CHAPTER 1

INTRODUCTION

1.1 GENERAL

Concrete is the most widely used building material. It is versatile, has desirable engineering properties, which can be moulded into any shape and it is produced with cost effective materials. It is also brittle in nature.

The fresh concrete can be prepared by mixing the ingredients cement, river sand and aggregates with water to the required ratio. Cementing medium is the product of reaction between hydraulic cement and water. Concrete is made with several types of cement and also containing pozzolana, fly ash, blast furnace slag, a regulated set additive, sulphur, admixtures, polymers, fibres etc. Workability is the amount of useful internal work necessary to produce full compaction. The useful internal work is a physical property of concrete and the work or energy required to overcome the internal friction between the individual particles, formwork surface or reinforcement provided in the concrete.

Due to the hydration, the heat is liberated and so the concrete get hardened. It can be heated, steam cured, autoclaved, vacuum treated, extruded and sprayed. The concrete attains its strength with respect to its age.

The quality of concrete is determined by its mechanical properties as well as its ability to resist deterioration. The mechanical properties can broadly be divided into short-term and long-term properties. Elastic modulus,
compressive strength, tensile strength and shear strength are short term properties. The long term properties are porosity, impermeability, abrasion and freeze-thaw resistance.

With respect to strength, concrete is strong in compression. In addition to its compressive strength it is also to withstand against tensile and flexural strength.

With respect to durability, concrete must withstand freeze-thaw action. Normally concrete surface is subjected to temperature variation throughout. Due to the increase in temperature the concrete strength is affected to some extent compared with the concrete strength at normal temperature. Similarly sudden drop in temperature from a high temperature in concrete causes thermoshock. This is mainly during fire accidents in buildings. When water is forced over portion subjected to fire the concrete is subjected to thermoshock. Concrete must withstand this thermoshock.

Permeability is due to internal movement of water or liquid through the pores of concrete. Normally strength of hydraulic structures, marine structures and structures near chemical industries are affected by permeability. High permeability due to porosity or cracking provides ingress to water, chlorides and other corrosive agents. If such agents attack the reinforcement inside the structure, the bars will be subjected to corrosion which leads to the failure of the structure. A durable concrete is impermeable one and performs well in the working environment withstanding all exposure conditions.

The most commonly used fine aggregate is natural river or pit sand. The consumption of the river sand is becoming high now-a-days and so the cost also increasing rapidly. Due to this, developing countries like India are facing a lot of problems in getting of sand. Vast development of the
construction industry leads to the scarcity in the supply of natural sand especially in the states like Tamilnadu and Kerala. Therefore the construction companies are under stress to identify alternative materials to reduce the demand for natural sand.

Figure 1.1 represents the variation in cost of river sand over the past three years. It is observed that the cost of sand had increased rapidly. Figure 1.2 shows the variation in the average cost of river sand over the past six years. In that period the cost of river sand increased from 1900 rupees to 6500 rupees per 100 cft. This hike in cost of river sand leads to the increase in construction cost directly which affect the users heavily.
The scarcity of sand in Chennai has forced construction companies to import sand mined from the Mekong River in Cambodia. A consignment of sand from Cambodia has already reached Chennai. More consignments are likely. The importers are likely to use the sand for coping with the challenge of rising price of sand. According to sources, suppliers of sand in Cambodia are able to supply one cubic foot of sand at around Rs. 12. Even though the importer will have to spend on shipment and duty, the availability of imported sand is likely to facilitate speedy completion of projects. Various difficulties have to be faced to bring such imported sand to the interior part of Tamilnadu which needs additional cost. So we have to think of an alternative to river sand.

1.2 ALTERNATIVE MATERIALS TO SAND

Some of the alternative materials like crushed rock material, M-sand, fly ash and sea sand are found out in order to replace the natural sand.

Boulders of rock are crushed to small pieces in crushers to obtain different sizes of metal like 40 mm, 20 mm, 10 mm, 4.75 mm and the powder residue of size less than 4.75 mm. The powder is the unwanted material called as quarry dust and this is dumped like heap of mountain near crusher units which creates environmental pollution. It is used as filler to spread over newly laid bituminous road surface. If it is effectively used in concrete as an alternate material to sand, it helps to reduce environmental pollution. Its cost is less when compared to river sand.

The M-sand, the manufactured sand is prepared by washing quarry dust, dried and then sieved through 4.75 mm sieve. The particles having size in between 4.75 mm to 150 microns is called as M-sand. It is costlier than quarry dust but cheaper than river sand.
Fly ash generated and sintered ash from pulverized coal burner is an important aggregate. Large quantities of this industrial by-product are derived from pulverized coal operated boilers of thermal stations. These ashes are extensively used by the building industry. Ash as pozzolana is used for cellular and other types of concrete as mineral admixtures. Fly ash also used as fine aggregate as a partly replacement material.

Among the above alternative materials to sand, quarry dust is preferred for this study.

1.3 PRESENT STUDY – OBJECTIVE AND SCOPE

The main objective of this work is to study the behaviour of concrete replacing sand by quarry dust partly or fully. To analyse the possibility of its use, tests on workability, strength and durability are to be carried out on concrete using OPC and PPC with and without superplasticizer. In this study sand is replaced by quarry dust from 0 to 100% at increments of 10%, water cement ratio (w/c ratio) for all proportions is to be found out conducting slump cone test, to give a constant slump of 60 mm.

According to strength point of view the compressive strength of cube specimens, split tensile strength of cylindrical specimens and flexural strength of plain and reinforced concrete beams are to be determined.

According to durability point of view the compressive strength of cubes at increased temperature and under thermoshock are to be found out. The co-efficient of permeability of concrete is also to be found out to check whether the concrete is impermeable or not.

After the study through conducting the experiments, the intention of this work is to decide, whether quarry dust can be utilized and if so, up to
which range it can be used as a good substitute for natural river sand without sacrificing strength and durability.

1.4 ORGANISATION OF THE THESIS

This thesis is organised in six chapters. Chapter 1 gives a general introduction with the necessity of the study, stating the objectives and scope of the investigation. Chapter 2 presents the relevant works reported in the literature in connection with this topic. In Chapter 3, the properties of materials used in the investigation are provided. Chapter 4 is devoted for experimental study. Chapter 5 consolidates the results and discussion of entire experimental works carried out. The conclusion and recommendation for future research are given in Chapter 6.