EFFECT OF COMPOSITION OF PRECURSOR AND SOLID CONTENT ON RHEOLOGICAL BEHAVIOUR OF ALKALI ACTIVATED BINDERS

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ABSTRACT

Although alkali activated materials are widely accepted among the researchers, these materials have a few drawbacks which limit their usage on a large scale applications. In order to replace OPC which is being extensively used in various applications, with a new material, it is essential to assess its workability. As is prevalent in OPC binder, workability can be improved either by chemical or mechanical means. However, before making such efforts to make these binders more workable, it is essential to understand the workability in terms of its rheological behaviour which is the objective of this work. This study contributes to the fundamental understanding of the rheological behaviour of slag/fly ash based alkali activated materials.

EXPERIMENTS

Parameters and their levels

- Percentage replacement of slag with fly ash: 0, 25, 50, 75, 100%
- Water to binder (w/b) ratio: 0.40, 0.45, 0.50
- Activator dosage (% of Na_2O by weight of binder): 4, 6, 8%
- Molar modulus: 1.0, 1.5, 2.0

Tests Performed

- Material characterization: ICP-AES, XRD
- Yield stress and Apparent viscosity: Rheometer
- Spread diameter: Minislump cone

RESULTS

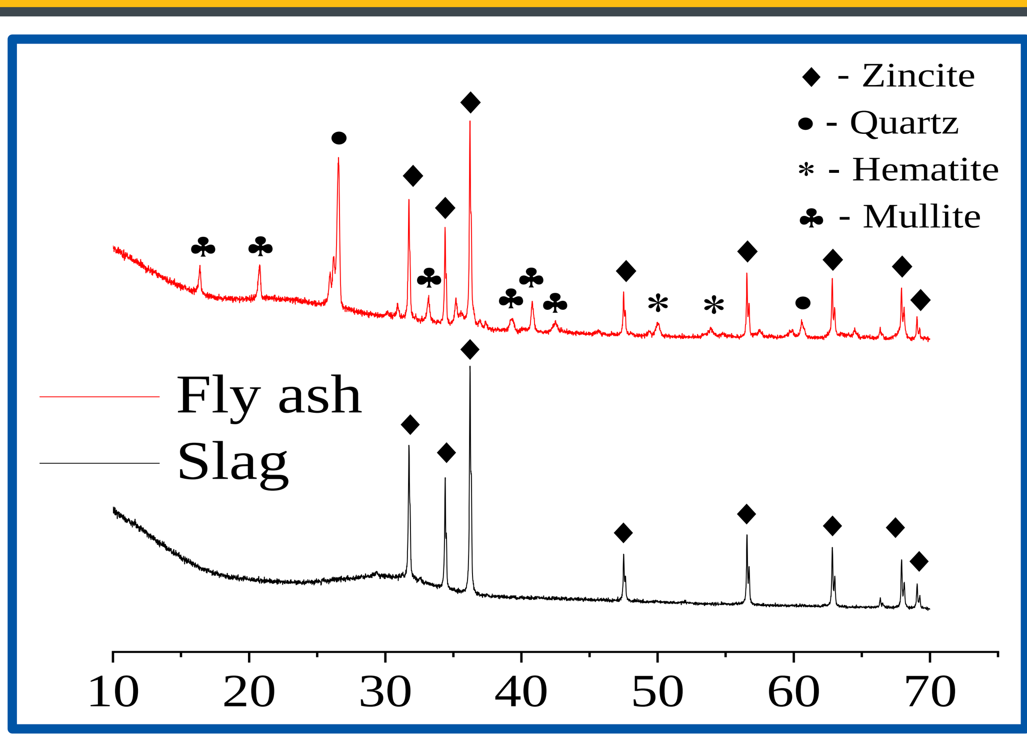

Figure 1: X-ray diffractograms of slag and fly ash

Table 1: Crystalline and amorphous phases

Material	Phase	Quantity (%)
Slag	Akermanite	2.3
Amorphous/unknown content		97.7
Fly ash	Mullite	25.2
	Quartz	21.1
	Hematite	2.0
Amorphous/unknown content		51.8

Table 2: Amorphous CaO and SiO_2 (wt. %) in binders

Binder	CaO	SiO_2	$\frac{CaO}{SiO_2}$
100% Slag + 0% Fly ash	34.9	39.2	0.89
75% Slag + 25% Fly ash	27.0	36.2	0.74
50% Slag + 50% Fly ash	19.1	33.2	0.57
25% Slag + 75% Fly ash	11.3	30.2	0.37
0% Slag + 100% Fly ash	3.4	27.3	0.12

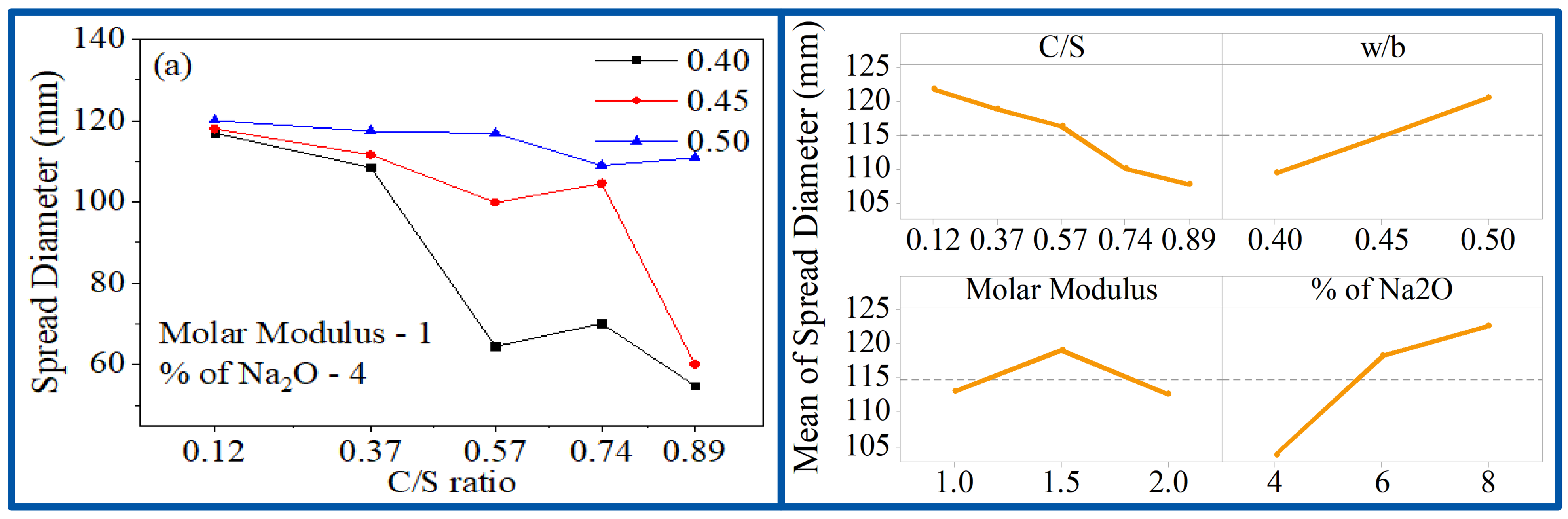

Figure 2: Variation in spread diameter (mm)

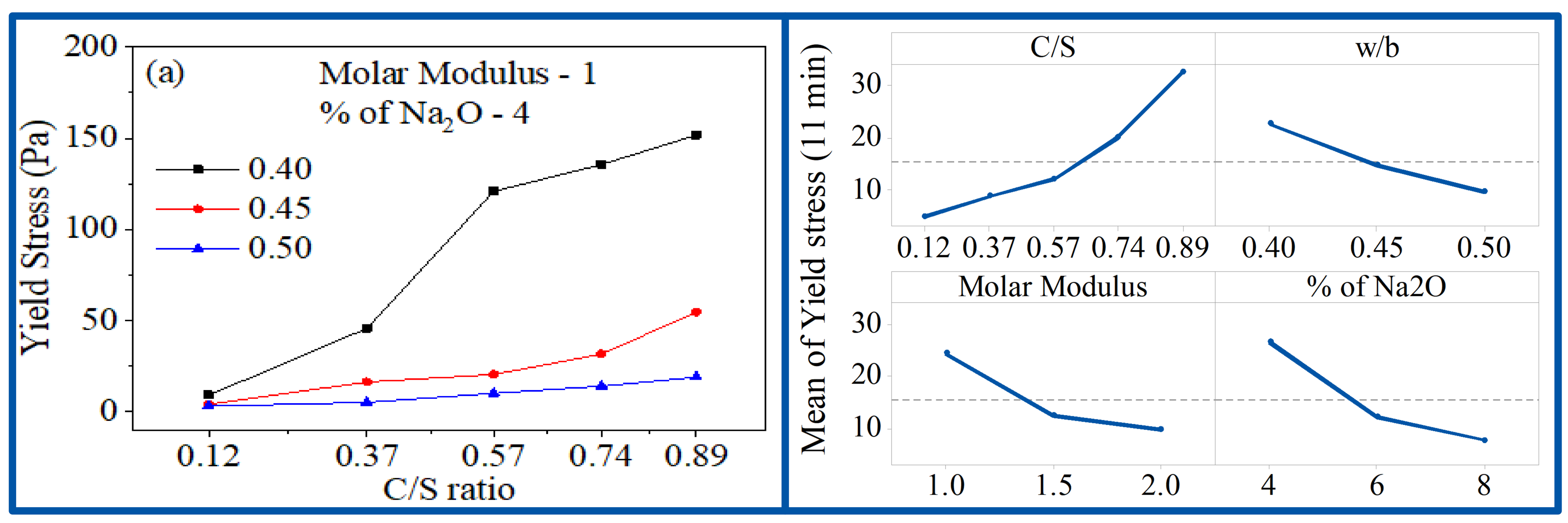

Figure 3: Variation in yield stress (Pa)

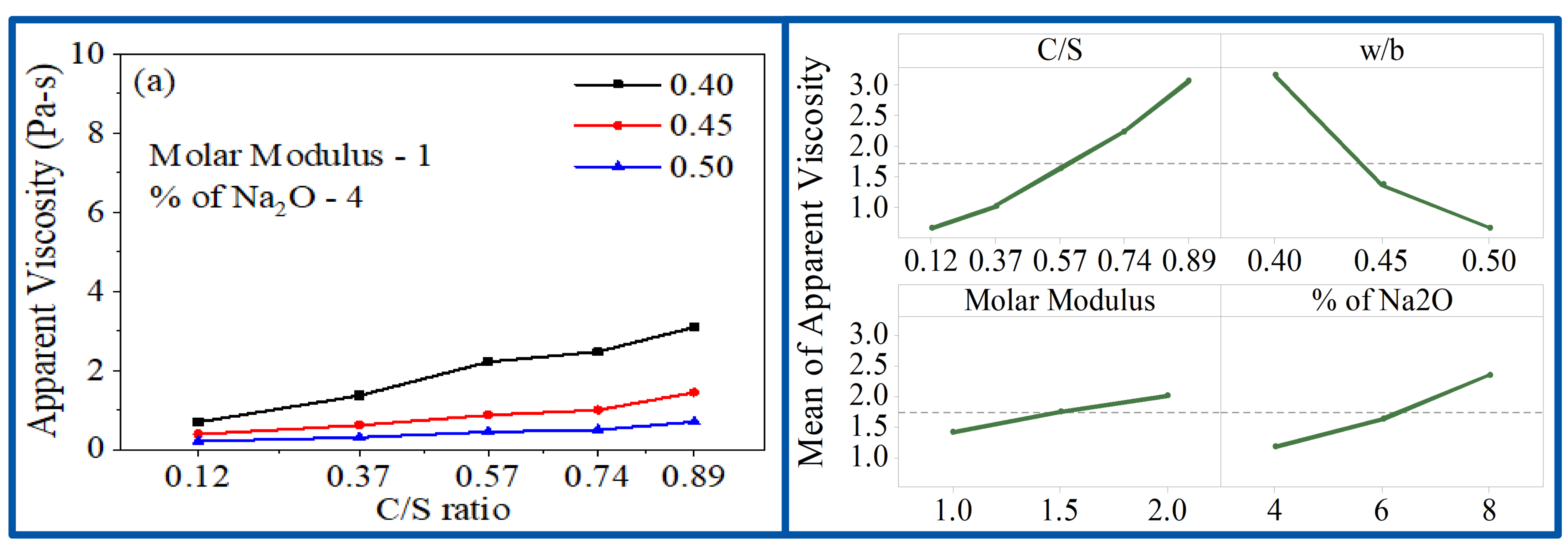

Figure 4: Variation in apparent viscosity (Pa-s)

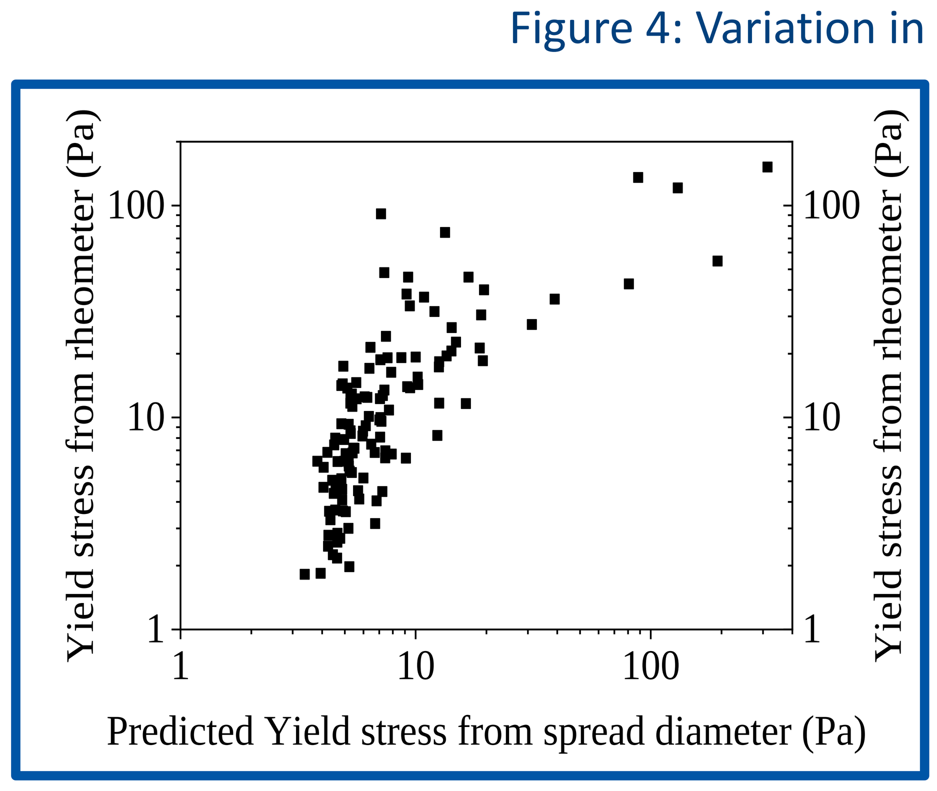

Figure 5: Correlation between predicted and measured yield stress

CONCLUSIONS

- CaO content in the precursor plays a major role in determining the rate of increment in yield stress and apparent viscosity.
- Evolution of yield stress and apparent viscosity is also governed by w/b ratio, molar modulus and activator dosage.
- No correlation was found between predicted and measured yield stress.

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