

CHAPTER 1

INTRODUCTION

Concrete is a heterogeneous mix of cement, aggregates and water. Concrete is used for various construction purposes such as in buildings and their components, roads, water retaining structures, air fields, docks and harbors because of its exceptional qualities. It has numerous other advantages over other construction materials. Concrete, a second largest material used worldwide next to water has emerged as the dominant construction material with the demand in for the infrastructure needs of the twenty-first century. The production of cement is an energy intensive process, resulting in emission of green house gases which adversely impact on the environment. At the same the cost of production of cement is increasing at alarming rate and natural resources giving the raw material for its manufacturing are depleting. The use of waste material having cementitious properties as a replacement of cement in cement concrete has become the thrust area for construction material experts and researchers. The main focus now a day's is on search of waste material or by product from manufacturing processes, which can be used as partial replacement of cement in concrete, without compromising on its desired strength.

In the country like India, where the development of the infrastructures projects such as large irrigation, road and building projects are either being constructed or in completion of their planning and design stage, such uses of waste material in cement concrete will not only reduce the emission of green house gases but also will be the sustainable way of management of waste. The Fly ash (FA), GGBS, Rice Husk Ash (RHA), and Silica Fume (SF) are some of the pozzolanic materials which can be used in concrete as partial replacement of cement. A number of studies are going on in India as well as abroad to study the impact of use of these pozzolanic materials as cement replacements and the results are encouraging. These materials include fly ash, silica fume and ground-granulated blast furnace slag used separately or in combination. The strength, durability and other characteristic of concrete depends on the properties of its ingredients, proportion of mix, method of compaction and other controls during placing and curing. For concretes, a combination of mineral and chemical admixtures is always essential to ensure achievement of the required strength.

In the view of global warming efforts are on to reduce the emission of CO₂ to the environment. Cement Industry is major in contributor in the emission of CO₂ as well as using up high levels of energy resources in the production of cement. By replacing cement with a material of

pozzolanic characteristic, such as the fly ash, the cement and the concrete industry together can meet the growing demand in the construction industry as well as help in reducing the environmental pollution. India is a resourceful country for fly ash generation with an annual output of over 110 millions tones, but utilization is still below 20%. Availability of consistent quality fly ash across the country and awareness of positive effect of using fly ash in concrete are pre requisite for change of perception of fly ash from a waste material to a resource material. The ground granulated blast furnace slag (GGBS) is a waste product from the iron manufacturing industry, which may be used as partial replacement of cement in concrete due to its inherent cementing properties. In the country like India, where the development of the infrastructures projects such as large irrigation, road and building projects are either being constructed or in completion of their planning and design stage, such uses of waste material in cement concrete will not only reduce the emission of green house gases but also will be the sustainable way of management of waste.

The present day world is witnessing the construction of very challenging and aesthetic structures. Concrete being the most important and widely used material is called upon to possess very high strength and sufficient workability properties. Efforts are being made in the field of concrete technology to develop such concretes with special characteristics. In the present experimental investigation the Fly Ash and GGBS has been used to study the effect on compressive and split strength on M25 grade of concrete.

Human safety in the event of fire is one of the considerations in the design of residential, public and industrial buildings. Concrete has a good service record in this respect. Unlike wood and plastics, concrete is incombustible and does not emit toxic fumes on exposure to high temperature. Composition of concrete is important because both the cement paste and the aggregate consist of components that decompose on heating. The permeability of concrete, the size of the element, and the rate of temperature rise are important because they govern the development of internal pressures from the gaseous decomposition products.

The main objective of this experimental study is to investigate the strength performance of concrete produced by replacing cement by Fly Ash and GGBS as binary and secondary cementitious materials in various percentages like 10%, 20%, 30% and 40% when subjected to sustained elevated temperature of 400°C. The various strength parameters studied are compressive strength and split

tensile strength. In this research we prepared specimen of cubes for compressive strength test, cylinder for split tensile strength test. Three samples for each set of percentage have been taken for conducting test and average of results are taken. The samples were tested at the age of 28 days. The test on hardened concrete are destructive test while the destructive test includes compressive strength test as per IS: 516-1959, split tensile strength test as per IS: 5816-1999.

Concrete acts as non-flammable construction material; however most of its mechanical properties are changeable due to chemical and physical changes that may occur due to high temperature effect. In order to assess the structural safety of such structures after fire, it is important to exposure the concrete to high temperatures so as to determine the mechanical properties of concrete. The aim of this investigation is to study the influence of exposing to high temperature on some mechanical properties of concrete by replacing by Fly Ash and GGBS in various percentages when subjected to elevated temperature. Elevated temperatures affect concrete microstructure strength properties.

The most important effects of elevated temperature on concrete are: dehydration of cement paste, porosity increase, modification in moisture content, thermal expansion, alteration of pore pressure, strength loss, thermal cracking due to incompatibility, thermal creep and thermal spalling due to excessive pore pressure. Water distribution and transport, whether in gaseous or liquid form, play important roles in the local damage of concrete structures. During heating, the endothermal nature of vaporization creates locally high thermal gradients and high vapour pressure, which can lead to tensile stresses exceeding the concrete's strength. The escape of chemically bounded water in the Calcium Silicate Hydrates (CSH) leads to the failure of concrete at temperatures over 450 °C. Aggregate type strongly influences the behavior of concrete at elevated temperatures. The aggregate's thermal expansion is partly opposed to the drying of the cement paste. This phenomenon makes it possible to think that limestone aggregate, whose thermal coefficient of expansion is lower than that of siliceous aggregate, is more favourable to the behavior of concrete at elevated temperatures.