Using Multicomponent Cements To Improve Mechanical Properties of Concrete

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***Abstract*- Nowadays, due to the increasing use of different cement applications as well as the discussion of sustainable development, the use of multipurpose cement and the production of high strength concrete has been considered. In multicomponent cement, clinker is partially replaced by cementitious additives such as Pozzolans, which alter the physical, mechanical, and durability properties of cement and concrete. So, this work lead to reduction in cement production and consequently reduction in emission in greenhouse gases, as well as sustainable management of the waste. In this study, the mechanical properties of concrete constitute of multi component cement is investigated. Also, the concept of multi blended cement exploits the beneficial characteristics of all pozzolanic materials in creation of better concrete. . This research investigated mechanical properties of concrete created from multi component cement.**

Keywords – Multi component, Mechanical properties, Natural pozzolan, Sustainable Development

1. INTRODUCTION

Nowadays, with the new developments in the construction industry and the different application requirements, use Multi-component cement has become commonplace. Multi-component cements are cements whose clinker is partially replaced by one or more cementitious additives and can improve the cement function [1]. The advantages of using multipurpose cements are including economic and environmental benefits such as reduced greenhouse gas emissions, resource storage, natural, reduced energy consumption and improved physical, chemical and durability properties of concrete [2]. Also reducing the heat of hydration, removing thermal cracks, reducing creep problems, reducing the need for super-lubricants to reduce the viscosity of fresh concrete and improving the properties of fresh and hardened concrete are other advantages of multipurpose cement in concrete. Pozzolans are substances that react with calcium hydroxide at normal temperatures in the presence of water and produce compounds with cementitious properties (mainly hydrous calcium silicate gel) [3]. The performance of mineral mixtures in multilayer and concrete cements depends on factors such as particle size distribution, specific surface area, chemical composition and crystal shape [3]. Replaceable pozzolans include silica soot that is a byproduct of ferrosilicium plants, pozzolans used in natural cement plants and other reactive materials capable of pozzolan reactivity [4].

Much research has been carried out on these types of cements that various pozzolans such as silica fume, zeolite, natural pozzolans and other cementitious materials used. Silica soot plays a very important role in improving the chemical and physical properties of concrete, which due to its large surface area and a favorable pozzolanic activity [5]. Li et al investigated the effects of cementitious agglomeration and silica agglomeration on cement to improve cement performance, as a three-component blend. Adding fine cement supplements to fill the voids between the cement particles is an effective way to increase the agglomeration density and reduce the volume of voids filled with water. In general, concrete containing fine cementitious materials often has better performance, durability and durability. The materials used in this study were ordinary cement, fly ash, and agglomerated silica fume. Combined with fine cementitious additives, aggregate density will be improved dramatically. Increasing aggregation density, the three-component blend of fly ash and silica agglomerate, showed better effects than either separately [6].

Due to the small size of the agglomerated silica fume particles, the effect of its two-component composition is more effective than the double-component of fly ash.

2. MATERIALS SPECIFIVATIONS

Table 1: Physical Properties of Consumed Cement

Test	Determination of fineness		Setting time (min)		Compressive Strength (Kg/m^3)	
	Blain (cm^2/g)	Sieve No170 (%)	Initial	Final	4 days	8 days
Result	2230		110	152	214	260
Method of analysis	ASTM C204	EN196-6	ASTM C191		EN 196-1	

In this research, Portland Type 2 cement was used to make experimental mixtures. The physical properties of the cementitious cement are shown in Table 1. The used cement had a specific weight of 3180 Kg/m^3.

Silica or microsilica soot from soot accumulation in the alloy production process Silica and ferrosilis are obtained from high-purity quartz and coal in a submerged arc furnace. The soot particles of silica or microsilica are spherical and very fine. The physical properties of silica fume are shown in Table 2.

Table2: Physical Properties of silica fume

Specific Weight (Kg/m^3)	Structure	Paticle shape	Specific Surface (m^2/Kg)
2200	Amorphous	Spherical	20000

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In this study, five mixing designs including a quadripartite mixture of silica soot, pozzolan and metakaolin were prepared

with water to cement ratio of 0.5. All the specimens are located in water tank for curing and then tested as per IS norms and standard. All the cube specimens are tested for compressive strength in compression testing machine (CTM), all cylinder specimens are tested for split tensile strength in compression testing machine (CTM) and all beam specimens are tested for flexural strength in universal testing machine (UTM).

2.2. Results

The compressive strength, split tensile strength and flexural strength of concrete including different % of multi blended cement at the age of 8, 25 and 48 days are reported.

Table 3: Percentage of Replacing Cement

	cement %	Silica fume %	Pozzolan %	Metakaolin %
Mix 1	50	20	20	10
Mix 2	50	15	20	15
Mix 3	50	20	10	20
Mix 4	50	20	15	15
Mix 5	50	15	15	20

2.2.1 Compressive Strength

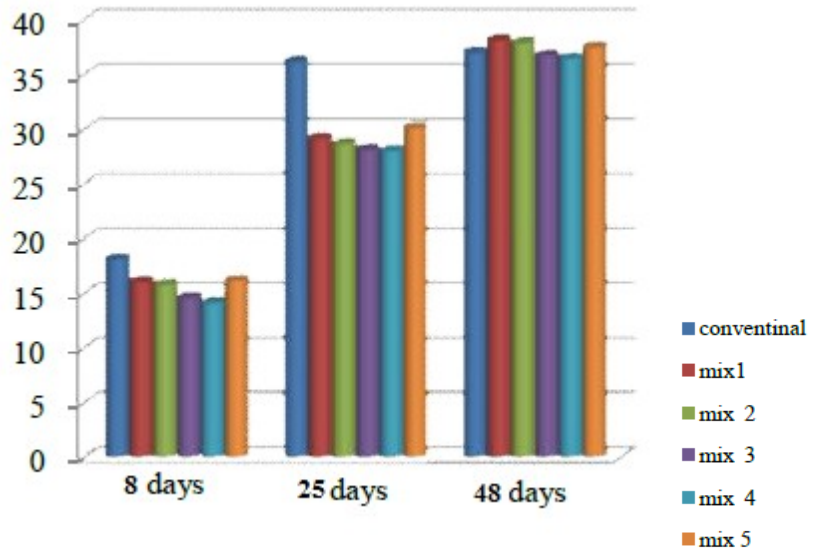

Table 4: Compressive Strength (N/mm^2)

	compressive strength		
	8 days	25 days	48 days
CONV	18.06	35.26	37.6
Mix 1	17.15	29.14	38.64
Mix 2	15.4	28.17	37.65
Mix 3	13.68	27.14	36.65
Mix 4	14.3	28.13	36.15
Mix 5	16.81	30.24	37.19

3. CONCLUSION

The result depicts the blending of material haven't compromised in strength concrete. And Strength of concrete slightly depends on the amount of silica fume and metakaolin. The partial replacement of silica fume in concrete by waste material

assists environmental friendly disposal of the waste. The use of natural pozzolans, especially in the high replacement percentages, significantly reduced the resistance to mixtures containing silica fume and control mixtures, especially at an early age, although the compressive strength of the mixtures decreased with increasing age to 48 days.

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