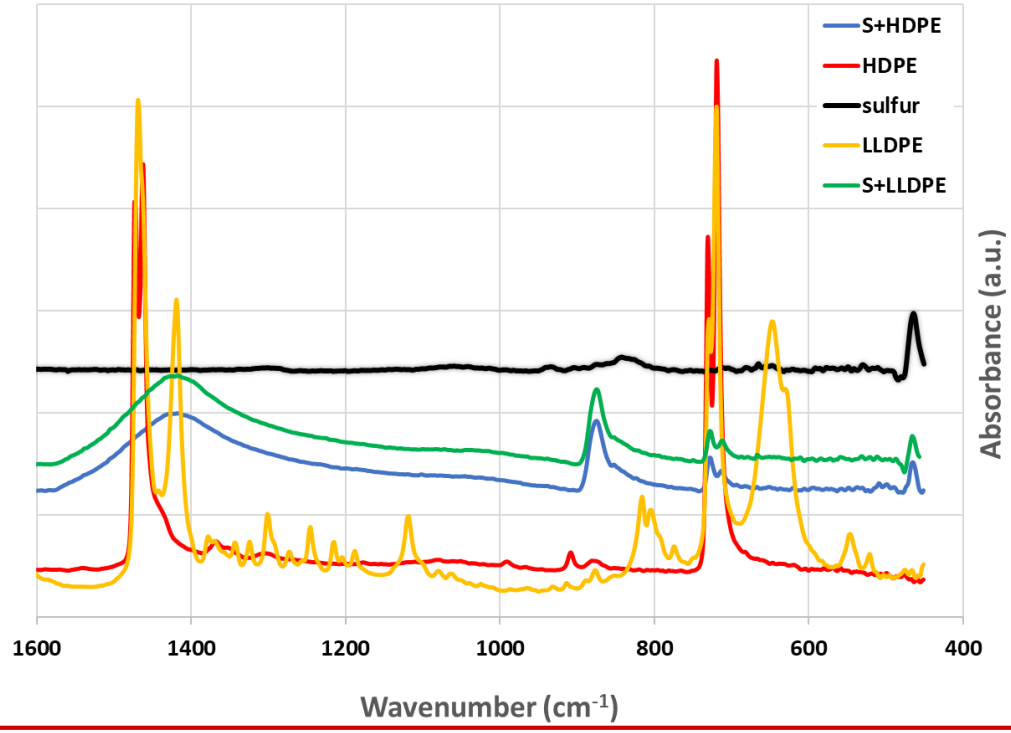
Results and Discussion: Characterization

FTIR spectra of the

Sulfur,

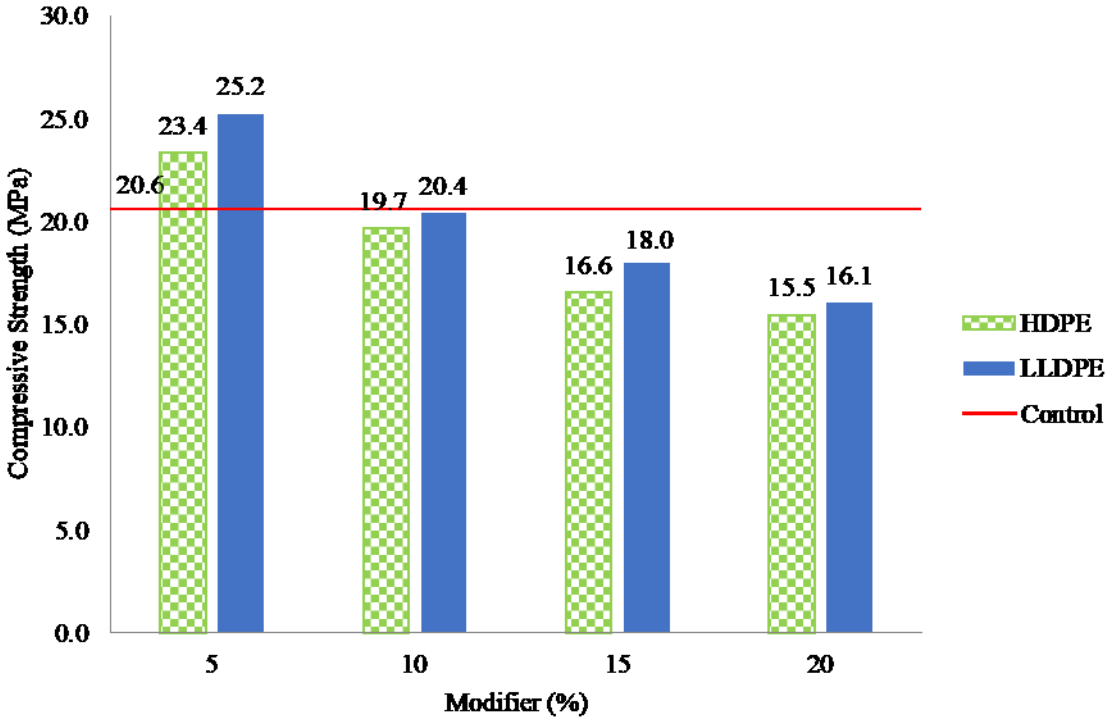
HDPE and sulfur-HDPE composite,

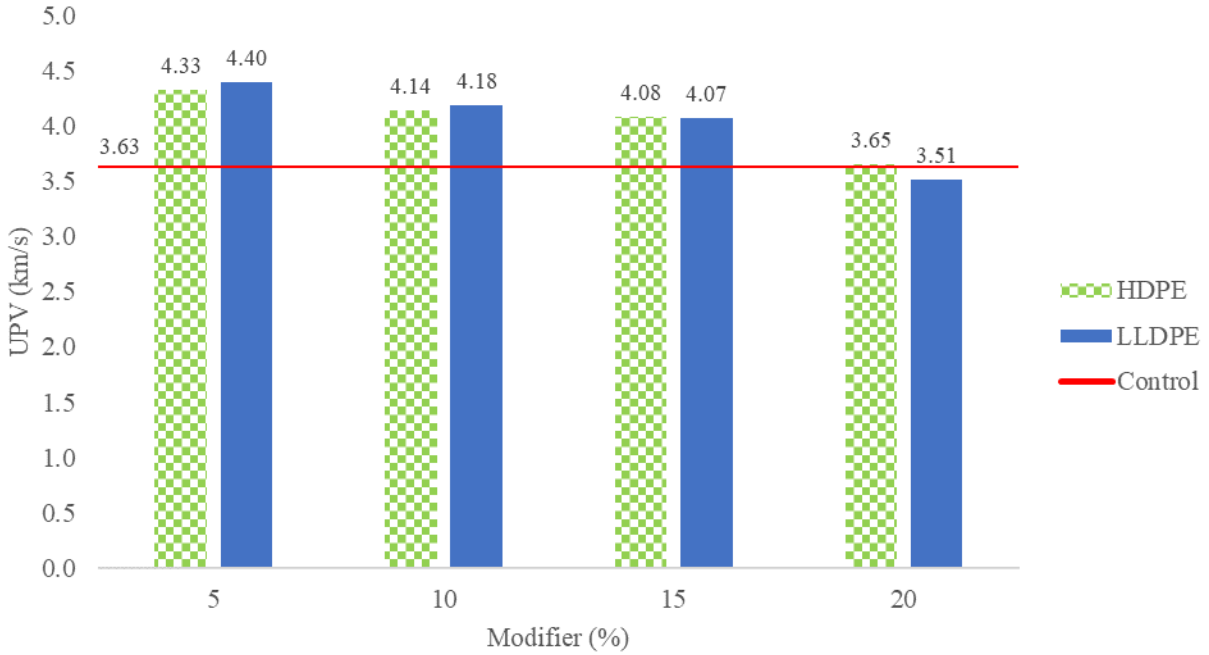
LLDPE and sulfur-LLDPE composite



FTIR results confirm that sulfur is not decomposed, however no chemical reactions between polymers and sulfur occurred.

Results and Discussion: Compressive strength and UPV test results after 3 days of casting





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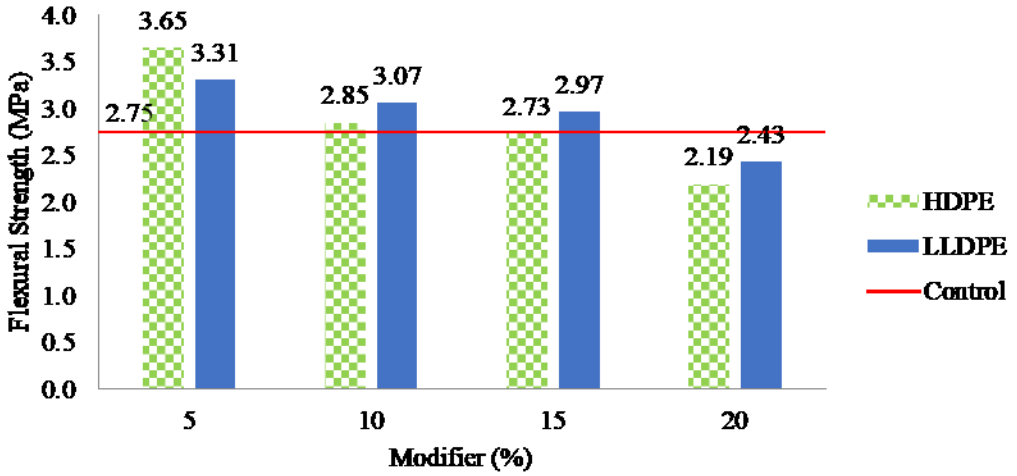
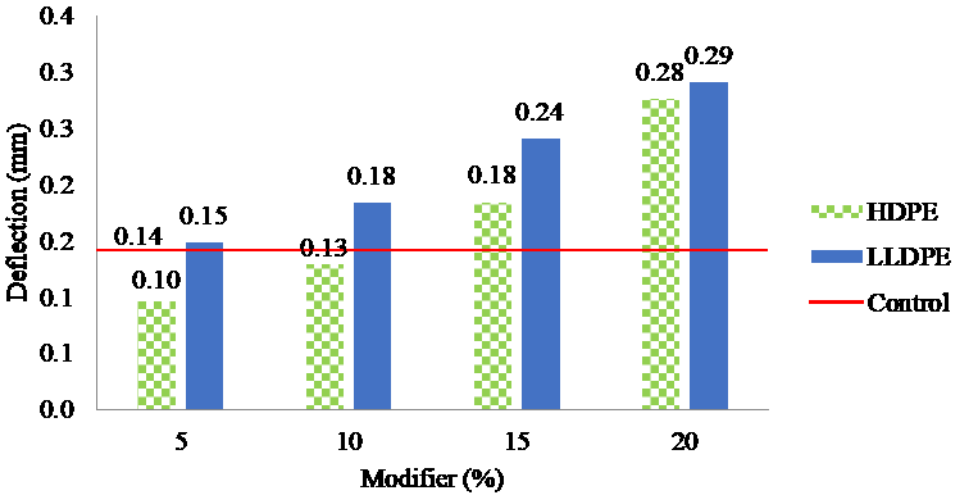
Results and Discussion





Polymer stretch after breaking specimen

Conclusion

1. Based on the FTIR results, it was determined that sulfur is not decomposed, however no chemical reactions between polymers and sulfur occurred.

2. It is revealed by the UPV test that specimens with the lowest percentage of polymers are denser and more homogeneous than those with higher levels.

3. Compared to the control sulfur concrete, with no modification, the concrete with 5% and 10% of each polymer exhibited improved compressive and flexural strengths.

References

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