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Experimental Study on Use of Fly Ash in Concrete

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Abstract - F*ly ash utilization in concrete as partial replacement of cement is gaining importance day by day. Technological improvements in thermal power plant operations as well as collection systems of fly ash improved the quality of fly ash. To study the use of fly ash in concrete, cement is replaced partially by fly ash in concrete. In this experimental work concrete mix prepared with replacement of fly ash by 0%, 25%, 50%, 75% and 100%. Effect of fly ash on workability, setting time, compressive strength and water content are studied. To study the impact of partial replacement of cement by fly ash on the properties of concrete, experiments were conducted on different concrete mixes.*

Key Words: Fly Ash, Concrete, Workability, Strength, Curing.

1. INTRODUCTION

Pozzolans are materials which have little or no inherent cementitious properties, but which develop cementitious properties in the presence of calcium hydroxide (lime) and water. Such materials usually derived from natural deposits. Many modern pozzolans still derive from natural deposits, but the bulk of pozzolana derive from the combustion of powdered coal during electric power generation. This product is commonly called fly ash. There are currently three classes of pozzolana defined by the ASTM: Class N, Class C, and Class F. Class N are natural pozzolans: calcined shale, calcined volcanic ash, etc. Class F is fly ash nominally produced from anthracite, bituminous, and some sub-bituminous coals. Class C is nominally produced from fly ash derived from combustion of lignite and some sub-bituminous coals. Total USA production of Fly ash in 1983 was 52.4 million tons, of which 3.6 million tons was used in cement and concrete products [6]. An additional 5.3 million tons was used for other things, such as mud stabilization, agriculture, and raw material for cement manufacture, the remainder going to landfills [1].

The components of the concrete are fine aggregate (FA), coarse aggregate (CA), cement and water. The vital environmental problems related with cement production is releasing of CO_2, one of the major greenhouse gas which causes Global Warming. Keeping this ill effect of cement, various replacements include fly ash, ground granulated blast furnace slag, rice husk and silica fume is used. Fly ash is a much cheaper material than Portland cement, so that large replacements can result in significant economic savings. [2] estimated that a 25 percent savings in materials cost was realized in the construction of the Upper Stillwater Dam through use of large amounts of fly ash.

1.1 Effects of Large Quantities of Fly Ash on Properties of Fresh Concrete

1.1.1 Time of Setting

Setting is defined as the onset of rigidity in fresh concrete. Although specific events are defined, i.e. initial and final setting. Portland cement is the principal active ingredient in concrete that causes setting. Fly ash usually has a tendency to retard the time of setting of cement relative to similar concrete made without fly ash. [8] examined the effect of 35 to 55 percent (by mass) of Class C fly ash on time of setting. Initial time of setting increased about 1hr for each 10 percent increase in fly ash content. [9] Reported increases in time of setting from a few minutes to a few hours. The effect was most pronounced in high-replacement concretes made with Class C fly ashes. [10] investigated two Class F fly ashes used at 60 percent (by mass) of total cementitious material at a w/c of 0.31. They found that initial time of setting was not changed relative to control, but the final time of setting ranged from 8 to 11hr. [7] found that 37 percent Class F fly ash (by mass) caused a maximum delay in time of setting of 3 hr.

1.1.2 Workability, Water Requirement, and Bleeding

Water required for constant workability is usually lower for fly ash containing mixtures, but the amount of water reduction varies among fly ashes. At conventional replacement levels, Class C ashes tend to affect greater water reduction than the Class F ashes. [9] Used a troweling test and found a general improvement in workability with increasing fly ash contents. [4] Found that workability of a 50 percent (mass) replacement improved when measured by the Veebe test, for eight fly ashes studied. [5] Found a reduction of water demand with increasing fly ash content for both 0.5 and 0.8 w/c mixtures.

1.2 Effects of Large Quantities of Fly Ash on Properties of Hardened Concrete

1.2.1 Strength

Strength is one of the properties of concrete in which fly ash has a notable effect, but the size of the effect is strongly