International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 02 | Feb 2020 www.irjet.net p-ISSN: 2395-0072

EXPERIMENTAL INVESTIGATION ON NO-FINES CONCRETE WITH TYRE AS A PARTIAL REPLACEMENT AND SODIUM SILICATE AS AN ADMIXTURE

Hariprasanth S [1], Senthil Kumar V [2] and Vivek Karthik J [3]

[1]P.G Scholar, M.E. Structural Engineering, Kumaraguru College of Technology, Coimbatore

Assistant Professor, Civil Engineering Department, Kumaraguru College of Technology, Coimbatore

---

Abstract - No-fines concrete, also known as cellular concrete, is a porous concrete obtained without the use of fine aggregate. The most widespread applications of no-fines concrete include road paving and surface treatments to permit water drainage. Sodium silicate is a surface hardener, filler material and easy to apply and is used for workability. Tyre rubber wastes are already used for paving purposes however, it can only recycle a part of these wastes. Hence efforts have been taken to identify the potential application of waste tires as replacement to coarse aggregate. Coarse aggregates were replaced by waste tires of size 20mm 2.5%, 5% and 7.5% by weight. The specimens were tested for no fines aggregate of ratio 1:6 and tested for slump cone test, compressive strength, split tensile strength and flexural strength at 7,14,28 days of curing and the results obtained. The results were compared with conventional no fines concrete. From the results it is concluded that partial replacement of coarse aggregate up to 2.5% proves effective strength characteristics.

1. INTRODUCTION

Concrete is a composite material composed of cement, aggregates and water. It is a very strong and versatile mouldable construction material. One of the main disadvantages of concrete is its increased dead-weight. It has a density of the order 2400-2600 kg/m3. Light-weight concrete has become more popular in recent years due to high voids and has more advantages than the conventional concrete. Usage of light weight concrete elements in building has grown widely in the recent years due to its high strength-to-weight ratio. There are different methods to produce lightweight concrete either by using lightweight aggregates or by omitting fine aggregates or by introducing air in the mix. Temporary ban on extraction of sand from river bed, demand and increasing market price for sand has made to think to produce a concrete which is free from fine aggregates, light in weight and also to attain sufficient strength with low cost of production. As the omission of fine particles in concrete leads to lower surface area of aggregates that would be coated with cement paste, less cement content will be used in this no-fines concrete than the conventional concrete which ultimately results in low cost of production.

1.1 NO –FINES CONCRETE

No-fines concrete blocks are used in buildings as masonry unit which will reduce the overall dead weight of the structure which gives the flexibility in designing the size of foundation. Using no-fines concrete in pavement reduces the runoff thereby recharging ground water. There is no segregation in no-fines concrete as light hand compaction is given and either less or no fine particles are used in no-fines concrete. Large number of voids present in no-fines concrete makes it more permeable and a very good sound absorber.

1.2 SODIUM SILICATE

Sodium silicate is an easy to apply, ready to use curing compound. Sodium silicate develops greater strength. It will react with concrete's free lime and calcium carbonate filling and sealing the capillaries and voids making a dense hard surface which will minimize any future dusting and will allow resilient mastics and coating to adhere securely.

1.3 RUBBER TYRE

Tyre rubber wastes represent a major environmental problem of increasing significance. An estimated 1000 million tyres reach the end of their useful lives every year. At present enormous quantities of tyres are already stockpiled or landfilled. Tyre rubber wastes are already used for paving purposes however, it can only recycle a part of these wastes. Another alternative is an artificial reef formation but some investigation has already questioned the validity of this option. Tyre waste can also be used in cement kilns for energetic purposes and to produce carbon black by tyre pyrolysis, a thermal decomposition of these wastes in the absence of oxygen in order to produce by-products that have low economic viability. Some research has already been conducted on the use of waste tyre as aggregate replacement in concrete showing that a concrete with enhanced toughness and sound insulation properties can be achieved.

Furthermore, it discusses the effect of waste treatments, the size of waste particles and the waste replacement volume on the fresh and hardened properties of concrete. Investigations carried out so far reveal that tyre waste concrete is specially recommended for concrete structures located in areas of severe earthquake risk and also for applications submitted to severe dynamic actions like 3 railway sleepers. This material can also be used for

non-load-bearing purposes such as noise reduction barriers. Investigations about rubber waste concrete show that concrete performance is very dependent on the waste aggregates. Further investigations are needed to clarify for instance which are the characteristics that maximize concrete performance.

1.4 OBJECTIVE

1. The main objective of this project is to conduct research on the application of no fines concrete as a light weight concrete block masonry.
2. To find the optimum mix of no-fines concrete for partial replacement with tyre based on Compressive, Split Tensile and Flexural strengths criteria.
3. To reduce the self-weight of concrete by adding waste tyre rubber material as coarse aggregate.
4. To enhance property of no-fines concrete such as workability, permeability and surface hardening using sodium silicate as chemical admixture.
5. By conducting different laboratory tests on prepared specimens, it is intended to analyze the results.

1.5. LITERATURE REVIEW

Abdul Malik et al. have investigated on Experimental Study on Properties of No-Fines Concrete. The main objective of this project was to conduct research on the application of no-fines concrete as a lightweight concrete block masonry unit. The mixture is composed of cement, coarse aggregate and a little or no fine aggregate. In this study a/c ratio of 6:1, 8:1 & 10:1, w/c ratio of 0.35, 0.4 & 0.45 have been used.

Sirile Eathakoti et al. (2015) have studied on innovative no-fines concrete pavement model. In this journal, M20 grade concrete is achieved with a w/c ratio of 0.45, Coarse aggregate of nominal size 20 mm and with a cement to Coarse aggregate ratio of 1:4. Its density and flexural strength were observed to be 21 kN/m3 and 35 kg/cm2 respectively. A pavement slab suitable for low traffic volume roads is designed as per IRC SP62: 2004 which allows storage of water up to 125 lit. / m3 of concrete pavement giving time for infiltration thereby reducing the runoff and recharging the ground water or sufficient time for transport of it.

Chothe Onkar K et al. have studied on Effect of replacement of coarse aggregate by scrap tyre rubber. In this study, effects on concrete has been observe by experimental results. In this experimental study M20 grade concrete used as reference point. Tyre rubber waste used as a coarse aggregate in 5%, 10%, 15% replacement for conventional aggregate. As per this percentage cost benefit and strength ratio also identified.

2. MATERIAL USED

2.1. Cement

A cement is a binder, a substance used in construction that sets, hardens and adheres to other materials, binding them together. Cement is seldom used solely, but is used to bind sand and gravel together.

2.2. Coarse aggregate

Construction aggregate, or simply aggregate, is a broad category of coarse particulate material used in construction, including sand, gravel, crushed stone, slag, recycled concrete and geosynthetic aggregates. Aggregates are the most mined materials in the world.

2.3. Tyre rubber aggregate

About 30 cm long waste tyre rubber pieces are obtained from local market the pieces were cleaned with soap water and rinse with clean water. After drying under sun at open place, both faces of the tyre pieces were rubbed with hard wire brush to make surfaces as rough as can be done by hand. The source of the rubber aggregate is recycled tyres which were collected from the local market. For uniformity of the concrete production and convenience, all the tires collected are from medium truck tyre. The reason for choosing medium truck tires is that they can give the required shape and size which is similar to the common natural gravel. This study has concentrated on the performance of a single gradation of rubber prepared by manual cutting. The maximum size of the rubber aggregate was 20 mm.

3. PROPERTIES OF MATERIALS

3.1 CEMENT

Specific gravity = 3.2

Consistency test value = 32%

Initial setting time = 24 mins Final setting time = 570 mins

3.2 COARSE AGGREGATE

Specific gravity = 2.68

Size = Passing through 20 mm sieve and Retained on 10 mm sieve.

3.3 TYRE

Specific Gravity = 1.3

Water absorption = 0.25%

4. EXPERIMENTAL INVESTIGATION

4.1 Hand Mixing

The concrete batch shall be mixed on a water-tight, non-absorbent platform with a shovel, trowel or similar suitable implement, using the following procedure:

a) The cement coarse aggregate and tyre shall be mixed dry until the mixture is thoroughly blended and is uniform in colour.

b) The coarse aggregate shall than be added and mixed with the cement until the coarse aggregate is uniformly distributed throughout the batch, and the water shall then be added and the entire batch mixed until the concrete appears to be homogeneous and has the desired consistency. If repeated mixing is necessary, because of the addition of water in increments while 14 adjusting the consistency, the batch shall be discarded and a fresh batch made without interrupting the mixing to make trial consistency tests.

Figure 1 Hand Mixing

4.2. Casting

No fines Concrete with and without admixtures were casted for three numbers of each specimen. The inside of the mould was oiled to prevent adhesion of concrete.

Figure 2 Casting of specimens

4.3. Compaction

Vibrators shall not be used for compaction of no fines concrete. No-fines concrete is compacted by rod or gentle ramming. No water shall be added during ramming. Ramming should be done by one or more lines of men arranged across the width of the concrete with a lateral space of not more than 0.5 m. Square rammers shall be used for corners.

4.4. Curing

If curing is inadequate no fines cement concrete will lose its water contents resulting in incomplete hydration of cement which will cause disintegration of concrete. Fresh concrete is extremely sensitive to intense sunshine and wind and must be protected by damp sheet covers and by spraying with ample water, spraying should not be started too early since it may wash off the cement from the surface. Spraying must be maintained for at least seven days.

4.5 TESTING OF SPECIMENS

The cube compressive strength, cylinder split tensile strength, prism flexural strength and permeability is determined.

Figure 3 Testing of Specimens

5. RESULTS AND DISCUSSION

5.1 COMPRESSION TEST RESULTS

Table -1: Compression Test of the specimen

Mix proportion			Compressive strength (N/mm^2)		
a/c Ratio	w/c Ratio	Proportion	7days	14days	28days
6:1	0.35	0%	6.32	7.9	9.8
		2.5%	7.22	9.025	10.46
		5%	6.5	8.2	9.86
		7.5%	6.3	7.87	9.6

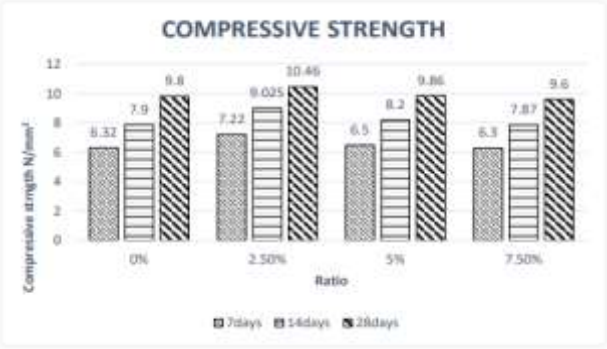

chart -1: Comparative results of Compressive Strength for 7,14,28 days

5.2 SPLIT TENSILE TEST RESULTS

Table -2: Split Tensile Strength of the specimen

Mix proportion			Split tensile strength (N/mm^2)		
a/c Ratio	w/c Ratio	Proportion	7days	14days	28days
6:1	0.35	0%	0.8	1.1	1.3
		2.5%	0.92	1.3	1.56
		5%	0.86	1.18	1.4
		7.5%	0.78	0.97	1.23

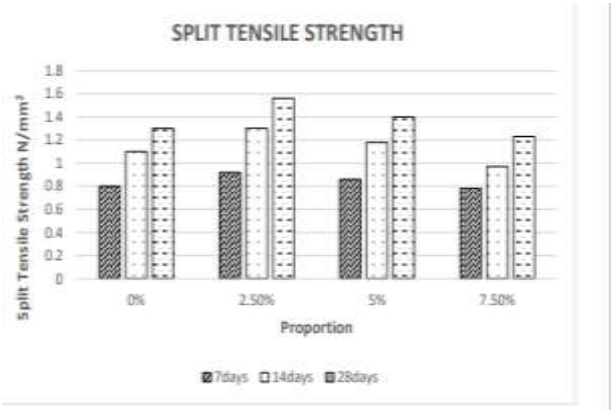

chart -2: Comparative Results of Split Tensile Test of 7, 14, 28 days

5.3 FLEXURAL TEST RESULTS

Table -3: Flexural Test of the specimen

Mix proportion			Flexural strength (N/ mm^2)
a/c Ratio	w/c Ratio	Proportion	28days
6:1	0.35	0%	1.6
		2.5%	1.56
		5%	1.52
		7.5%	1.46

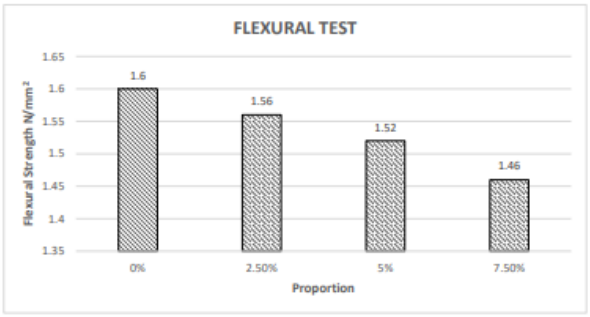

chart -3: Comparative Results of Flexural Test of 7, 14, 28 days

After the text edit has been completed, the paper is ready for the template. Duplicate the template file by using the Save As command, and use the naming convention prescribed by your conference for the name of your paper. In this newly created file, highlight all of the contents and import your prepared text file. You are now ready to style your paper.

3. CONCLUSIONS

Experimental study on behaviour of no-fines concrete using waste tyre as replacement of coarse aggregate and sodium silicate as admixture was conducted. The following conclusions were made,

- The process of substituting the waste tyre as coarse aggregate in presence of 0-7.5% was studied and then parameters of slump, compressive strength, split tensile strength, flexural strength was measured.
- This study has been proved to be successful in replacing aggregate by waste tyre in terms of strength.
- The results were compared with conventional no fines concrete. From the results it is concluded that partial replacement of coarse aggregate up to 2.5% proves effective strength characteristics.
- The Compressive strength of the specimen at 28 days of 2.5% is 10.46 N/mm2, which is 6% greater than the strength of conventional no-fines concrete.
- The Split Tensile strength of the specimen at 28 days of 2.5% is 1.56 N/mm2, which is greater than the strength of conventional no-fines concrete.
- The Flexural strength of the specimen at 28 days is 1.56 N/mm2, which is lower the strength of conventional no-fines concrete.

REFERENCES

1. IS 12727: 1989 – No-fines cast in situ cement concrete – CODE OF PRACTICE.
2. "An Experimental Study on Properties of No-Fines Concrete" by Abdul Malik.
3. An innovative no-fines concrete pavement model - Sirile Eathakoti, Navya Gundu, Markandeya Raju Ponnada. IOSR Journal of Mechanical and Civil

Engineering (IOSR-JMCE), e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 12, Issue 5 Ver. III (Sep. - Oct. 2015), PP 34-44.

4. "Effect of replacement of coarse aggregate by scrap tyre rubber experimental study", by Mr. Chothe Onkar K., Mr. V.S.Kadam, Patil Vikram, Patil Pravin.
5. "Experimental study of effect of sodium silicate (NA2SIO3) on properties of concrete", by Ifrah Habib Lone, Abdul Muneeb, Javid Ahmad, Syed Mohammad Jasim, Mintazir Ali, Mushtaq Ahmad Khan and Amir Hussain Malik.
6. "Investigation of no-fines concrete in building blocks", By K.Satham An Experimental Study on Properties of No-Fines Concrete - Abdul Malik, Imperial Journal of Interdisciplinary Research (IJIR), Vol-2, Issue-10, 2016, ISSN: 2454-1362.
7. "Mechanical properties of no-fines bloated slate aggregate concrete for construction application, experimental study", Bashir Alam, Mohammad Javed1, Qaisar Ali, Naveed Ahmad, Muhammad .