International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 05 | May-2018 www.irjet.net p-ISSN: 2395-0072

Properties of Recycled Asphalt Pavement Aggregate Concrete

Mahitha .T[1], Aswini .J[2]

[1]*MTech Scholar, SCMS School of Engineering & Technology, Kerala, India, 0484 2450330,*
[2]*Assistant Professor, SCMS School of Engineering & Technology, Kerala, India, 0484-2450330.*

Abstract –*Concrete is an important construction material. Due to the enormous consumption of natural resources for the concrete production, there is an increase in threat to the environment and ecosystem. There lies the need to look towards locally and cheaply available materials in substitute for aggregates.*

The replacement of natural gravel aggregate with recycled asphalt would help in reduction of environmental and ecological effects. The presence of asphalt film around Recycled Asphalt Pavement aggregates had been found out as the main reason for lowering the properties of RAP inclusive concrete. This project aims to investigate feasibility of improving strength properties of recycled asphalt by abrasion and attrition process. M-30 grade concrete was designed for a water cement ratio of 0.43. Recycled Asphalt pavement Aggregate is used as coarse aggregate in concrete at 100% replacement, 30% replacement by doing process of abrasion and attrition and without doing the process. The 7th and 28th day strengths were found out at these replacements. It was observed that the strength properties improved after the process.

***Key Words*: Recycled asphalt pavement, Abrasion, Compressive strength, flexural strength, split tensile strength**

1. INTRODUCTION

In this scenario, where there is an immense scarcity of natural aggregates, it is important to move to a sustainable approach to offset the utilization of natural aggregates and one of the best alternatives is to utilize recycled aggregate. India has the extensive road network, the second largest in world after US. Recycled Asphalt Pavement (RAP) is the term given to removed or reprocessed pavement materials containing asphalt and aggregates. These materials are generated when asphalt pavements are removed for reconstruction, resurfacing or to obtain access to buried utilities. Interfacial transition zone properties and phase distribution at later ages with recycled asphalt has high porosity, larger interfacial transition zone size , less CH and CSH contents near interface. This resulted in reduction in concrete strength and bulk modulus[1].Concrete made with only coarse RAP show least reduction in strength and significant increase in toughness[2].Concrete made with reclaimed coarse asphalt aggregates and sand showed less reduction in strength compared to others[3].Cement-fiber-treated RAP material as an environmentally and structurally sound alternative to non bonded materials for base and subbase applications in pavement engineering[4]. The increase in aggregate surface roughness results in increase in surface hardness of concrete[5].Maximum improvement in compressive, flexural and split tensile strength of ABTRAPC mix was found when 10% OPC was part replaced by silica fume followed by 20% replacement by flyashand 5% replacement by sugarcane bassage ash[6].The coarse RAP with sufficient intermediate size particles can help to make dense graded RAP-PCC mixtures which can show better workability and mechanical properties compared to other gap-graded RAP-PCC mixtures[7].Asphalt coating around aggregates had been found out as the main reason for the reduction in strength causing crack around the aggregates than through it. Abrasion and attrition process would remove the asphalt layer around aggregates and also increase the bond strength.

2. EXPERIMENTAL PROGRAM AND RESULTS DISCUSSION

2.1 Experimental Program

A. Materials and Mix design

The mix design was done to obtain a compressive strength of 30 MPa as per IS 10262-2009..Portland Pozzolana Cement (PPC) is used for work. Specific gravity of cement is 2.89.Natural coarse aggregates of size passing through 20 mm sieve and retained on 12.5 mm sieve are taken. Recycled Asphalt aggregates of size passing through 20 mm sieve and retained on 12.5 mm sieve are taken. Recycled Asphalt Aggregates were collected from the road works at Koratty, Ernakulam, Kerala.M-Sand of specific gravity 2.6 is used for the work. Fine aggregate confirms to zone 2 of IS 383-1983. Water used for the study was free of acids, organic matter, suspended solids, alkalies and impurities. Master Glenium-high range water reducing concrete super plasticizers of specific gravity 1.09 are used in this work. Abrasion and attriton process is done for the RAP aggregates in mixer using steel balls. Mix designations for the casted specimens are given in Table 1.

Table.1Mix designations

Mix	Mix Designation
Control Mix	NAC
RAP replaced at 100%	RAPC
RAP replaced at 30%	R-APC
ABTRAP replaced at 30%	ABTRAPC

Mixes casted are NAC (Control mix), RAPC (RAP replaced as coarse aggregate at 100%), R-APC (RAP replaced as coarse aggregate at 30%) and ABTRAPC (RAP replaced as coarse aggregate at 30% after abrasion).

B. Compressive Strength Test

The test is conducted on cubes of size 15 cmx15 cm x 15 cm. Compressive strengths of cubes for various mixes are at 7th day and 28th day are shown in Fig. 1.

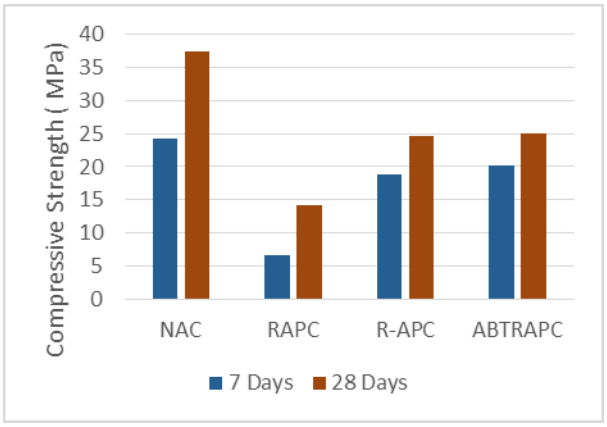

Fig.1. Compressive strength for all mixes

C. Flexural Strength Test

Beam Specimens of size 500X100X100 mm was tested after 7 & 28 days of water curing. Flexural strengths of beams for various mixes are at 7th day and 28th day are shown in figure 2.

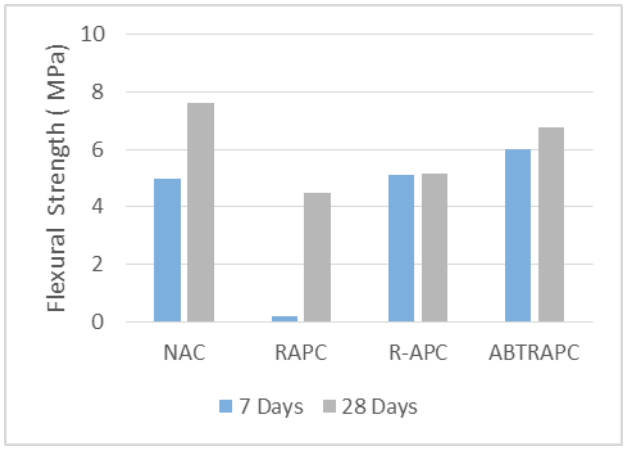

Fig.2. Flexural strength for all mixes

D. Split Tensile Strength Test

Cylinders of size 150 mm diameter and 300 mm long are used.. Tensile strengths of beams for various mixes are at 7th day and 28th day are shown in figure 3.

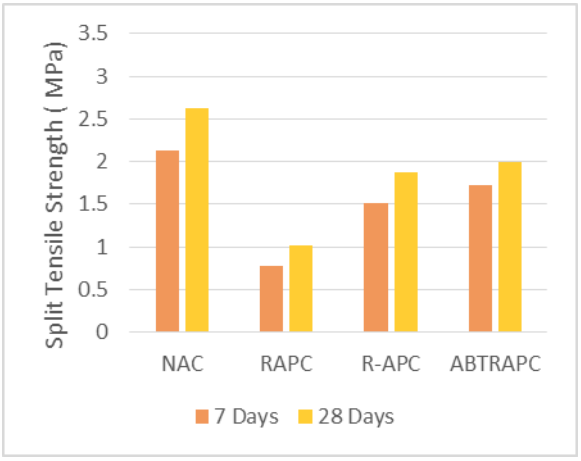

Fig.3.Tensile strength for all mixes

E. Water Absorption Test

Water absorption test is done on 100 mm cubes at 28th day. Result is as shown in Fig.4.

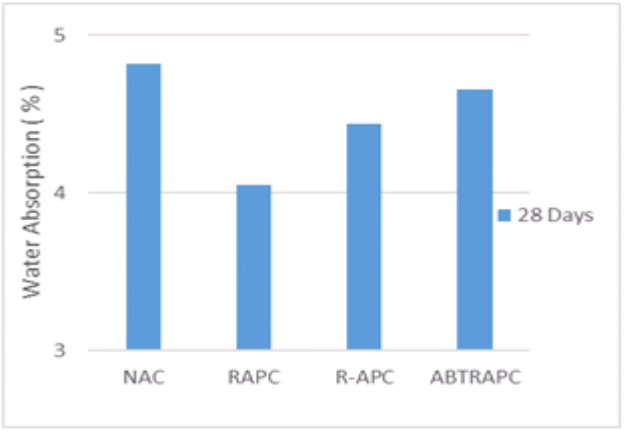

Fig.4.Water absorption test for all mix

E. Acid Attack Test

Acid attack test is done on 100 mm cubes at 3rd, 7th , 14th and 28thday. Result is as shown in Fig.5.

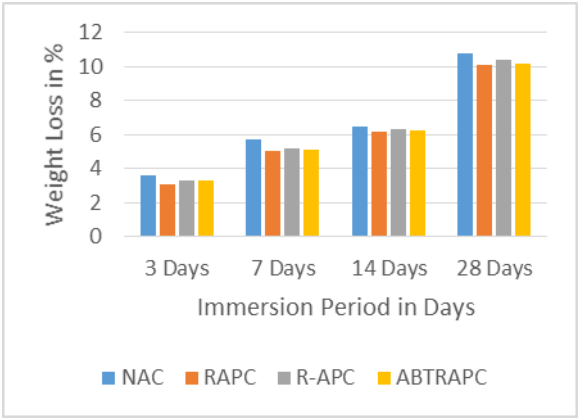

Fig.5.Acid Attack test for all mix

2.2. Results and Discussions

Compressive strength decresed for 100% recycled asphalt pavement aggregate as coarse aggregate. Abrasion process improved the compressive strength to a little higher .Abrasion process also improved the compressive and flexural strengths than the fully replaced recycled asphalt pavement aggregate concrete and 30% replaced recycled asphalt pavement aggregate concrete. A higher water absorption is shown by recycled asphalt pavement aggregate treated by abrasion at 28th day. Acid attack causes loss in weight of specimen with age. The highest resistance was shown by fully recycled asphalt pavement aggregate concrete than the normal concrete. Recycled asphalt pavement aggregate after abrasion had higher resistance to acid attack than that without abrasion at 30%.

3. CONCLUSION

Abrasion and attrition improved the mechanical properties in concrete like compressive, flexural split tensile strength in the concrete with reclaimed pavement aggregates with out . Durability properties were found to be good for fully recycled asphalt pavement aggregate concrete. Abrasion process improved the resistance to acid attack to some extent.

4. SCOPE FOR THE FUTURE STUDY

This study was limited to the evaluation of the mechanical properties of abrasion treated reclaimed asphalt pavement aggregate concrete. Various durability studies can be investigated in a future study.

ACKNOWLEDGEMENT

I am grateful to Dr. ANITHA.G.PILLAI, Head of the Department of Civil Engineering, for her valuable suggestion and guidance. I thank my guide, Ms.ASWINI.J, Assistant Professor, Department of Civil Engineering, for her innovative guidance and encouragement throughout.

REFERENCES

1. Alexander.S.Brand and Jeffery.R.Roesler (2016)Bonding in Cementitious Materials with Asphalt Coated Particles: Part I – The Interfacial Transition Zone,Construction and Building Materials, Vol 130,182-192

2. Baoshan Huang, Xiang Shu and Guoqiang Li (2005)Lab Investigation of Portland Cement Concrete Containing Recycled Asphalt Pavements, Cement and Concrete Research, Vol 35,2008-2013

3. K.E.Hassan, J.J.Brooks and M.Edman (2000)The Use of Reclaimed Asphalt Pavement Aggregate in Concrete, Waste Materials in Construction, Vol 1,121-128

4.Laureano.R.Hoyos, M.ASCE[1], Anand.J.Puppala, M.ASCE[2] and Carlos.A. Ordonez3(2011)Characterization of Cement-Fiber-Treated Reclaimed Asphalt Pavement Aggregates: Preliminary Investigation, Journal of Materials in Civil Engineering, ASCE, Vol 23, 977-989

5. Rafal L Ali-Mufti and Anton.N.Fried (2017)Improving the Strength Properties of Recycled Asphalt Aggregate, Concrete, Construction and Building Materials, Vol 149 ,45-52

6. Surender Singh, G.D.Ransinchung and Praveen Kumar(2017)Effect of Mineral Admixtures on Fresh, Mechanical and Durability Properties of RAP Inclusive Concrete, Construction and Building Materials, Vol 156, 19-27

7. Xijun Shi, Anol Mukhopadhyay and Kai-Wei Liu (2017)Mix Design Formulation of Portland Cement Concrete Paving Mixtures Containing Reclaimed Asphalt Pavement, Construction and Building Materials, Vol 152, 756-768