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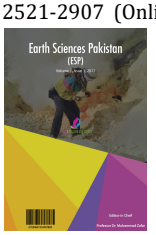

EXPERIMENTAL STUDY ON STRENGTH AND DURABILITY OF CEMENT AND CONCRETE BY PARTIAL REPLACEMENT OF FINE AGGREGATE WITH FLY ASH

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ABSTRACT

Cement is a binding material that is used to bind different aggregate (coarse and fine) through a chemical process known as hydration in the presence of moisture. This research work is planned with the purpose to determine the most appropriate and efficient proportions of admixture i.e. fly ash so as to modify the strength properties of concrete. By adding this admixture strength properties of cement and concrete can be enhanced. Cement be replaced with different percentages levels of Fly ash as 0%, 10%, 20%, 30%, 40% and 50% by weight of cement. To work out the strength properties and the variation pattern due mixing in different proportions of fly ash for different tests such as compressive and tensile strength are planned to be performed after 7, 14, 21 and 28 days curing. These experiments were conducted at Laboratory scale. Addition of fly ash as an admixture in replacement of cement enhanced strength properties of cement and concrete up to a limit. At 10% fly ash cured for 28 days maximum compressive and tensile strength was achieved i.e. 1170 psi and 66 psi respectively. Furthermore, addition of fly ash as cement replacement showed gradual reduction in the strength properties i.e. minimum compressive and tensile strength was found to be for 50% fly ash sample cured for 7 days. As an outcome of this research fly ash is concluded to be an effective replacement of cement for non-loading constructions.

1. INTRODUCTION

Cement and Concrete is widely used in all countries like Pakistan for construction purpose i.e. in building industry because of its advantages like high strength and durability. For constructing road, Buildings, Hospitals, Schools, Colleges, Government Institution etc large quantity of cement is required. Due to increase in demand of cement prices of cement are increasing and also caused shortage of cement. Fly Ash can be used for partial replacement of cement. Fly ash can be used as an admixture in cement and concrete by replacement of fine aggregate (sand) and cement to enhance the binding properties of cement and concrete. Millions of tonnes of Fly Ash is produced in power plant and brick kilns in Pakistan that deteriorate the environment. Fly ash produced in power plant is handled improperly and contained in open surfaces from where minor quantities are used in road construction. When wind is moves particles of fly ashes disperse in atmosphere and disturbs the constituents of atmosphere and causing environmental destruction and air pollution. By use of fly ash we can save sand, cement and consuming industrials waste can be enhanced the binding and mechanical properties of cement and concrete [1].

Fly ash (FA) is the core solid waste emitted mainly from coal power stations. Most vital areas of using fly ash as an alternative reported are: concrete production, road basement material, waste stabilization/solidification, cement clinkers and more recently geopolymer concrete [2-6].

In power generation perspective, FA is a waste material and electricity generation stations are looking for economically advantageous ways to exploit fly ash. However, from construction industry perspective, FA is considered as a supplementary cementitious material (SCM) that is used as a cement replacement in conventional, mass and high performance concrete material [7,8]. Fly ash increases workability, reduces thermal cracking and heat of hydration in concrete at early stage and improves mechanical and durability characteristics of concrete particularly at later ages [9]. In spite of the benefits of incorporating FA in concrete, utilizing 100% of fly ash is not achieved due to several limitations reported [10]. Fly ash can be obtained from sugar mills where sugar cane waste is used for burning. Significant results can be obtained as more durability, greater strength and binding properties by incorporating fly ash in cement [11]. According to environmental protection agency, the use of fly ash in concrete decreases the GHGs emissions equivalent to emissions from 2.5 million cars on road per year [12]. Hence, significant reduction in greenhouse emissions can be achieved by utilization of FA in concrete.

In power plants coal is used, during its combustion fly ashes are produced. Properties of fly ashes depend on chemical composition. For instance Class C of fly ash have higher CaO as compared to Class F of fly ash. Class F of fly ash having constituent silicate, Fe, Al and alkalies. Class F fly ash having solid particles are produced from anthracite [13]. Lime stone and fly ash can be added in concrete separately. By adding these hydrolysis process of concrete was changed. Also increased the durability, mechanical and physical properties of concrete [14]. Fly ash is effective on properties of concrete. Fly ash adding as admixture by partially replacement of cement we can enhance the workability and strength properties of concrete [15].

A researcher has studied effect of admixture on concrete [16]. He added fly ash as an admixture with different percentage as 5% and 10% by partially replacement of fine aggregate and cement to enhance the mechanically properties of cement and concrete. Ordinary Portland cement was used under study because it has greater strength as compared to other type of cement. Water permeability and compressive strength was measured at curing 28 days and concluded that by adding admixture result showed higher compressive strength and low water permeability. Also, a group scientist studied rheological properties, carbonation and compressive strength of concrete by adding fly ash with percentage of 25% and 50% with replacement of fine aggregate [17]. Test result indicate that compressive strength and rheological properties of concrete increased by increasing level of fly ash. Some researcher used bottom ash by replacement of aggregate that obtained from municipal solid waste for concrete masonry units (CMU) [18]. Test result were obtained from concrete by adding MSWBA as aggregate meets ASTM 90 (American Society for Testing and Materials) standard. Next, there also a researcher used dry bottom ash by replacement of fine aggregate in concrete [19]. Six specimens of different proportions of concrete were prepared and fabricated according to ASTM C 11709 (American Society for Testing and Materials for concrete) procedure. Each specimens were tested and concluded that each sample have good strength, stiffness and resistance to wear. In other study stated that United States used coal to generate electricity [20]. From burning of coal almost 80 million tonnes fly ash is produced per year. Fly ash is dumped in landfills but also used for constructional purpose by replacement of cement. By replacing cement resistance to alkali- silica reaction can be improved. And also, Electromagnetic interference shielding effectiveness can also be enhanced.

Some of researcher evaluated the compressive strength and corrosion resistance properties of concrete by mixing fly ash as an admixture with replacement of sand [21]. For this purpose 10%, 20% and 30 % by weight of cement fly ash was used and concluded that compressive strength and corrosion resistance characteristics can be enhanced. In addition, there also a studied the effect of fly ash on tensile and compressive strength of concrete [22]. Fly ash was obtained from lignite coal based power station and added with different percentages 0%, 5%, 10% and 15% by weight of cement. The specimens were cured in 20o C. Compressive and tensile strength were determined at 7, 28, 56, 90, 120 days curing. It was observed that mechanical properties of concrete be enhanced by increasing fitness of fly ash. Two researcher used ordinary Portland cement and partially replaced by difference level of fly ash as 10%, 20%, 30%, 40%, 50% and

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