A STUDY OF EFFECTS OF AGGREGATE ON CONCRETE RHEOLOGY

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ABSTRACT

The concept of concrete rheology affects the homogeny and the workability of clean concrete with the properties of the hardened concrete, hence achieving importance. The paper is about different models for forecasting properties of concrete rheology and mortar. The proposed work is based on experimental and modeling approach. As for the experimental approach is concerned there are three factors involved for the preparation of mortar and concrete samples. The first factor used is mortar rheology, second one is aggregate content and the third one used is aggregate properties. Famous Brookfield and IBB rheometers are used to investigate the effects of aggregate properties on concrete rheology and mortar. To analyze the test data using AI network, the comparative degree of significance of factors that power the mortar and concrete rheological behavior are evaluated and in the proposed models the imperative factors are then considered. The results specify that the low un-compacted void content aggregate resulted in low yield stress and viscosity as compared to high friction angle aggregate resulted in high yield stress and viscosity.

Keywords: IBB, AI, ANN, SSD, OD.

I. INTRODUCTION

Right now, the rheology of a progression of paste, concrete and mortar merges with various aggregates is estimated by paste or mortar and concrete rheometers, individually. In view of the exploratory outcomes, two-stage hypothesis, and the abundance thickness hypothesis, new representations are shaped to anticipate mortar and the concrete rheology considering the impact of total size, degree, shape and surface. The created representations can legitimately assist concrete business with predicting concrete rheology from blend structure. Concrete is considered one of the main broadly utilized structure materials in construction and technology. The significance of considering concrete rheology has been comprehended for a long time, in light of the fact that the simplicity of stream and arrangement can essentially lessen costs and permit greater adaptability in engineering and auxiliary structure. The rheology of concrete can be influenced by various components: blend extents, attributes of the concrete, total properties, sum and sort of time, admixtures, temperature, and blending conditions. Among these parameters, total properties are considered the most significant on grounds that the total typically possesses 70-80 % of the complete concrete volume. The usage of various tools helps to change the flowability of the concrete and the total legitimately influences the concrete flowability by inter-particle powers like interlocking and erosion of strong particles and the development of strong and fluid stages inside new concrete blends. A few components, for example, size, type, degree and

surface of totals, likewise influence the properties of new concrete. The investigation of the impact of total on concrete rheology is still extremely restricted, and no proficient concrete rheology representation considering the impact of total had been grown up until now. Different concepts have been formed to anticipate the rheological parameters of concrete from the organization, yet the utilization of existing concepts is frequently confined because of at least one of the accompanying reasons:

- Some models are experimental models, which are not appropriate for regular circumstances. The majority of the current models need more hypothetical investigation or the deduction is excessively confounded, including a gigantic and unreasonable measure of computation and PC recreation.
- Most of the representations are not legitimately identified with the rheological based parameters, because of the constraint of rheology estimation hardware.
- There are some of the representations that can be simply identified with one rheological parameter, which is inadequate to mirror the concrete flowability.
- Some aggregate properties like surface and shape are once in a while memorize for the representations.

II. PROBLEM FORMULATION

The concept of concrete rheology affects the homogeny and the workability of fresh concrete with the properties of the hardened concrete, hence achieving importance. The work is about to develop new representations or models for identifying mortar and concrete rheological based properties and rotational rheometers are used to investigate the rheological behavior of paste, concrete and mortar. As for the cement is concerned type I Portland cement is used, as the coarse aggregate the limestone is used and as the fine aggregate the riversand and limestone is used. Different parameters based on mortar and concrete rheology concerning to the effects of aggregate like type, proportion, size, and gradation are studied and analyzed.

III. METHODOLOGY

The overall methodology is outlined in the following figure:

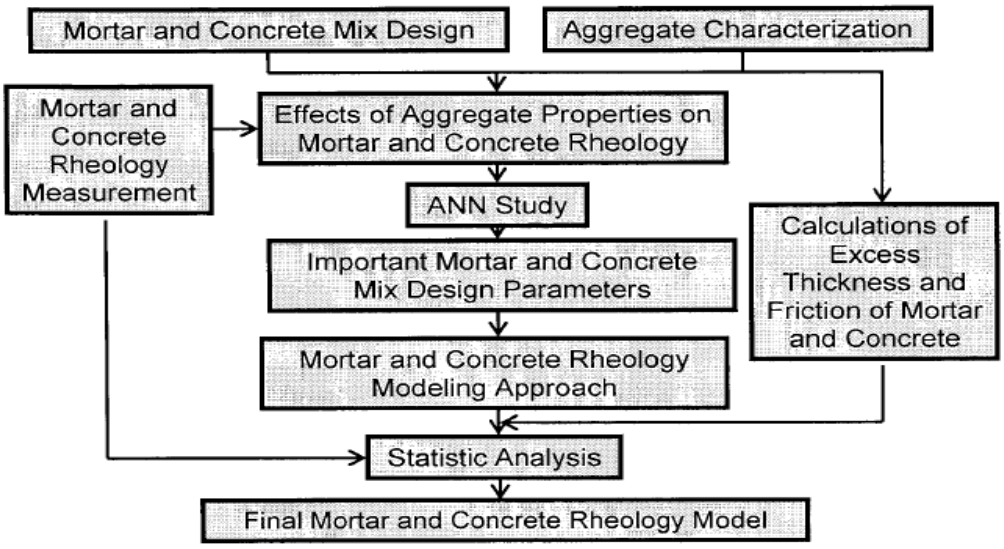


Figure 1.1: Diagrammatic representation of concrete rheology model

Distinctive materials of concrete and mortar, including type I/II Portland concrete, fine aggregate, and coarse

aggregate are selected for this examination. As indicated by factorial blend structure, examples with various mortar and concrete blends were set up in a thought of three components: mortar rheology properties, aggregate substance and aggregate degree. Both the grinding point test and uncompacted void substance test describes a variety of sizes, shapes, degrees and surfaces of fine and coarse aggregate. The Brookfield and versatile IBB rheometers are used separately to estimate the impact of aggregate based properties of on mortar and concrete rheological properties. In view of the test information, the significance of variables that impact concrete rheology and mortar are assessed by fake Neural System (ANN) investigation. As per the abundance glue hypothesis and consider concrete as a two-stage material of coarse aggregate and mortar, the overabundance fine aggregate glue thickness, and overabundance coarse aggregate mortar thickness are determined dependent on the mortar concrete blend plan and aggregate representation. The rheology added from aggregate erosion is determined dependent on the deliberate fine aggregate grinding point. Mutually with the deliberate lattice rheology from indistinguishable blend structure and by examination with real estimated concrete rheology and mortar, the concrete rheology and mortar model is confirmed according to the analysis of statistical regression.

IV. RESULTS

Aggregate Test:

The following table presents the gravity and absorption of the fine aggregates.

	Riversand	Limestone	Standard Sand
OD	2.58	2.41	2.65
SSD	2.62	2.52	2.65

Table 1.1: Specific gravity of riversand and limestone

Coarse Aggregate Properties:

The limestone aggregates examined are single sizes of (#4, 3/8", 1/2", and 3/4"). The three recombined limestone with intended different gradations (G1, G2, G3) are also examined. As for ASTM C127 the coarse aggregate based specific gravity and absorption are measured in this work. 2.52 is the measured specific gravity of limestone and 2.45 under the circumstances of SSD and OD respectively. The following table presents the absorptions of coarse aggregates. The results suggest that the absorption capacity of an aggregate turn down when size increases. In this work the absorptions of graded coarse aggregate used are close to the absorption capacities of (3/8", 1/2") aggregate.

	Single-sized				Graded		
	#4	3/8"	1/2"	3/4"	GI	G2	G3
Absorption (%)	3.76	3.21	3.14	2.75	3.06	3.13	3.25

Table 1.2: Coarse aggregate absorption

Paste Rheology Test:

The Brookfield rheometer is used to investigate the rheological performances of cement pastes and the effects of different mixing representations and w/c 0.30, 0.35, 0.40, 0.50, 0.60) are also examined. To examine the effect of w/c on various rheology based parameters, famous statistical analyses are performed and can be used to find out the paste rheological properties.

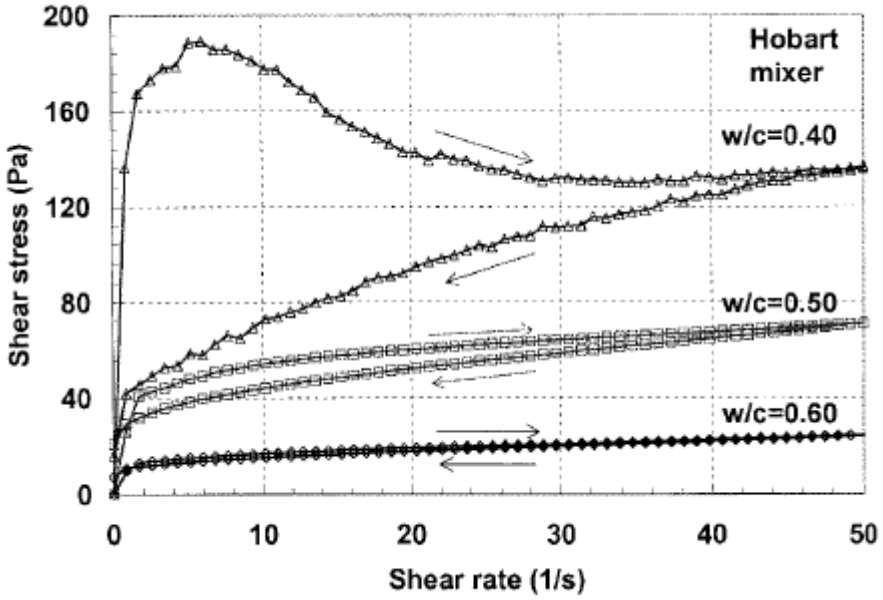


Figure 1.2: w/c effect on paste rheology

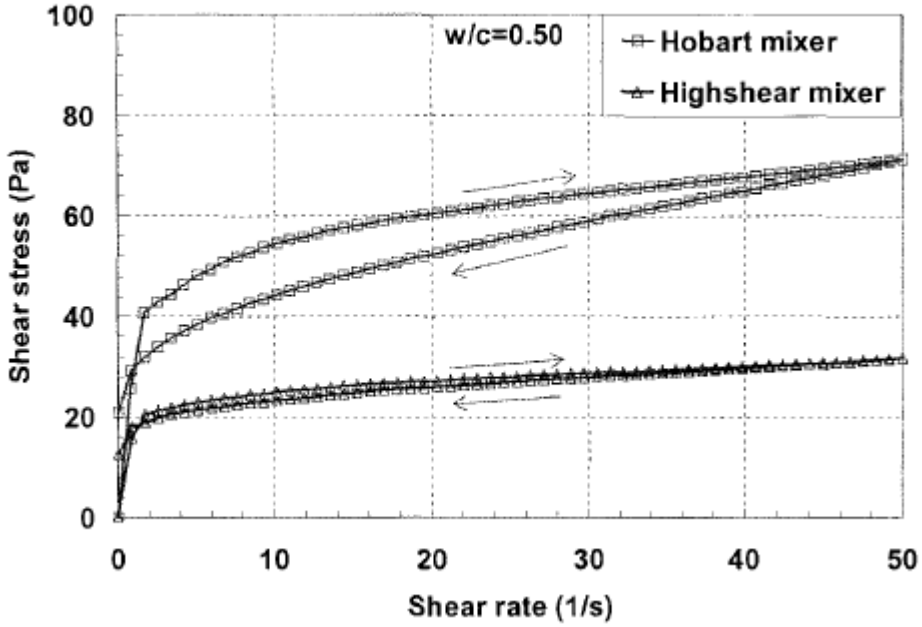
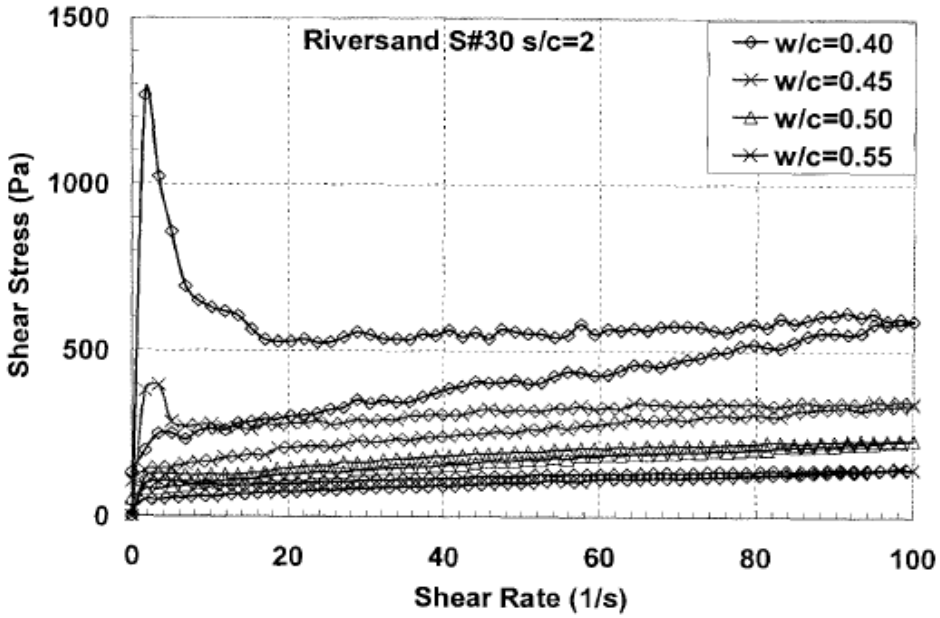


Figure:1.3 Mixer effect on paste rheology

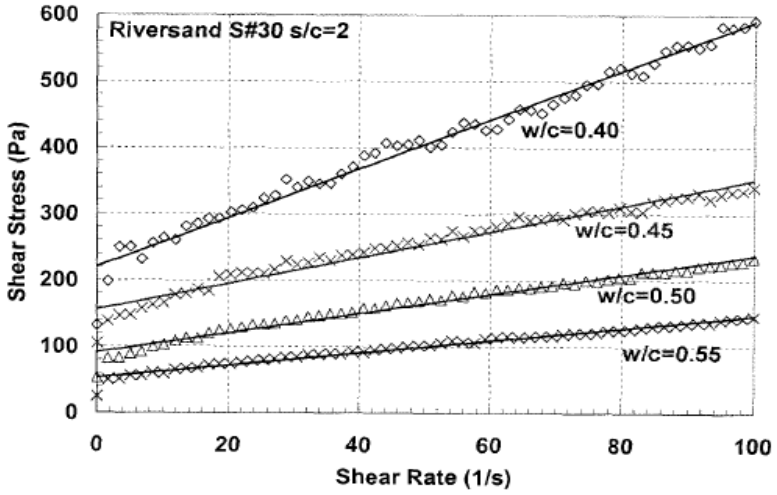
Mortar Rheology Test:

The test is based on the investigation of the effect of fine aggregate charasteristics on the mortar rheology. The material considered includes different sand content, type (limestone, riversand), w/c (0.2 to 0.62), size (#8, #16, #30, #50,#100) and fine aggregate gradations. For each type of sand three to five w/c ranging from 0.20

to 0.62 are used. The selected ratios help to make mortar with proper flowability and measurable rheological based parameters. The w/c with too low and too high are not favorable because results in low consistency and are considered inappropriate for rheology measurement. The following Figure 1.4 (a) presents typical flow curves of mortar samples made with different w/c and the Figure 1.4 (b) presents the down parts of the flow curves of mortars with different w/c. Like cement paste, the viscosity and yield stress of the mortars increased with the decrease of w/c .



(a) Complete flow curves



(b) Down curves

Figure 1.4: Effect of w/c on mortar rheology

Concrete Rheology Test:

The test is based on using IBB rheometer to examine the rheological performances of different concretes and the effects of coarse aggregate content, coarse aggregate gradations and sand to cement ratios are also examined.

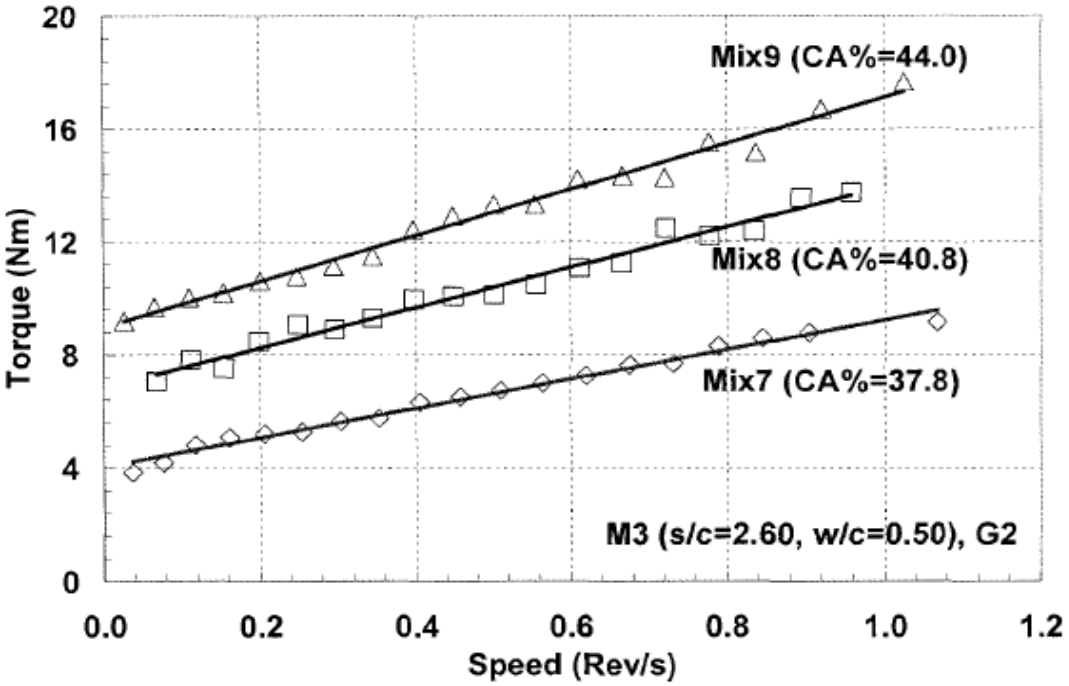


Figure 1.5: The coarse aggregate content effect on concrete rheology

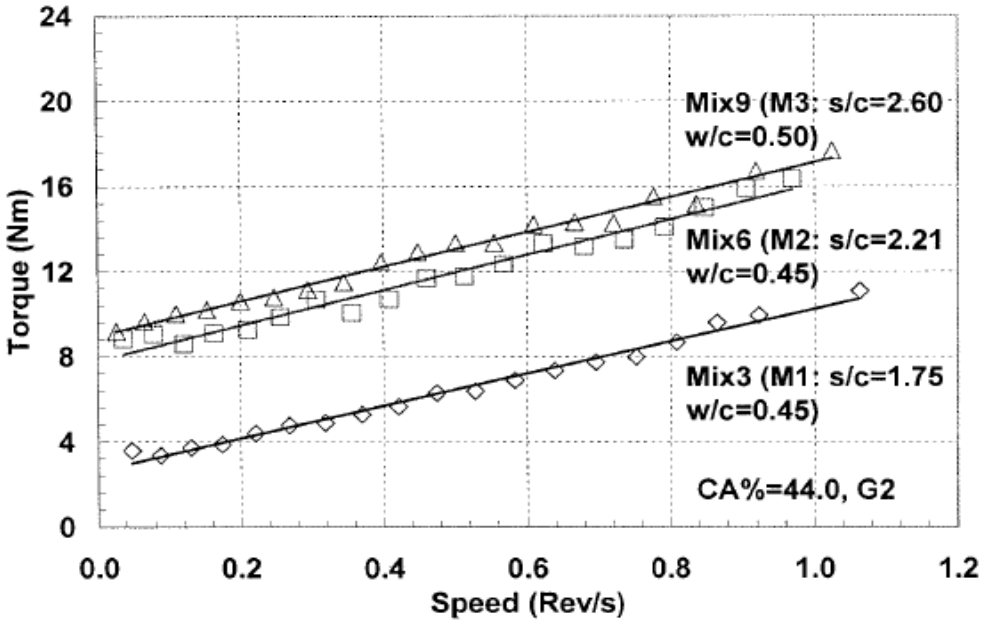


Figure 1.6: The fine aggregate content effect on concrete rheology

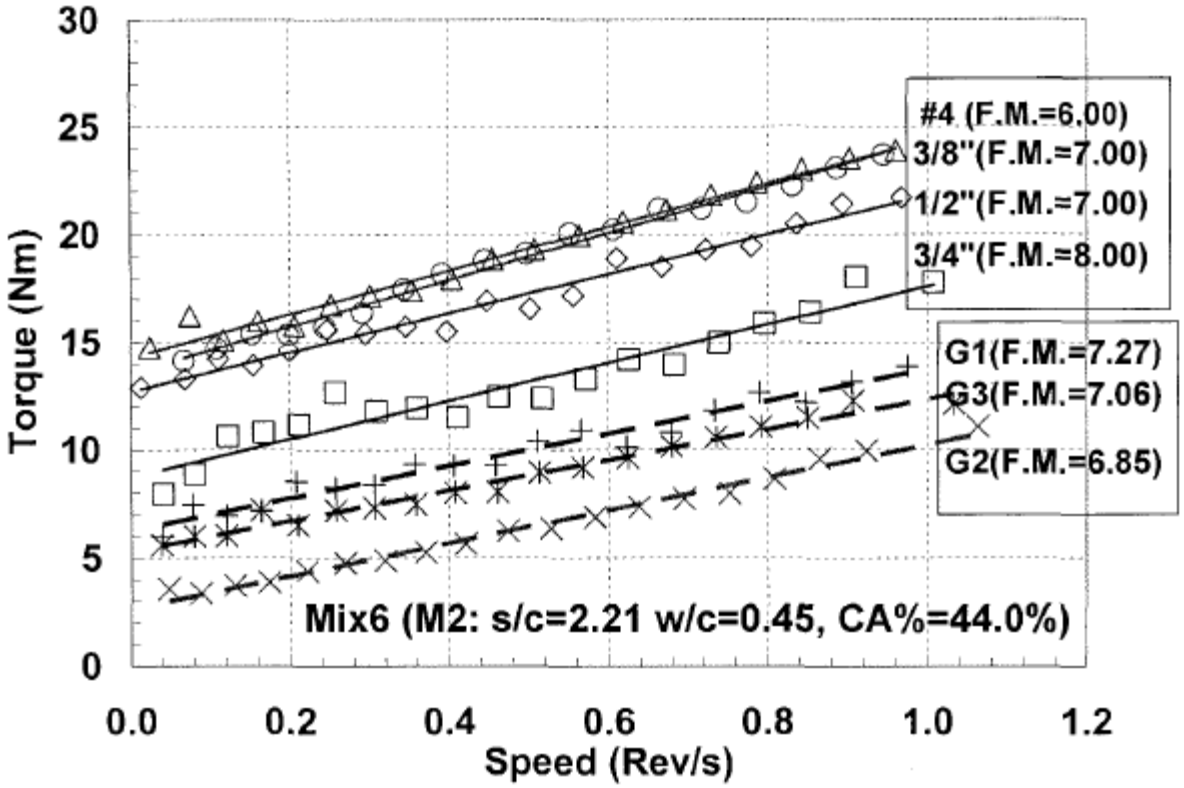


Figure 1.7: The coarse aggregate grading effect on concrete rheology

The above figure clears the distinction between graded and single size coarse aggregates. The down curves of the three concrete mixtures with graded coarse aggregate lay below concrete mixtures with uniform size coarse aggregate, indicates that the aggregates with gradation offers concrete with improved flowability.

V. CONCLUSION

The paper presents the importance of concrete rheology and the deployment of rotational rheometer for predicting the rheological behavior of concrete, paste and mortar. In the proposed work the cement used is Type I Portland cement, as the coarse aggregate the limestone is used and as the fine aggregate riversand and limestone is used. As for the evaluation is concerned 10 cement paste mixes, 23 concrete mixes and 136 mortar mixes are sampled and number of variables based on mortar and concrete rheology are properly examined.

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