ABSTRACT

River sand, the most commonly used fine aggregate in concrete is very expensive now. Day by day, the cost of sand is increasing due to the scarcity and restrictions. Huge quantity of sand excavated from river bed destroys the stability of river banks. To avoid such situation and to meet the demand we have to think of an alternative or replacement material to sand.

Crushed rock material, fly ash and sea sand are some of the alternatives. Different sizes of metal like 40 mm, 20mm and 10mm are obtained by crushing boulders of rock into small pieces in crushers. The residue of size less than 4.75 mm is called quarry dust which attracts various researchers as an alternative to river sand.

This experimental work describes the study on the feasibility of the quarry dust for usage in concrete. Various tests on concrete strength like compressive strength, tensile strength and flexural strength were conducted on concrete using quarry dust to replace sand from 0% to 100% with increments of 10%. The concrete grades M15, M20 and M25 were taken for the study by keeping a constant slump of 60 mm.

In the first phase quarry dust was sieved and classified into coarse, medium and fine according to the grain size. Using ordinary Portland cement, M15 grade concrete was prepared to cast specimen to determine the
compressive strength, tensile strength and flexural strength. From the test results it is observed that the maximum strength is obtained at 30% sand replacement by fine quarry dust. If medium or coarse quarry dust is used instead of fine, the maximum strength is obtained at 50% sand replacement. Thus when quarry dust of size 4.75 mm and below is used as whole with the combination of coarse, medium and fine we get maximum strength at 50% sand replacement.

In the second phase two types of cement namely ordinary Portland cement (OPC) and Portland pozzolana cement (PPC) were used to prepare concrete. M20 and M25 grade concretes were prepared using quarry dust of size below 4.75 mm replacing sand from 0% to 100% with increments of 10%. The compressive strength of concrete cubes at ages of 7 days and 28 days were obtained at normal temperature. The concrete cubes after 28 days curing were heated to 100°C in an oven for 24 hours and then tested for compressive strength to study the effect of temperature on strength. Also concrete cubes kept at 100°C for 24 hours are suddenly immersed in water to cause thermoshock and tested for compressive strength. The temperature and thermoshock effects on 28 days cured concrete cubes are compared with control concrete to check the variation in strength. From the results, it is found that the maximum compressive strength is obtained at 50% replacement of sand by quarry dust at normal temperature. There is loss in strength when the temperature is increased above normal temperature. The minimum loss in strength is only at 50% replacement both in temperature and thermoshock effects. The tensile strength of cylindrical specimen, flexural strength of plain
and reinforced concrete beams were obtained at the age of 28 days. Here also the maximum strength is obtained only at 50% sand replacement by quarry dust.

In the third phase the co-efficient of permeability of concrete was determined by conducting water permeability test on concrete cubes at an age of 28 days. Both OPC and PPC were used to cast cube specimens in M20 and M25 grades of concrete. From the test results it is found that the co-efficient of permeability of concrete is comparatively less at 50% sand replacement by quarry dust.

In the final phase to study the effect of quarry dust on the use of superplasticizer, sulphonated naphthalene based superplasticizer was added with fresh concrete of grades M20 and M25 using OPC and PPC seperately. Superplasticizer was added at 1.2 lit/100 kg of cement as per the recommendation of the manufacturer. Water cement ratio was found out by conducting slump test for a constant slump of 60 mm. Tests were conducted in limited ratios of sand: quarry dust choosing one ratio each above and below the one giving maximum strength say 60:40, 50:50 and 40:60. At the age of 28 days the compressive strength, tensile strength and flexural strength were determined.

The temperature and thermoshock effects on concrete cubes were also determined. The co-efficient of permeability of concrete was determined by conducting water permeability test on concrete cubes cured for 28 days. From the test results it is found that the co-efficient of permeability of
concrete is minimum at 50:50 ratio whereas, the compressive strength, tensile strength and flexural strength are maximum in that ratio.

These results on strength and permeability studies give a clear conclusion that quarry dust can be used as a good substitute for natural river sand with higher strength at 50% replacement compared with control concrete.