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Using various materials as a partial replacement of cement

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ABSTRACT

Day by bay population growth rate is increasing as the same construction growth rate is also rising. Since a large quantity of natural resources and materials were used. Also, cement is used in a huge quantity which causes rising Co2 pollution, so because of this, we need to find a new substitute for cement. Disposal problem of waste material is becoming critical day by day. Millions tone of waste is generated every year in the world. In this topic, an attempt has been made to utilize, which is waste of industry, municipal solid waste, agricultural waste. The research work is the determination of the effect of the use of various waste as a replacement of cement to assess the pozzolanic nature. Also comparing the chemical compositions of various waste materials, physical and chemical properties were studied. Then final result concluding the best materials which are most widely used globally in a bulk quantity. Reduce the demand for cement, glass powder decreases the unit weight as well as the porosity as indicated by the decrease in water absorption. It reduces the quantity of cement to be used in concrete. Also, glass powder is proved to be economical and is considered as environmentally friendly construction material.

Keywords— *Glass powder, Silica flumes, Fly ash, Sugarcane bagasse ash, GGBS, Rice husk ash, Paper pulp ash replacement to PPC, Cost-effective material*

1. INTRODUCTION

1.1 General Information

Cement-based materials are the most abundant of all man-made materials and are among the most important constructional materials and it is most likely that they will continue to have the same importance in the future, however, these construction and engineering materials must meet new and higher demands. When facing issues of productivity, economy, quality and environment,

they have to compete with other construction materials such as plastic, steel, wood. Concrete is the 2nd largest of the most widely used materials, but there are environmental issues associated with its use which are needed to be taken under consideration and cannot be ignored.

The yearly production of cement in India in the year 2017-18 is 455 MT. Concrete production uses large quantities of natural resources as aggregates and contributes to the release of carbon dioxide during the production of cement. Cement possess binding properties and provide strength but, at the same time, around 7% of greenhouse gases are emitted by only the cement industry in the earth’s atmosphere.

In order to address the environmental effects associated with cement, there is a need to develop alternative binders to make concrete cost effective and more strengthen. Today various researchers are studying the use of supplementary material which acquired cementitious properties for example blast furnace slag, Silica Fumes, Fly Ash, Waste Glass Powder, GGBS, Rice Husk, Paper Pulp Ash, Sugarcane Baggase Ash. In this paper, the various materials properties like chemical, physical, cost of materials and availability of material in worldwide and strength effects in concrete is explained. Acquired cementitious properties, for example, blast furnace slag, Silica Fumes, Fly Ash, Waste Glass Powder, GGBS, Rice Husk, Paper Pulp Ash, Sugarcane Baggase Ash. In this paper, the various materials properties like chemical, physical, cost of materials and availability of material in worldwide and strength effects in concrete is explained.

2. CHEMICAL COMPOSITION

The following tables explains the chemical compositions.

Table 1: PPC and waste glass powder chemical composition

S. no	Properties	PPC %	Waste glass powder %
1	SiO_2	20.2	67.33
2	Al_2O_3	4.7	2.62
3	Fe_2O_3	3	1.42
4	TiO_2	0.157	-
5	CaO	61.9	12.45
6	MgO	2.6	2.73
7	Na_2O	0.19	12.05
8	K_2O	0.82	0.638
9	ZrO_2	-	0.019
10	ZnO	-	0.008
11	SrO	-	0.016
12	P_2O_5	-	0.051
13	NiO	-	0.014
14	CuO	-	0.009
15	Cr_2O_5	-	0.022
16	So_3	3.9	-
17	MnO	-	-

Table 2: Suger cane and bagasse ash and fly ash chemical composition

S. no	Properties	GGBS %	Silica Flumes %
1	SiO_2	28-38	93.2
2	Al_2O_3	8 TO 24	0.44
3	Fe_2O_3	-	0.22
4	TiO_2	0.58	0
5	CaO	30TO50	0
6	MgO	1TO18	0.81
7	Na_2O	0.27	0.59
8	K_2O	0.37	1.28
9	ZrO_2	-	-
10	ZnO	-	-
11	SrO	-	-
12	P_2O_5	-	-
13	NiO	-	-
14	CuO	-	-
15	Cr_2O_5	-	-
16	So_3	-	0.45
17	MnO	0.68	-

Table 3: GGBS and silica flume chemical composition

S. no	Properties	Sugar cane bagasse ash %	Fly ash %
1	SiO_2	65	52.87
2	Al_2O_3	3.95	33.08
3	Fe_2O_3	9.17	3.58
4	TiO_2	-	1.89
5	CaO	12.6	4.29
6	MgO	0.6	0.9
7	Na_2O	-	0.3
8	K_2O	-	0.29
9	ZrO_2	-	-
10	ZnO	-	-
11	SrO	-	-
12	P_2O_5	-	0.55
13	NiO	-	-
14	CuO	-	-
15	Cr_2O_5	-	-
16	So_3	0.1	0.38
17	MnO	-	0.05

Table 4: Rice husk ash and paper pulp ash chemical composition

S. no.	Properties	Suger rice husk ash %	Paper pulp ash fly ash %
1	SiO_2	91.1	16.57
2	Al_2O_3	0.4	2.06
3	Fe_2O_3	0.4	0.92
4	TiO_2	-	-
5	CaO	0.4	14.94
6	MgO	0.5	3.59
7	Na_2O	0.1	0.22
8	K_2O	2.2	0.16
9	ZrO_2	-	-
10	ZnO	-	-
11	SrO	-	-
12	P_2O_5	-	-
13	NiO	-	-
14	CuO	-	-
15	Cr_2O_5	-	-
16	So_3	-	-
17	MnO	-	-

3. REPLACING MATERIALS

3.1 Glass powder

The glass is a transparent material produced by melting a mixture of materials such as silica, soda ash, and CaCO3 at high temperature followed by cooling during which solidification occurs without crystallization. The glass is widely used in our lives through manufactured products such as sheet glass, bottles, glassware, and vacuum tubing. The amount of waste glass is gradually increased over the recent years due to an ever-growing use of glass products. Most waste glasses have been dumped into landfill sites. The Landfilling of waste glasses is undesirable because they are not biodegradable, which makes them environmentally less friendly. So we use the waste glass in concrete to become the construction economical as well as eco-friendly.

It was found that if the glass was ground to a particle size of 300 µ or smaller, the alkali-silica reaction (ASR) induced expansion could be reduced. In fact, data reported in the literature show that if the waste glass is finely ground, under 150 µ, this effect does not occur and mortar durability is guaranteed. Its also well know that typical pozzolanic materials might feature high silica content, an amorphous structure and have a large surface area. The composition of cement and Glass Powder is as shown in Table 1.

Fig. 1: Glass Powder

3.2 Sugarcane bagasse ash

The sugarcane bagasse consists of approximately 50% of cellulose, 25% of hemicellulose and 25% of lignin. Each ton of sugarcane generates approximately 26% of bagasse (at a moisture content of 50%) and 0.62% of residual ash. The residue after combustion presents a chemical composition dominates by silicon dioxide (SiO2). In spite of being a material of hard degradation and that presents few nutrients, the ash is used on the farms as a fertilizer in the sugarcane harvests.

Sugar Cane Bagasse can be burnt into ash that fulfils the physical characteristics and chemical compositions of mineral admixtures. Pozzolanic activity of sugar cane bagasse (SCBA) depends on (I) silica content (II) silica crystallization phase (III) size and surface area of ash particles in addition ash mush contain an only small amount of carbon. The optimized SCBA by controlled burn and or grinding has been used as a pozzolanic material in cement and concrete. Using it provides several advantages, such as improved strength and durability properties, and environmental benefits related to the disposal of waste material and to reduce carbon dioxide emissions. Sugar Cane Bagasse Ash produced after burning of sugar cane bagasse has high reactivity and pozzolanic property chemical composition of "SCBA" are affected due to burning process and temperature. Silica content in the ash increases with higher burning temperature.

Fig. 2: Glass Powder

3.3 Fly ash

Fly ash may be a by-product from coal-fired electricity generating power plants. The coal utilized in these power plants is especially composed of flammable parts like carbon, hydrogen and oxygen (nitrogen and sulphur being minor elements), and non-flammable impurities (10 to 40%) typically present within the type of clay, shale, quartz, feldspar and sedimentary rock. the size of ash ranges from 1.0 to one hundred microns and the typical size is around 20 microns. it is found that particle size below ten microns contributes towards early Development of strength (7& 28 days).

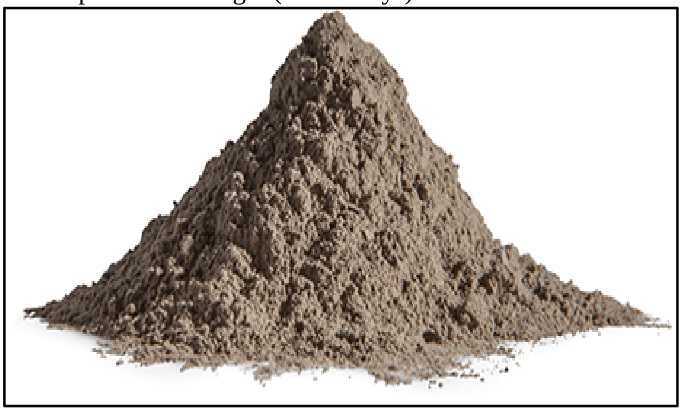

Fig. 3: Fly Ash

Fly ash has been found to have numerous advantages for use in concrete. Some of the advantage include improved workability, reduced permeability, increased ultimate strength, reduced bleeding, and better surface and reduced heat of hydration. Several types of fly ash are produced depending on the coal and coal combustion process. It is a pozzolanic material and has been classified into two classes Fly ash is one of the residues generated in combustion and comprises the fine particles that rise with the flue gases. Ash which does not rise is termed bottom ash. In an industrial context, fly ash usually refers to ash produced during combustion of coal. Fly ash is generally captured by electrostatic precipitators or other particle filtration equipment before the flue gases reach the chimneys of coal-fired power plants and together with bottom ash removed from the bottom of the furnace is in this case jointly known as coal ash. Depending upon the source and makeup of the coal being burned in the past, fly ash was generally released into the atmosphere, but pollution control equipment mandated in recent decades now require that it be captured prior to release. In some cases, such as the burning of solid waste to create electricity the fly ash may contain higher levels of contaminants than the bottom ash and mixing the fly and bottom ash together brings the proportional levels of contaminants within the range to qualify as non-hazardous waste in a given state, whereas, unmixed, the fly ash would be within the range to qualify as hazardous waste.

3.4 GGBS

Fig. 5: GGBS

GGBS is a non-hazardous and non-metallic waste of the iron industry, it is also eco-friendly and used in construction work. It helps to improve the properties of concrete like compressive strength, workability etc. it has low cost and easily available. In India, about 7.8 million tons of GGBS is produced per year and it is used an admixture should become common. The GGBS replacement resulting in higher yearly strength lower permeability and durability compared to OPC. GGBS has been widely used in Europe, and increasingly in the United States and in Asia (particularly in Japan and Singapore) for its superiority in concrete durability, extending the lifespan of building from fifty years to hundred years.

Ground Granulated Blast furnace slag (GGBS) is a by-product from the blast furnace used to make iron. These operate at a temperature of about 1500^0C TO 1600^0C and arc fed with a carefully controlled mixture of iron ore, coke and limestone. The ore is reduced to iron and the remaining materials from a slag that floats on top of the iron. This slag is periodically tapped off as a molten liquid and if it is to be used for the manufacture of GGBS it has to be rapidly quenched in a large volume of wate. The quenching optimises the cementitious properties and produces granules similar to course sand. this granulated slag is then dried and ground to a fine powder.

3.5 Silica flumes

Fig. 6: Silica Fumes

Silica fumes was conducted in 1952 and it was not until the early 1970s that concretes containing silica fume came into even the history of silica is relatively short, the first recorded testing of silica fume in Portland cement based concretes was conducted in 1952 and it was not until the early 1970s that concretes containing silica fume came into even limited use. The early work done in Norway received most of the attention since it had shown that Portland cement-based-concretes containing silica fumes had very high strengths and low porosities. Since then the research and development of silica fume made it one of the world's most valuable and versatile admixtures for concrete and cementitious products.

It is waste by-product in the manufacturing of elemental silica. Also referred to as micro silica or condensed silica it is a pozzolanic material. Having size less than a 1µm and spherical shape, this is an ultrafine material. The specific surface is approximately 20,000 m2/kg. It is of light to a dark grey colour and generally acts as filler material in fine aggregates, thus improves the various properties of concrete. Due to its high surface area, high pozzolanic action and its chemical properties it has both engineerings as well as economic benefits.

3.6 Rice Husk

Rice husk is generated from the rice processing industries as a major agricultural by-product in many parts of the world, especially in developing countries. About 500 million tons of paddies are produced in the world annually after incineration only about 20% of rice husk is transformed to RHA. Still, now there is no useful application of RHA and is usually dumped into water streams or as landfills causing environmental pollution of air, water and soil. RHA consists of non-crystalline silicon dioxide with the high specific Surface area and high pozzolanic reactivity, thus due to growing environmental concern and the need to conserve energy and resources, utilization of industrial and biogenic waste as supplementary cementing material has become an integral part of concrete construction. Pozzolanas improve strength because they are smaller than the cement particles, and can pack in between the cement particles and provide a finer pore structure. RHA has two roles in concrete manufacture, as a substitute for Portland cement, reducing the cost of concrete in the production of low-cost building blocks, and as an admixture in the production of high strength concrete. Rice Husk Ash is the ash that is obtained by burning the rice husk until it gets reduced by 25%. The Rice Husk for the research was obtained locally. These Husks then were deliberated until fine ash is being produced. These ashes were sieved by the 600 microns where further impurities are being minimized.

Fig. 7: Rice Husk

Rice husk is an agricultural residue widely available in major rice producing countries. The husk surrounds the paddy grain. During the milling process of paddy grains about 78 % of weight is obtained as rice, broken rice and bran. Remaining 22 % of the weight of paddy is obtained as a husk. This husk is used as fuel in the various mills to generate steam for the parboiling process. This husk contains about 75 % organic volatile matter and the rest 25 % of the weight of this husk is converted into ash during the firing process, this Ash is known as rice husk ash. This RHA contains around 85 % - 90% amorphous silica.

3.7 Paper pulp ash

Pulp and paper mill residual solids also called sludge is composed mainly of cellulose fibres, moisture and papermaking fillers like kaolinite clay and calcium carbonate. The raw dry paper sludge mainly contains silica and calcium oxide followed by alumina and magnesium oxide.

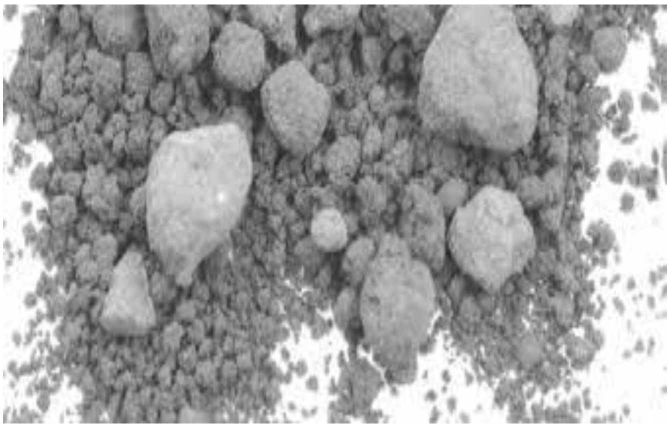

Fig. 8: Paper pulp ash

Paper mill sludge is composed of mineral fillers, small cellulose fibres, water, inorganic salts and organic compounds. Paper sludge ash is produced by incinerating waste paper sludge from the paper manufacturing process. pH ranges widely from a nearly neutral level to around 12 depending on its composition and the particle density is around 2.2 to 2.9(g/cm3), the maximum dry density is 0.65 to 0.95(g/cm3) paper sludge contains 60% water and 40% solids. And solids contains 30% ash, others are ignition loss. Moisture content in paper sludge is 75.40% and ignition loss is 70.11% and after co-generation of ashes, ignition loss is 19.63% The principal constituents present in Waste Paper Sludge Ash (WPSA) are lime (CaO) and silica (SiO2). The amounts of the other major elements were low (less than 2%), except for MgO (4%). Therefore it contains also

Aluminium trioxide (Al2O3), Ferric trioxide (Fe2O3) ,Magnesium Oxide (MgO), Sulphate (SO3), Potassium oxide (K2O) etc. The volume/weight can be reduced by dewatering at low temperature (<200°C) and incineration at high temperature (>800°C). During incineration, organic compounds are burned at temperatures of around 350 to 500°C, whereas mineral fillers and inorganic salts are transformed into the corresponding oxides at higher temperatures (>800°C). CaO, Al2O3, MgO, and SiO2 are the most abundant oxides in Paper sludge Ash observed that the presence of CaO in WPSA has both negative and positive concerns for the use of WPSA as a hydraulic binder. The main destructive aspect is the enlargement due to the hydration of CaO to Ca(OH)2, which outcomes in unsoundness using the ash as a hydraulic binder. The fast hydration of lime would give high alkalinity to the solution.

3.8 Result

Table 5: Properties of materials

S no.	Properties	Silica fumes	Rice Husk ash	Glass powder
1.	Colour	Grey	grey	Greyish white
2.	Ph	≥12.5	5.16 to 6.20	10.25
3.	Odour Of Material	Odourles s	Odourless	Odourles s
4.	Specific Gravity Of Material	2.2 to 2.3	2.14	2.63
5.	Bulk Density	750-850 Kg/m3	0.781 g/cc	2.6
6.	Particle Size	< 1µm	< 45 microns	< 100 microns
7.	Particle Shape	Irregular	Irregular	Irregular
8.	Specific Surface (M^2/Kg)	15,000-30,000	1.7 g/cc	----
9.	Availability Of Material (Worldwide)	Mostly	frequently	Mostly in bulk quantity

The result is taken for the best materials out of these seven waste materials present this paper, whose chemical composition and all other properties are most similar to the PPC cement. Table 5 shows the best material among them.

4. CONCLUSION

- All material we can use as a replacer.
- Chemical and physical properties maximum contents are same as PPC.
- If the replacing material is used, the strength of the concrete will be as compared to conventional concrete same but the cost will be reduced.
- Silicon dioxide is used to increase the strength and reduce the initial setting time, and the same chemical is more in PPC, SILICA FUME, RICE HUSK, GLASS POWDER, so we can use these three materials.
- From this, we diagnosed that silica flumes are sio2, in the form of sio2, so with the help of cement, the strength of the cement increases and the initial setting time decreases compared to the rest of the material. And in the same way, other ingredient is rice husk and the third waste glass powder.
- If you think in terms of economically and quantity then it will be noted that the quantity of waste glass powder made from silica flume and rice husk is prepared in large quantities each year, and it is worthwhile to use this as waste material as compared to the rest of the cost of glass powder.

5. REFERENCES

[1] Harish B A1, Hanumesh B M2, Siddesh T M3, Siddhalingesh B K4. "An Experimental Investigation on Partial Replacement of Cement by Glass Powder in Concrete."). Volume: 03 Issue: 10 Oct-2016.

[2] Dr G.Vijayakumar1, Ms H. Vishaliny2, Dr D. Govindarajulu3. "Studies on Glass Powder as Partial Replacement of Cement in Concrete Production". International Journal of Emerging Technology and Advanced Engineering. Volume 3, Issue 2, February 2013)

[3] F.N.Okoye1* and O.I Odumodu2. "Investigation Into The Possibility of Partial Replacement of Cement with Bone Powder in Concrete Production". Volume 12, Issue 10 (October 2016), PP.40-45

[4] Kris Gahoi1, Rajeev Kansal2. "Waste Glass Powder as a Partial Replacement of PPC." Index Copernicus Value (2013): 6.14 | Impact Factor (2015): 6.391

[5] Dr G.Vijayakumar1, Ms H. Vishaliny2, Dr D. Govindarajulu3. "Studies on Glass Powder as Partial Replacement of Cement in Concrete Production." Volume 3, Issue 2, February 2013

[6] Abdullah Anwar1 *, Syed Aqeel Ahmad2. "An Experimental Investigation on Strength Behaviour of Concrete by Partial Replacement of Fine Aggregate with Copper Slag and Cement with Silica Fume." Volume-6, Issue-1

[7] Gurdeep Singh1, Rajwinder Singh Bansal2. "Effect of Partial Replacement of Cement by Silica Fume and Sand by Quarry Dust on Strength and Durability of Concrete." International Research Journal of Engineering and Technology (JET) Volume: 04 Issue: 09 | Sep -2017

[8] Prof. Vishal S. Ghutke1, Prof. Pranita S.Bhandari2. "Influence of silica fume on concrete".IOSR Journal Of Mechanical And Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, p-ISSN: 2320-334X PP 44-47

[9] Ram Kumar1, Er.Jitender Dhaka2. "PARTIAL REPLACEMENT OF CEMENT WITH SILICA FUME AND ITS EFFECTS ON CONCRETE PROPERTIES" International Journal For Technological Research In Engineering Volume 4, Issue 1, September-2016

[10] Praveer Singh1, Mohd. Afaque Khan2, Abhishek Kumar3. "The Effect on Concrete by Partial Replacement of Cement by Silica Fume: A Review". International Research Journal of Engineering and Technology (JET) Volume: 03 Issue: 03 | Mar-2016

[11] Er. Ravi bhushan1, Sopan Gochhe2, Er. Harneet Singh3, Bikram Prasad Bastola4. "Partial replacement of cement by rice husk ash". International Research Journal of Engineering and Technology (JET) Volume: 04 Issue: 10 | Oct -2017.

[12] Rishabh Kashyap1, Manu Chaudhary2, Abhishek Sen. "Effect of Partial Replacement of Cement by Rice Husk Ash in Concrete" International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064

[13] Cherian Varkey1, Jefin P John1, Neema V N1, Namitha Joshy1. "Study on utilization of waste paper sludge by partial replacement of cement in concrete" International Research Journal of Engineering and Technology (JET) Volume: 03 Issue: 05 | May-2016

[14] Nidhi Relan1, Dr A K Saxena2. "Experimental Study of Replacement of Cement by SCBA in Concrete" International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Index Copernicus Value (2013): 6.14

[15] Er. Manoj Kumar Meena1, Er. Jagriti Gupta2, Dr Bharat Nagar3. “Performance of concrete by using glass powder” An Experimental Study” International Research Journal of Engineering and Technology (IRJET) International Research Journal of Engineering and Technology (IRJET)

[16] Pratheba.S1, Deepeka.K2, Kanimozhi.A3, Malathi.J4, Nandhini.J5 “An experimental study on bagasse ash as partial replacement for cement in concrete” International Research Journal of Engineering and Technology (JET) Volume: 05 Issue: 03 | Mar-2018

[17] 1Ankur Anand, 2Dr.A.K.Mishra 1M.tech Student, Madan Mohan. “Comparative study of concrete strength by partially replacing cement with sugarcane bagasse ash and Fly Ash” International Journal of Science, Engineering and Technology Research (IJSETR) Volume 5, Issue 4, April 2016

[18] Vinod Goud (1) Niraj Soni (2) (1) Goutam Varma (2) Kapil Kushwah (3) Sharad Chaurasia (4) Vishwajeet Sharma “Partial Replacement of Cement with Fly Ash In Concrete And Its Effect” IOSR Journal of Engineering (IOSRJEN) ISSN (e): 2250-3021, ISSN (p): 2278-8719 Vol. 06, Issue 10(Oct. 2016), ||V2|| PP 69-75

[19] Pujari Sainath, 2ponnala Ramaiah. “PARTIAL replacement of cement with fly ash and it’s compressive strength” ” International Journal of research Volume 5, Issue 3 AUG 2016

[20] T.G.S Kiran1 , M.K.M.V Ratnam2. “Fly Ash as a Partial Replacement of Cement in Concrete and Durability Study of Fly Ash in Acidic (H2so4) Environment” international Journal of Engineering Research and Development e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com Volume 10, Issue 12 (December 2014), PP.01-13

[21] Sajad Ahmad, M. Iqbal Malik, Muzaffar Bashir Wani, Rafiq Ahmad. “Study of Concrete Involving Use of Waste Paper Sludge Ash as Partial Replacement of Cement” IOSR Journal of Engineering (IOSRJEN) e-ISSN: 2250-3021, p-ISSN: 2278-8719 Vol. 3, Issue 11 (November. 2013), ||V3|| PP 06-15

[22] Lathamaheswari, R., Kalaiyarasan, V andMohankumar, G. “Study on Bagasse Ash As Partial Replacement of Cement in Concrete” International Journal of Engineering Research and Development e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com Volume 13, Issue 1 (January 2017), PP.01-06

[23] Mallikharjuna Rao Kelam, V.Sandeep2. “Evaluation of Sugarcane Bagasse Ash as a Replacement for Cement in Concrete Works for the Grade of M35” International Journal of Engineering Technology Science and Research IJETSR www.ijetsr.com ISSN 2394 – 3386 Volume 4, Issue 6 June 2017

[24] Sumit A Balwaik* ; S P Raut “Utilization of Waste Paper Pulp by Partial Replacement of Cement in Concrete” International Journal of Engineering Research and Applications (IJERA) Vol. 1, Issue 2, pp.300-309

[25] Bangar Sayali S.*1,Phalke Shubhangi N.2 ,Gawade Anjali Y.3 ,Tambe Rutuja S.4 & RahaneA. B. “A review paper on replacement of cement with bagasse ash” international journal of engineering sciences &management ISSN 2277 – 5528.

