Experimental Study on Agro Waste as Fine Aggregate in Concrete

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ABSTRACT

The increased cost of building materials is a major factor of concern. We would all like to see our buildings strong and build at reasonable prices with the building materials. All building industries rely totally on cement, sand and concrete aggregates. Today, most researchers investigate the material, which can both reduce construction costs and increase strength.Due to the rapid urbanization and waste disposal problem in developed countries, high natural resource demand has given the construction market opportunity for Agro-waste use. Alternatives to cement, fine aggregates, coarse aggregates, and reinforcement materials in concrete are already in use with a large number of agricultural wastes.This paper examines some of the Agro-waste materials used to partially replace finest concrete aggregates. The use of coconut, ash rice husk and tobacco waste as a substitute of fine aggregates into concrete by various proportions (15 % and 30 %). This study provides an impact of these waste on concrete properties such as workability, compressive and split tensile resistance for M25 concrete grade.
Keywords: Agro waste, Fine aggregate and concrete.

1. INTRODUCTION

Concrete is a combination of cement, fine aggregates and coarse aggregates primarily obtained from natural resources. Growing population, urban expansion and increased lifestyle through technological innovations in the construction industry have demanded an enormous volume of natural resources, leading to resource scarcity. This shortage encourages researchers to use the solid waste generated by industry, mining, household and agriculture.It is noted that more than 600 million tons of waste has been generated from agricultural waste in India, which is causing serious problems with disposal. Waste recycling as sustainable construction materials tackles contamination issues, area fillings and construction material expenditure. Agricultural waste is normally used as a substitute for aggregates, and further research is needed for concrete durability.Sugar cane ash, groundnut shell, oyster shell, sawdust, giant reed ash, rice husk ash, cork, cocoon waste and tobacco waste are the agricultural waste used in concrete as fine aggregate.These are used to replace fine aggregates, providing additional pozzolan concrete property.The aim of this review is to examine the properties of farm waste as a partial replacement to fine aggregate in concrete.

1.1 Objectives

- The purposes of this study are to maximize the use of Agro wastes in replacing the fine aggregate in concrete without affecting in concrete without affecting the properties of the concrete or strength.
- This research has also studied the use of agro-waste construction and therefore reduced the need for natural materials for concrete in this project, to achieve a building economy.

2. METHODOLOGY

Figure 1 shows the Methodology of the study.

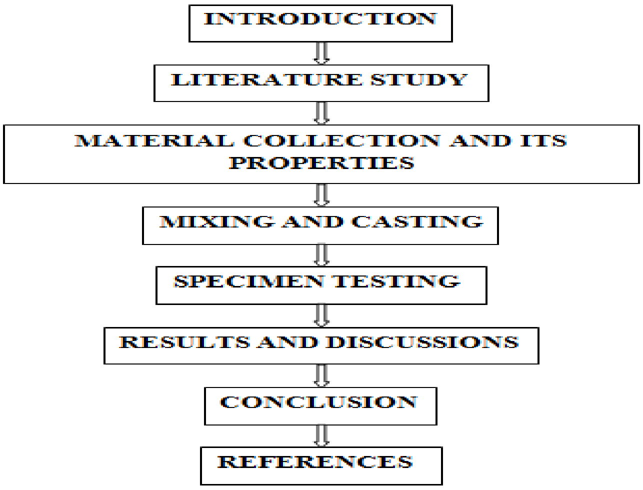

Figure 1 Methodology

3. MATERIAL COLLECTION AND ITS PROPERTIES

3.1 Cement

The most common type of binder used in concrete production is Ordinary Portland cement, which means that OPC 53 Grade conforms with Indian Standard IS 12269:1987 used as binder.

3.2 Fine Aggregate

River sand was used as a fine aggregation according to grading zone III according to IS 383:1970, throughout the investigation. The sand has been air-dried and sieved before mixing to remove any foreign particles.

3.3 Coarse Aggregate

The material whose particles are of size are held on IS strainer of size 4.75 mm is named as coarse aggregate which conforms to IS: 383-1970 20 mm size coarse aggregate is used in here.

3.4 Coconut Waste

Fine powdered coconut shell is used as a fine aggregate in concrete. The coconut shells are produced from a local coconut field. They are dried up by sun for 1 month and then manually crushed. A machine crushed the coconut shells. Next, until a fine powder was obtained the coconut shells were grounded. The size of the coconut shells used was approximately identical to those of rough aggregates measuring 20 mm.

3.4.1 Properties of Coconut Shell Powder

A local coconut miller produced the coconut shell in the form of powder. It's a light brown with 0.7gcm-3 bulk density. The coconut shells are also 2 mm thick to 8 mm thick and about 1.60 g / cm3 density. Earlier studies have also shown a complex structure for the powdered coconut shell. Figure 2 shows the coconut shell powder.

Figure 2 Coconut shell powder

3.5 Rice Husk Ash

Rice Husk, a by-product of the processing of rice, is produced in large quantities worldwide every year. The husk is used as a furnace in the rice mills, which are turned into rice husk ash (RHA) in the firing process.Due to its very high silica content, RHA can be used as a partial substitute for finest concrete aggregates.

3.5.1 Properties Of RHA

RHA consists principally of silicon, iron and aluminium oxides with a small calcium oxide and magnesium oxide. The chemical composition of rice husk depends upon the temperature of the burning and the heating duration. Due to the high content of silicon, aluminium and iron RHA have good pozzolanic properties. Figure 3 shows the rice hush ask.

Figure 3 Rice Husk Ash

3.5.1.1 Physical Properties Of RHA

The specific gravity of RHA is 2 – 2.3 g/cm^3, initial setting time is 190 – 200 minutes, final setting time is 260 – 265 minutes. Table 1 shows the chemical composition of Rice hush ash.

Table 1: Chemical composition of Rice Husk Ash (RHA)

Components	Mass %
Silica as SiO_2	86.91
Calcium as CaO	1.04
Potassium as k_2O	3.16
Iron as Fe_2O_3	0.87
Sodium as Na_2O	0.69
Aluminium as Al_2O_3	0.5
Magnesium as MgO	0.85
Titanium as TiO_2	< 0.06

3.6 Tobacco Waste

Tobacco waste is produced in large quantities annually by the cigarette processing industry. Studies have been conducted to evaluate the possibility of using tobacco ash waste in concrete. Properties have been studied with different levels of substitution of tobacco waste ashes. The specific gravity of tobacco waste was found to be 2.68. Figure 4 shows the tobacco dust.

Figure 4 Tobacco dust

3.7 Water

Quality of water is important because impurities can adversely affect the strength of the concrete. Water used for concrete production and treatment. It must be fairly safe and free of harmful compounds, such as oil, acid, alkaline, salt, sugar, silt and organic matter, as well as other components that harm the concrete. If the water is potable, it is considered suitable for the production of concrete. The pH of water shall not exceed 6 for the building construction.

4. MIXING AND CASTING

4.1 Mixing

Mix design is the process by which the appropriate percentage of cement, fine and coarse aggregate and water is selected to create a concrete with certain working characteristics, strength and durability. The best combination is to balance the economy with the necessary concrete properties. The mixed proportions of concrete were approximated according to the method of absolute volume according to IS 10262:2009 according to the properties of the materials available.In order to partially substitute fine aggregates in concrete, target strength of 25 MPa were attempted by different agro-waste types. Table 2 shows the Mix proportions of agro-waste based concrete.

Table 2: Mix proportions of agro-waste based concrete

Mix	Type of Agro waste	% of replacement
1	CW + RHA +TW	5 % each (Total 15%)
2	CW + RHA +TW	10% each (Total 30%)

Note: CW – Coconut Waste; RHA – Rice Husk Ash; TW – Tobacco Waste

4.2 Casting

With the different agro-waste concrete mixes the cube and cylinders were prepared. a) typical compression strength cubes of 150 x 150 x 150 mm. b) Standard cylinders for cylindrical tensile split strength of 150 mm diameter, 300 mm height.At casting cubes, the slumps were assessed. After 24 hours, the cube and cylinders are removed and cured over 7, 14 and 28 days.

5. TESTING OF SPECIMENS

5.1 Slump Cone Test

The Concrete Slump or Slump Cone Test is used to determine whether a concrete mixture produced in the lab or construction site is feasible or consistent during the work. Batch slump tests are performed to monitor uniform batch quality during construction.The slump test is the simplest practical and cost-effective test and results are immediate. The concrete slump value is generally used for determining operational capacity, but different factors like material properties, mixing procedures, dosage, mixtures, etc. often influence the specific slump value.

5.2 Compression Strength Test

The compressive strength is the ability of the material or structure to carry the loads on its surface without cracking or bending.A compressed material appears to lower the scale, while scale elongates in stress. The test is conducted on a Universal Test Machine or compressive test machine using 150 mm concrete cubes.

5.3 Split Tensile Strength Test

One of the most important properties for concrete is the 'tensile strength,' which makes concrete sensitive to tensile cracks due to structural loads. Concrete tensile strength is significantly weaker than compressive strength (that is why it uses steel to bear the tension forces). The tensile strength of concrete has been estimated to be around 10% of the compressive strength.Indirect methods are used to assess the tensile strength, due to the complexity of the direct test. Noting that the obtained values from these methods are higher than those obtained from the uniaxial tensile test.

6. TEST RESULTS AND DISCUSSIONS

6.1 Compression Strength Test

The Table 3 shows the compression strength test results of conventional and agro wastebased concrete. Mix – 1 shows higher strength than the conventional and mix – 2 concrete.

Table 3: Compression strength test results

S. No	Mix	7 days	14 days	28 days
1	cc	16.5	23.1	26.1
		16.8	23.5	25.8
		16.3	23.3	25.3
	Average	16.5	23.3	25.7
2	Mix – 1	17.2	24.3	26.5
		17.5	24.9	26.8
		18.0	24.6	26.4
	Average	17.5	24.6	26.5
3	Mix – 2	15.2	22.5	24.1
		15.5	22.8	24.8
		16.0	22.0	24.6
	Average	15.5	22.4	24.5

Figure 5 shows the compression strength results of the designated concrete mix.

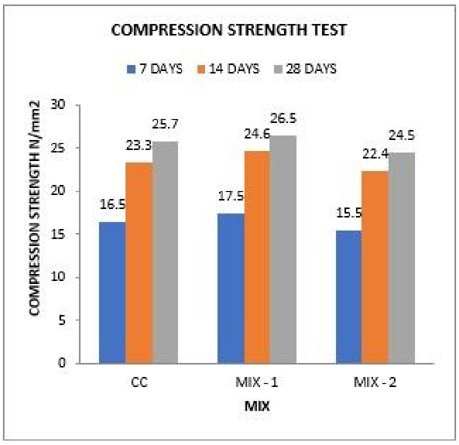

Figure 5 Compression strength test

6.2 Split Tensile Strength Test

Table 4 shows the compression strength test results of conventional and agro waste-based concrete. Mix – 1 shows higher strength than the conventional and mix – 2 concrete.

Table 4: Split tensile strength test results

S. No	Mix	7 days	14 days	28 days
1	cc	1.65	2.31	2.64
		1.63	2.38	2.54
		1.61	2.35	2.61
	Average	1.63	2.34	2.59
2	Mix - 1	1.76	2.51	2.63
		1.74	2.43	2.65
		1.82	2.45	2.68
	Average	1.77	1.79	2.65
3	Mix - 2	1.55	2.21	2.43
		1.51	2.25	2.51
		1.50	2.20	2.48
	Average	1.52	2.22	2.47

Figure 6 shows the chart ofSplit tensile strength test

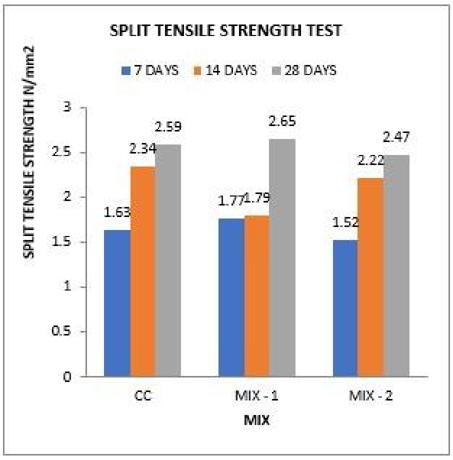

Figure 6 Split tensile strength test

6.3 Slump Cone Test

Table 5 shows the slump cone test results.

Table 5: Slump cone test results

S. No	MIX	SLUMP VALUE (mm)
1	cc	75
2	Mix – 1	85
3	Mix - 2	45

Figure 7 shows the graph of slump cone test.

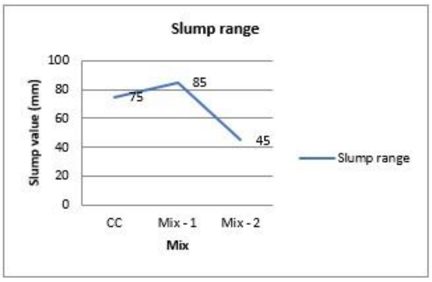

Figure 7 Slump cone test

7. CONCLUSION

The following findings were achieved based on the experimental review.

- The compression and split tensile strength of concrete shows better results for 15 % partial replacement of agro wastes as fine aggregates(Mix–1), compared toconventional concrete. If we increase the percentage of agro wastes, it is seen that the strength is decreased.
- Hence, the optimum percentage of agro wastes that can be used to produce concrete to obtain better strength is 15% (Mix - 1)
- Slump values also affects reasonably for different mixes in workability point of view.

References

[1] T.Subramani., S.Krishnan. S.K.Ganesan., G.Nagarajan ”Investigation of Mechanical Properties in Polyester and Phenyl-ester Composites Reinforced With Chicken Feather Fiber” International Journal of Engineering Research and Applications Vol. 4, Issue 12(Version 4), pp.93-104, 2014.

[2] T.Subramani, J.Jayalakshmi , " Analytical Investigation Of Bonded Glass Fibre Reinforced Polymer Sheets With Reinforced Concrete Beam Using Ansys" , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp. 105-112 , 2015
[3] T.Subramani, D.Latha , " Experimental Study On Recycled Industrial Waste Used In Concrete" , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp. 113-122 , 2015
[4] T.Subramani, V.Angappan , " Experimental Investigation Of Papercrete Concrete" , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp. 134-143 , 2015
[5] T.Subramani, V.K.Pugal , " Experimental Study On Plastic Waste As A Coarse Aggregate For Structural Concrete" , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp.144-152 2015
[6] T.Subramani, B.Suresh , " Experimental Investigation Of Using Ceramic Waste As A Coarse Aggregate Making A Light Weight Concrete " , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp. 153-162 , 2015
[7] T.Subramani, M.Prabhakaran , " Experimental Study On Bagasse Ash In Concrete" , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp. 163-172 , 2015
[8] T.Subramani, A.Mumtaj , " Experimental Investigation Of Partial Replacement Of Sand With Glass Fibre" , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp. 254-263 , 2015
[9] T.Subramani, S.B.Sankar Ram ***Experimental Study on Concrete Using Cement With Glass Powder, IOSR Journal of Engineering,****Volume 5 , Issue 5, Version 3, pp43-53, 2015*
[10] T.Subramani, S.Kumaran , " Experimental Investigation Of Using Concrete Waste And Brick Waste As A Coarse Aggregate " , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp. 294-303 , 2015
[11] *T.Subramani, G.Ravi,* ***"Experimental Investigation Of Coarse Aggregate With Steel Slag In Concrete", IOSR Journal of Engineering,*** *Volume 5,Issue 5, Version 3, pp64-73, 2015*
[12] T.Subramani, K.S.Ramesh , " Experimental Study On Partial Replacement Of Cement With Fly Ash And Complete Replacement Of Sand With M sand" , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5 , pp. 313-322 , 2015
[13] T.Subramani, G.Shanmugam , " Experimental Investigation Of Using Papercrete And Recycled Aggregate As A Coarse Aggregate " , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 4, Issue 5, pp. 323-332 , May 2015
[14] T.Subramani, P.Sakthivel , " Experimental Investigation On Flyash Based Geopolymer Bricks" , International Journal of Application or Innovation in Engineering & Management (IJAIEM) , Volume 5, Issue 5, pp. 216-227 , 2016 .
[15] T.Subramani, R.Siva, "Experimental Study On Flexural And Impact Behavior Of Ferrocement Slabs" International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 5, Issue 5, pp. 228-238 , 2016
[16] T.Subramani, A.Anbuchezian , " Experimental Study Of Palm Oil Fuel Ash As Cement Replacement Of Concrete " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 3, March 2017 , pp. 001-005 , ISSN 2319 - 4847.
[17] T.Subramani, A.Anbuchezian , " Experimental Study Of Mineral Admixture Of Self Compacting Concrete " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 3, March 2017 , pp. 006-010 , ISSN 2319 - 4847.
[18] T.Subramani, A.Anbuchezian , " Experimental Test On Bitumen With Addition Of 35% Of Plastic Fibre " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 3, March 2017 , pp. 017-022 , ISSN 2319 - 4847.
[19] T.Subramani, A.Anbuchezian , " Stabilization Of M30 Concrete Pavement By Partially Replacing Cement By 20% Of Flyash And Sodium Silicate " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 3, March 2017 , pp. 023-031 , ISSN 2319 - 4847.
[20] T.Subramani, A.Anbuchezian , " Experimental Investigation On Flexural Behavior Of Folded Ferro Cement Panels " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 3, March 2017 , pp. 045-049 , ISSN 2319 - 4847.
[21] T.Subramani, A.Anbuchezian , " Experimental Study On Replacement Of Concrete Material By Water Treatment Plant Waste Sewage " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 3, March 2017 , pp. 050-057 , ISSN 2319 - 4847.

[22] T.Subramani, A. Fizoor Rahman , " An Experimental Study On The Properties Of Pet Fibre Reinforced Concrete " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 3, March 2017 , pp. 058-066 , ISSN 2319 - 4847.
[23] T.Subramani, M.Meganathan, S.Priyanka , " Experimental Study On Strength Properties Of Diaphanous Concrete With Vermiculite " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 5, May 2017 , pp. 229-238 , ISSN 2319 - 4847.
[24] T.Subramani, T.Anandavel, S.Priyanka , " Experimental Investigation Of Waste Plastic Fiber In Reinforced Cement Concrete Using Recycled Coarse Aggregate " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 5, May 2017 , pp. 239-250 , ISSN 2319 - 4847.
[25] T.Subramani, S.Priyanka , " Experimental Test On Carbon Nano Powder On The Properties Of Concrete " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 5, May 2017 , pp. 294-303 , ISSN 2319 - 4847.
[26] T.Subramani, P.Babu, S.Priyanka , " Strength Study On Fibre Reinforced Concrete Using Palmyra Palm Fibre Using Fem Software " , International Journal of Emerging Trends & Technology in Computer Science (IJETTCS), Volume 6, Issue 3, May - June 2017 , pp. 198-207 , ISSN 2278-6856.
[27] T.Subramani, G.Unni Krishnan, R.Arumugam, A.Godwyn Michael Cornelies, H.Gopu , " Experimental Study Of Quarry Sand And Rice Husk Replacing In Concrete " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 5, May 2017 , pp. 312-319 , ISSN 2319 - 4847.
[28] T.Subramani, R.Sengottaiyan, K.Roop Kumar, V.Arun Kumar , S.S.Shanjay Sundara Sood , " An Expremental Investigation On Mineral Admixture For High Perfomence Of Concrete " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 6, Issue 5, May 2017 , pp. 320-326 , ISSN 2319 - 4847.
[29] T.Subramani, M.Senthilkumar, V.Ashok Kumar, Pawan Kumar Singh, R.Silambarasan , " Experimental Study On M-Sand With Addition Of Sugar As Admixture In Concrete " , International Journal of Emerging Trends & Technology in Computer Science (IJETTCS), Volume 7, Issue 2, March - April 2018 , pp. 100-107 , ISSN 2278-6856.
[30] T.Subramani, A.Fizoor Rahman, K.M.Mohamed Irfan, G.Ramajayam, Shubram Mohan , " Experimental Study Of Applying Translucent Concrete In Green House Building Concrete Using M-Sand " , International Journal of Emerging Trends & Technology in Computer Science (IJETTCS), Volume 7, Issue 2, March - April 2018 , pp. 116-125 , ISSN 2278-6856.
[31] T.Subramani, M.Senthilkumar, G.Gopinathan, A.S.Kabil, R.Naveen Kumar , " Experimental Study On Pervious Concrete Using Different Size Of Coarse Aggregate " , International Journal of Emerging Trends & Technology in Computer Science (IJETTCS), Volume 7, Issue 2, March - April 2018 , pp. 126-133 , ISSN 2278-6856.
[32] T.Subramani, S.Sekar, Kuriakose saji, Syam gopalakrishnan, A.Arul prakash , " Experimental Study On Pollution Control Concrete " , International Journal of Emerging Trends & Technology in Computer Science (IJETTCS), Volume 7, Issue 2, March - April 2018 , pp. 149-157 , ISSN 2278-6856.
[33] T.Subramani, N.Liyamin Ahad, Eldhose Jolly, Manuel Cheriyan, S.Priyanka , " Experimental Study On Mechanical Behavior Of Roof Panel Using Steel Fibre With Alkaline Solution " , International Journal of Emerging Trends & Technology in Computer Science (IJETTCS), Volume 7, Issue 2, March - April 2018 , pp. 169-176 , ISSN 2278-6856.
[34] T.Subramani, S.Gunalan, Hari Prasath, K.Vasantha Sethupathi , S.Priyanka , " Experimental Investigation Of Concrete Using Peengan Waste " , International Journal of Emerging Trends & Technology in Computer Science (IJETTCS), Volume 7, Issue 2, March - April 2018 , pp. 208-215 , ISSN 2278-6856.
[35] T.Subramani, V. Karthick, A. Mohammed Asif, Mohammed Salman, S.Priyanka , " Experimental Study on Hybrid Fiber Concrete With Banana And Sugarcane Fiber " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 8, Issue 3, March 2019 , pp. 200-209 , ISSN 2319 - 4847
[36] T.Subramani, Akshay Vijayan, P.Mohammed Fayas, Jestin Thomas, S.Priyanka , " Experimental Study on Flyash and Lime With Gypsum in Concrete " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 8, Issue 3, March 2019 , pp. 257-268 , ISSN 2319 - 4847.
[37] T.Subramani, J.Karthick Rajan, F.Mohamed Ibrahim, K.Mano Vikaram, P.M.Rajesh , " Experimental Study on Hybrid Fiber Concrete (Polypropylene Fiber with Basalt Fiber) " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 8, Issue 3, March 2019 , pp. 269-278 , ISSN 2319 - 4847.
[38] T.Subramani, Febin Skaria Jacob, Limil Antoney, Rahul Pillai Suresh, S.Priyanka , " Experimental Study On Concrete With Plastic Waste And Master Gelinium " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 8, Issue 3, March 2019 , pp. 288-296 , ISSN 2319 – 4847

[39] T.Subramani, S.Priyanka , " Experimental Study on Research of Bricks with Copper Tailing Waste " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 8, Issue 3, March 2019 , pp. 329-334 , ISSN 2319 – 4847
[40] T.Subramani, S.Priyanka, K.Thirunavukkarasu , " Experimental Investigation of Concrete using Basalt Fibre And GFRP Sheet " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 8, Issue 3, March 2019 , pp. 335-340 , ISSN 2319 - 4847.
[41] T.Subramani, J.Karthick Rajan , " Experimental Study on Hybrid Fibre Concrete " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 8, Issue 3, March 2019 , pp. 349-356 , ISSN 2319 - 4847.
[42] T.Subramani, J.Karthick Rajan , " Experimental Investigation Paver Block Natural Fiber " , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 8, Issue 3, March 2019 , pp. 357-364 , ISSN 2319 - 4847.

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