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STUDY ON PROPERTIES OF CONCRETE WITH PARTIAL REPLACEMENT OF CEMENT BY USING PUMICE STONE POWDER

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Abstract - An The main scope of this study is to find various properties of concrete with replacement of cement by pumice stone powder. Now a days many of research are going to find the best possible alternate for cement in concrete. In this work pumice stone powder was partially replaced as cement in the range 10%, 20%, 30%, 40%. The fresh and hardened properties of concrete with pumice stone is to be compared with conventional concrete. Pumice powder, generated by the stone processing industry, is an inert by-product possessing excellent cementitious characteristics. Utilization of pumice powder in concrete can reduce the cost of construction and at the same time address the waste disposal problem. This study is focused on the strength properties of pumice powder in pozzolan concrete .The results indicate that the fresh and hardened properties of the modified mix with pumice stone powder as improved considerably. The use of pumice powder as a substitute for cement in the concrete mixture also has the ability to improve the compressive, and tensile strength of concrete.

Key Words: Fresh properties, hardened properties, pumice stone powder and cement replacement.

1.INTRODUCTION

A naturally occurring light aggregate known as pumice stone, which resembles a sponge, was created when molten lava swiftly cooled and solidified. Lightweight concrete has been used by ACI for more than 2000 years (American concrete institute, 2003). Constructions made of structural lightweight concrete are still fairly widespread, despite being used much less frequently than ordinary weight concrete today. In comparison to conventional cement, pumice powder has benefits such as increased thermal and acoustic insulation, fire resistance, abrasion resistance, decreased unit weight, hydration heat, drying shrinkage, and autoclave expansion. It also has advantages in terms of improved sulphate resistance, sea water resistance, acid resistance, electrical resistivity, and decreased alkali silica reaction expansion and porosity.

1.2PUMICE STONE POWDER

A naturally occurring lightweight aggregate known as pumice stone is created when molten volcanic material suddenly cools. Viscous magma that is primarily siliceous and rich in dissolved volatile components, particularly water vapour, erupts from volcanoes during eruptions to produce pumice.

Pumice can be utilised as a lightweight aggregate since it is both light and robust. When molten lava erupted from a deep location beneath the earth's crust, gas was able to escape, which is why they were so light. Due of its small weight and porous texture, pumice can float for a long time—sometimes years—before it ultimately gets wet. The bulk density of pumice, a light-colored, froth-like volcanic glass, ranges from 500 to 900 kg/m3.

1.3 Objectives of this study

This study's primary goals are to compare concrete's fresh and hardened qualities when pumice stone powder is used in place of cement.

2. METHODOLOGY

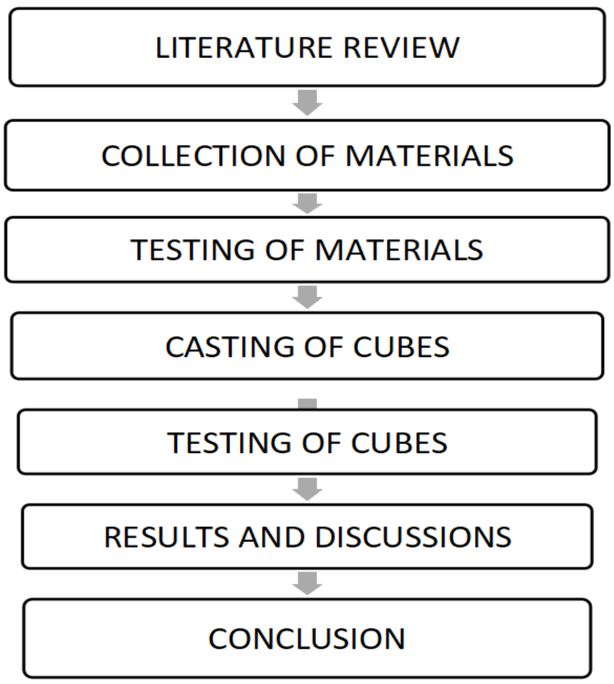

Figure 1: Methodology

3. LITERATURE REVIEW

The following research papers were studied before starting the project work

A thorough analysis of the characteristics of sustainable concrete employing ash from volcanic pumice as an additional cementitious material (2022)

Ali S. Alqarni

With regard to the use of VPPA in concrete and its effects on properties such as workability, compressive strength, flexural strength, splitting tensile strength, and durability performance, this article aims to provide a thorough review of the literature that has already been published in this area. Additionally, by using a scanning electron microscope to investigate the microstructure of concrete, this article seeks to determine how VPPA affects sustainability (SEM). The study's findings showed that using VPPA with partial substitution decreased workability and compressive strength, but enhanced performance in split tensile strength, flexural strength, and durability characteristics. This essay also emphasises the need for additional developments in this area of research.

2. Evaluation of the mechanical, thermal, and morphological characteristics of polyester composites reinforced with modified corn husk pumice powder (2022).

Nasmi Herlina Sari et al.

The SBA/CHF composites' mechanical and thermal properties were greatly enhanced. The strongest SBA/CHF interface bonds in the composites were responsible for the composite with 5:30 volume fraction (JPA) having the highest values of tensile strength (18.61 MPa), tensile modulus (3.23 GPa), flexural strength (36.12 MPa), and flexural modulus (3.39 GPa) among all the composites and the polymer matrix. While a significant number of CHF pullouts contributed to the composite specimens' lowest values being recorded. Similar to how JPA composites performed better in terms of thermal stability than the other composites. According to the morphological investigation, CHF pullout increased as the amount of CHF increased and decreased as the amount of SBA increased and became evenly distributed throughout the composite. The results show that the CHF/SBA composites had better mechanical characteristics than the fiber-glass composites.

4. MATERIAL PROPERTIES

4.1 Cement

S.No	Test For Cement	Result
1.	Standard consistency test	33%
2.	Fineness test	0%
3.	Specific gravity	3.12
4.	Initial setting time	30 min
5	Final setting time	395 min

Table 1: Properties of Cement

4.2 Pumice stone powder

TEST	RESULT
Moisture	0.98 %
Silicon Di Oxide	63.87 %
Aluminium Trioxide	11.47 %
Calcium Oxide	2.37 %
Magnesium Oxide	1.00 %
Sodium Oxide	6.81 %
Potassium Oxide	0.94 %
PH (5% Aq. Suspension)	8.20
Bulk Density	1.05 g/cc
Water Absorption	30 ml/100g

Table 2: pumice stone powder

4.3 Coarse aggregate

S. No	Properties	Value
1	Impact value	21 %
2	Crushing value	19.5 %
3	Specific gravity	2.75
4	Water absorption	0.5%

Table 3: Coarse aggregate properties

4.4 Fine aggregate

Tests	Results
Size of aggregate	4.75
Fineness modulus (%)	2.864
Grading zone	II
Specific gravity	2.516
Bulk density (kg/m^3)	1708
Percentage of voids	56.167
Percentage of bulking (%)	18.2
Moisture content (%)	2
Water absorption (%)	2.13

Table 4: Fine aggregate properties

4.5 Water

Workability, compressive strengths, permeability and water tightness, durability and weathering, and drying shrinkage potential for cracking are all controlled by the precise amount of water in concrete. It makes the mixture workable and serves as a lubricant for the fine and coarse material. It joins cement chemically to create the binding paste. It is used to dampen the aggregate surface to stop it from absorbing the water that is essential for chemical action.

5. Experimental Investigation

5.1 Slump Test

Figure 2: Slump cone test

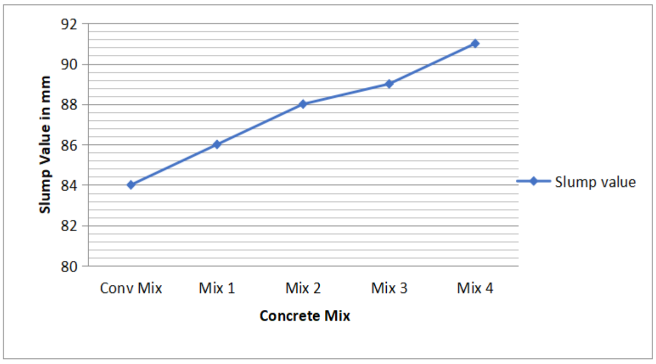

Figure 3: Slump cone test result

5.2 Compressive Strength

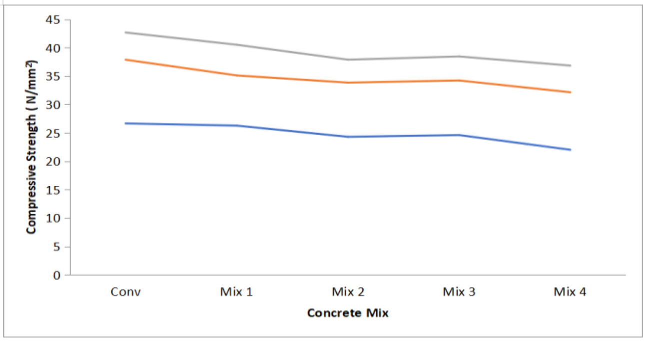

Figure 4: Compressive Strength results

5.3 Split Tensile Strength

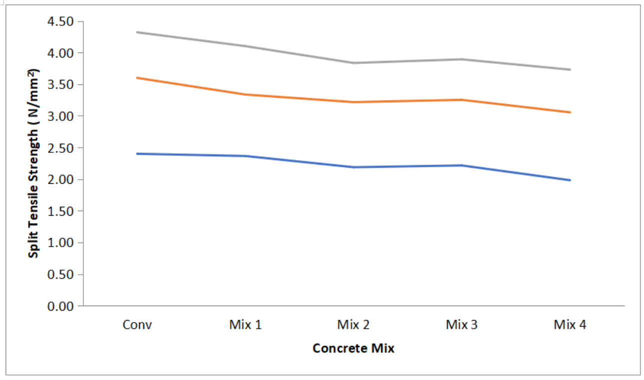

Figure 5: Split Tensile Strength results

5.4 Rebound Hammer test

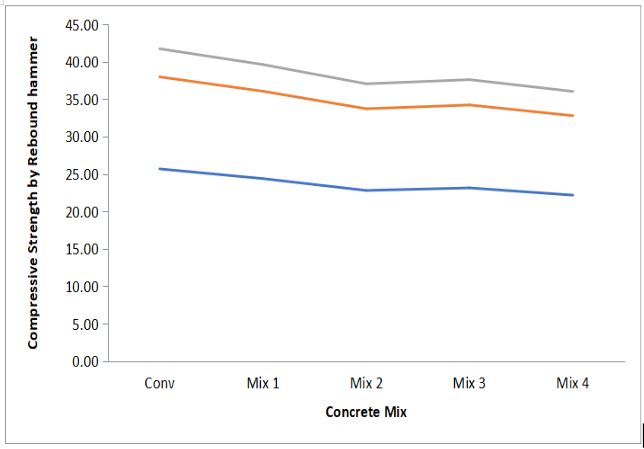

Figure 6: Rebound Hammer Strength results

5. CONCLUSIONS

From this research, the following conclusions were made,The following conclusions were drawn from this study:

Concrete elements become less dense when mixed with pumice stone powder. The experimental results also indicate that the percentage of cement that is replaced by pumice stone will enhance the slump value (Con -.84mm, C 90: PS -86mm, C 80: PS -88mm, C 70: PS -89mm, and C 60: PS -91mm). When compared to other mixes, the compressive strength of concrete made with 30 percent pumice stone powder as cement reaches its optimum at 7 days, 14 days, and 28 days. However, at all ages (7 days, 14 days, and 28 days), the strength starts to decline when more cement is added. Comparing different mixes, concrete with 30 percent pumice stone powder produces the strongest split tensile strength. It demonstrates that cement may be replaced with 30% pumice stone powder to provide the desired strength. Pumice stone powder can therefore be used as a substitute for cement to create concrete pieces that are lighter in weight.

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