

Testing on Ingredients for C-25 Self compacting Concrete

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Abstract: Testing concrete ingredients remains essential for maintaining quality standards and long-term structural performance. Through rigorous evaluation of components including cement, aggregates, and water, mix designs can be optimized, a process that simultaneously reduces project expenditures while enhancing material efficacy. This article highlights the essential testings of ingredients used to produce the C-25 self compact concrete.

Keywords: Silt content, Specific gravity, Moisture content, Physical composition

Introduction

Collection and testing of ingredients are primary role for engineers and researchers before their applications. There are specific methods and procedures for testing the ingredients especially for making the concrete. These tests would help for quality and suitability. Identifying the most suitable ingredients is the major part in the construction industries.

The physical and chemical characteristics vary with materials and the changes in their properties influences the behavioral changes and performance. These variations would impact the key properties like fineness modulus, specific gravity, moisture content, absorption capacity, workability, strength etc.

Cement, Fine aggregates, coarse aggregates and potable water are the basic essential needs for making sustainable concrete in civil engineering field.

In addition, the admixtures are the substances used for concrete mainly to alter the specific characters of ingredients. Testing of admixtures is also important to assure the quality of concrete.

Methodology

Banana peels are well dried openly as shown in figure-1. The well dried peels are then powdered into the ashes, stored typically in air tight containers or aluminum foil to prevent moisture absorption [1]. The clean Banana peels had been exposed to sun to dry and then it turned into reduce into small portions, filled in sacks and transported to Geosystems Consulting Limited at Accra.

At this research Centre, the broken dried Banana Peels are burnt with the use of a Furnace at excessive temperature of 500 Degree Celsius, to get the Banana Peel Powder Ashes (BPPA) [2]. Additionally, the

other ingredients like Dankote Ordinary Portland Cement (OPC) - Dankote Portland Limestone Cement Grade 42.5R from the nearby industries, Aggregates, and Potable water are collected. Sand considered for this study is a Pure River Sand. Quarry stones - Crushed Basaltic Rock (of size 20mm, clean, strong, and sharp, free of clay, loam, dirt, or organic matter) from Ken boat Ltd, Accra.



Figure-1 Open dried and powdered Banana peels

Results and Discussion

As suggested by Chiara F. Ferraris et al (2004), the particle size of cement used in concrete typically ranges from 1 to 50 micrometers (μm), contribute significantly to strength [3]. For banana ash used in concrete, the particle size is typically refined to a fine powder, often passing through a 90-micron or 150-micron sieve, to ensure proper pozzolanic activity and compatibility with cement particles. As per IS recommendation, Fineness of Cement and BBPA is less than 10% is satisfied.

Table-1 Comparison on Cement and BPPA

Materials	Density (g/cm^3)	Average Size (μm)	Fineness
Cement	3.15	48.32	< 10%
BPPA	2.16	63.5	< 10%

Table-2 Chemical compositions of cement in %

Chemicals	Composition in Percentage
Lime stone	85%
Clay	5%
Gypsum	5%
Silica Sand	5%

Density of Cement & BPPA – Water Displacement Method

A graduated cylinder was filled with a known volume of water. The Cement & BBPA samples (separately) were submerged into the water noted the new water level. The difference in water levels is the volume of the ash sample in cubic centimeters (cm^3).

Loss on Ignition method – Determining the amount of Organic matters in Banana Peel Powder Ash

Hoogsteen et al (2018)[4]; Yuhi Satoh et al (2023) [5] have shown the standard testing procedure on loss of ignition method. 1 gm of the dried and ground sample is ignited using a Muffle furnace and heated at high temperature of 550°C for 2 hours. After cooling, the crucible was weighed with the remaining ash.

The weight loss = (Initial weight – Final weight)

The organic matter content as a percentage: (Weight Loss / Initial Weight) * 100%.

The organic matters present in BPPA are found to be 91.50%.

Sieve analysis on fine aggregates

Table-3 Results on sieve analysis on fine aggregates

Weight of sample taken = 500gm					
Sieve Size	Weight Retain(gm.)	Weight Retained (%)	Cumulative Retained (%)	Cumulative Passing (%)	ES C. D3.201 Cumulative Passing (%)
9.5mm	0	0	0	100	100
4.75mm	10	2	0.2	98.8	95-100
2.36mm	41	8.2	8.4	91.6	80-100
1.18mm	65	13	21.4	78.6	50-85
600µm	185	37	58.4	41.6	25-60
300µm	140	28	86.4	13.6	10-30
150µm	55	10	96.4	3.6	2-10
Pan	3.3				
Total			271.4		
FM =2.71					

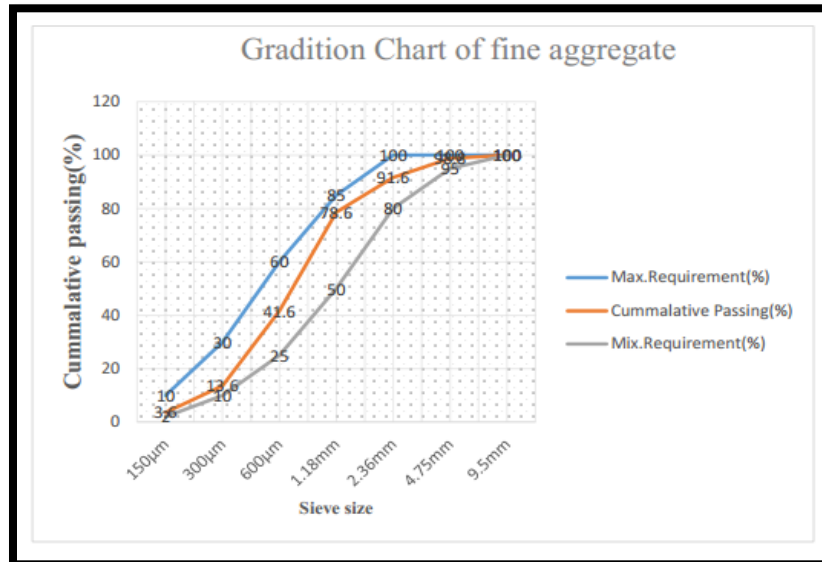


Figure-2 Gradation chart of fine aggregates

Table-3 and Figure-2 shows that the Cumulative percent passing in each sieve is within the standard limit. The test result of each sieve number complies with the standard; hence the sand fulfills the

requirements as per ASTM standard. For concrete applications, the fineness modulus of sand, which represents the average particle size, typically falls between 2.3 and 3.1. Hence, it is satisfied according to Chaocheng Yu et.al (2021)[6].

Test on 'Silt Content', 'Moisture content' and 'Specific gravity' of Fine Aggregate

The laboratory test (Figure 3) shows the silt content of the sample is found to be 1.35%, which is lower than the allowable limit 6%, so it complies with the standard [7]. Hence it is satisfied with the statement of Ogunbayo B.F et al (2018) [7].

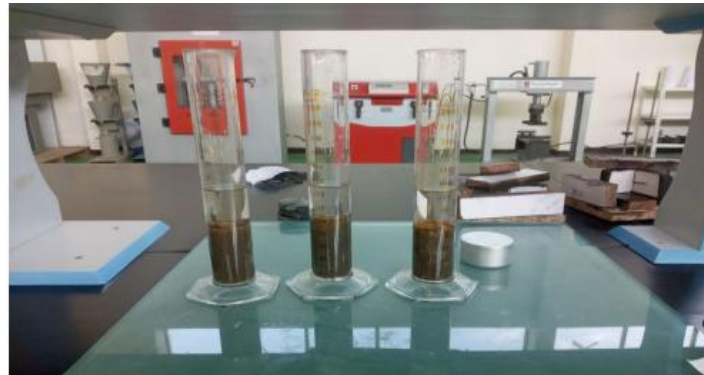


Figure-3 Test on silt content

The moisture content of sand was tested (Figure-4) using oven at 105°C [8]. For concrete mixes, the moisture content of sand should ideally be around 2-6% by weight, to ensure proper water-cement ratio and concrete quality. Observed Moisture Content of Sand was 2.2%, hence it is satisfied.



Figure-4 Test on Moisture content of sand

Generally, a water absorption value below 5% is considered good, and values between 2.5% and 3% are typical for washed sand, as declared by Etxeberria, M et al (2022) [9]. The observed value of water absorption for sands sample is 1.2%, which is well-satisfied.

The specific gravity of sand used in concrete typically ranges from 2.63 to 2.67, with an average value around 2.65, depending on the sand's composition pointed out by H.L. Dinh et al [10].



Figure-5 Test on specific gravity

Observed Specific gravity is found to be 2.60 (Closer to Minimum range). The specific gravity test results reveal that the fine aggregate is medium weight material. Hence it is OK.

Conclusions

All the basic tests were carried out on the ingredients used for making a special C-25 self compacting concrete. All the tests are checked against the suitability of ingredients for the study purpose. The results outcomes of the tests are satisfied as the values obtained are within the range as suggested by ASTM systems as well as IS standards.

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