International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 5, Issue 03, March-2019

A REVIEW ON EFFECT OF VARYING PROPORTIONS OF PET FIBRE WITH FLY ASH, BAGASSE ASH AND METAKAOLIN ON STRENGTH OF CONCRETE

[1]TANVEER SINGH BAINS, [2]KHUSHPREET SINGH

[1]*M.E Scholar, Department of Civil Department, Chandigarh University.*
[2]*Asst. Prof. Department of Civil Engineering, Chandigarh University.*

Abstract:- Today researchers everywhere are concentrating on methods for using either industrial or agricultural wastes as a wellspring of raw materials for the development business. These squanders usage would not exclusively be affordable, yet may likewise make a manageable and contamination free condition. They are focusing on utilization of industrial or agricultural wastes as a source of raw materials for the purpose of construction of concrete. Wastes utilization shall not only be cheaper but may also become a sustainable and pollution free raw material. Geopolymer concrete is another methodology of concrete generation by rejection of common Portland cement altogether with pozzolanic material. Adjacent to water, concrete is the biggest devoured substances, which request immense part of Portland cement. Geopolymer concrete is designed by replacing 100% cement with sustainable and recycled material which is a new technique of concrete production. Apart from water, demand of production of concrete is very huge in which cement is the main constituent. In this paper, the effect of adding industrial or agricultural wastes i.e. Pet fiber with Fly ash, Bagasse ash and Metakaolin in the concrete has been reviewed. From various studied, it is concluded that Pet fibre with Fly ash, Bagasse ash and Metakaolin increase the compressive and flexibility strength of concrete.

Keywords:- Geopolymer concrete, Metakaolin, Fly ash, Concrete.

I. INTRODUCTION

Concrete is the impeccable construction material in the world. It is fundamentally made out of two parts: paste and aggregate. The paste contains cement and water and different cementitious and chemical admixtures sometimes, though the total contains sand and rock or pounded stone. The paste binds the aggregates together. The proportion of these components, the paste and the aggregate is controlled by; the strength and durability of the desired concrete, the workability of the fresh concrete and the cost of the concrete. Cement which is one of the components of concrete plays a great role, but is the costly and environmentally unfriendly material. Metakaolin, bagasse ash, fly ash, etc have been used successfully for the purpose of replacing cement. Geopolymer concrete is crude material-based concrete that prompts the use of materials which are created as a raw material from ventures and when these raw materials were instigated in the geopolymer planning it prompts the decrease of carbon discharges and goes about as a greener concrete towards condition. It has low heat of hydration in examination with bond concrete. The imperviousness to fire is impressively superior to OPC based concrete. It offers better security to support steel from erosion when contrasted with customary bond concrete. This concrete is found to have high corrosive obstruction when tried under presentation to 2% and 10% sulphuric acids. Geopolymer concrete is designed by replacing 100% cement with sustainable and recycled material which is a new technique of concrete production. Apart from water, demand of production of concrete is very huge in which cement is the main constituent. Low heat of hydration can be achieved in geopolymers. The fire resistance is considerably better than OPC based concrete. It gives good protection to reinforcement bars against corrosion as compared to traditional cement concrete. This concrete is found to possess very high acid resistance when tested under exposure to 2% and 10% sulphuric acids. The utilizations of Geopolymer concrete are same as cement concrete. This concrete has been utilized for development of asphalts, holding dividers, water tanks, precast bridge decks.

The different technique of curing the geopolymer concrete are heat/oven curing, steam curing and ambient curing. Metakaolin is a dehydroxylated type of the clay mineral kaolinite. Joining metakaolin in concrete add to different properties of concrete. In new condition of concrete, their essence kills or limits the dying, decreases isolation and enhances functionality. Fly cinder is one of the waste items from the power plants. It is wealthy in silica and alumina; this property of fly cinder will use it in the readiness of geopolymer concrete. It is additionally a significant fixing in the making of geopolymer concrete because of its job in the geopolymerization procedure.

Polyethylene terephthalate (PET) investigated in present examination has a place with the polyester gathering. Because of quick improvement in the innovation the utilization of PET materials has been expanded. Among that PET jugs utilized for drink holders has turned into a noteworthy issue. This will, in the end, turn into a natural poison. Utilization of reused PET fiber in fiber fortified concrete would give an economical answer for environment pollution.

II. LITERATURE REVIEW

2.1. Effect of replacement/addition of Bagasse ash:-

Dr. Tayyeb Akram et al. [1] evaluated the feasibility of using of bagasse ash as partial replacement of cement. The main variables in this research study are the amount of bagasse ash (5, 10, 15, 20, 25, 30, and 35 percent by weight of cement) and dosage of superplastisizer. The parameters those kept constant are the amount of cementitious material equal to 430 Kg/m3 and water to cementitious material ratio equal to 0.55. Test results indicated that the compressive strength and density of control mix was higher than mixes containing bagasse ash. The setting time was longer and water absorption was lower for the mix containing bagasse ash as partial replacement of cement. Mix containing bagasse ash performed better than control mix against acid attack. The aggressiveness of sulfuric acid on concrete was more pronounced than hydrochloric acid. It can be concluded that partial replacement of cement by bagasse ash is feasible.

TABLE 1: Chemical composition of fly ash, bagasse ash and metakaolin:

Composition	Fly ash Mass (%)	Bagasse ash Mass (%)	Metakaolin Mass (%)
CaO	05.01	05.90	00.78
SiO_2	59.57	59.63	52.68
Al_2O_3	19.87	01.57	45.80
Fe_2O_3	06.01	06.69	02.14
MgO	07.23	02.11	00.16
SO_3	00.05	03.25	-
K_2O	00.19	07.94	00.62
Na_2O	00.29	00.58	00.26

Chayanee Tippayasam et al. [3] presented pozzolanic materials which were selected as source materials for making geopolymers into 4 different types. Sodium hydroxide concentration of 10 Molar (10MNaOH) and sodium silicate (Na2SiO3) solutions were used as alkaline activators by the mass ratio of Na2SiO3/NaOH at 1.5. The mixtures were cast in 25×25×25 mm. cubes. After casting, the geopolymers were cured at 80°C for 24 hrs. in an oven and then at room temperature for 7 days. The pozzolanic materials effects, the Si/Al molar ratio and the Na/Al molar ratio were studied and characterized. An X-ray fluorescence (XRF) was chosen to determine the percentages of silica and alumina in order to verify the proper ratio of the fly ash, Rice husk ash, Bagasse ash and Metakaolin. The study also included the impact on mechanical and physical properties such as compressive strength, water absorption, density and porosity.

Prashant O Modania et al. [5] presented the investigation in which untreated bagasse ash has been partially replaced in the ratio of 0%, 10%, 20%, 30% and 40% by volume of fine aggregate in concrete. Fresh concrete tests like compaction factor test and slump cone test were undertaken along with hardened concrete tests like compressive strength, split tensile strength and sorptivity. The result shows that bagasse ash can be a suitable replacement to fine aggregate.

Mrs.U.R.Kawade1 et al. [6] presented the experimental investigation in which Sugarcane bagasse ash has been chemically and physically characterized and partially replaced in the ratio of 0%, 10%, 15%, 20%, 25% and 30% by weight of cement in concrete. The properties for fresh concrete are tested like slump cone test and for hardened concrete compressive strength at the age of 7,28,56 and 90 days. The test result indicate that the strength of concrete increase up to 15% Sugarcane bagasse ash replacement with cement. The strength results obtained from the experimental investigations are showed in tables. All the values are the average of the three trails in each case in the testing program of this study. The results are discussed as follows.

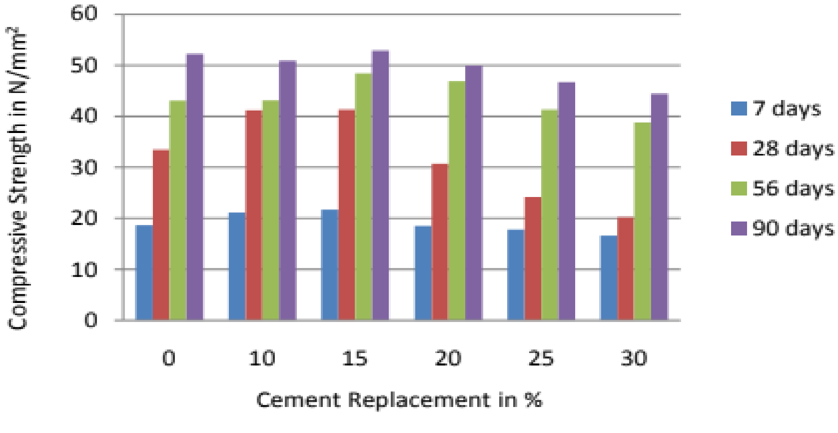

Figure1. Compressive strength of M 20 Grade concrete

M. S. Chennakesava Rao et al. [8] investigated the Bagasse ash has been chemically and physically characterized, and partially replaced in the ratio of 0%, 5%, 10%, 15% and 25% by the weight of cement in concrete. The bagasse ash was then ground until the particles passing the 90 μm sieve size reach about 85% and the specific surface area about 4716 cm2/gm. Ordinary Portland cement was replaced by ground bagasse ash at different percentage ratios. The compressive strengths of different mortars with bagasse ash addition were also investigated. M25 concrete mixes with bagasse ash replacements of 0%, 5%, 10%, 15%, 20% and 25%. Compressive strength, split tensile strength, flexural strength at the age of 7days, 28 days and 90 days was obtained. The test results indicated that up to 10% replacement of cement by bagasse ash results in better or similar concrete properties and further environmental and economic advantages can also be exploited by using bagasse ash as a partial cement replacement material.

Jayminkumar A. Patel et al. [9] investigated the sugar cane bagasse ash which is taken from one of the sugar mill of south Gujarat (INDIA) used in M25 grade of concrete by replacing cement 5% by weight and compare with normal M25 grade of concrete to check the feasibility of sugar cane bagasse ash in concrete.

Yasir Awad Allah Mohamed et al. [12] was investigated the influence of sugarcane bagasse ash (SCBA) as an additive in enhancing the properties of the portland cement. Thus, the ordinary Portland cement (OPC) was partially modified by adding fine sugarcane bagasse ash. The bagasse ash was sieved through No. 600 sieve, then the concrete and mortar mixtures samples were modified by adding 0%, 5%, 10%, 15%, and 20% of bagasse ash respectively. The obtained samples were examined and compared with the ordinary cement. The result revealed that addition of bagasse ash to cement up to 15% has improved the compressive strength of mortar. While the addition of 20% bagasse ash to cement results in decreasing the soundness of the cement and improving its fineness.

M Jaya Kumar et al. [14] investigated the comparison of bagasse ash and fly ash-bagasse ash based geopolymer concrete. In which cement is fully replaced by pozzolanic material that is rich in silicon and aluminum like fly ash and bagasse ash referred to as "Geopolymer concrete" which is a contemporary material.. Trial 1 is cement replaced by 100% bagasse ash and trial 2 is cement replaced by 80% fly ash and 20% bagasse ash. This paper presents the strength and durability of fly ash-bagasse ash based geopolymer concrete.

Jainesh Chouhan et al. [16] presented the experimental investigation in which the binding materials made by mixing fly-ash (pozzolanic material) with alkaline solution (activator) in a proper proportion. Also, to provide flexural strength to the material under observation, we have induced it with naturally occurring sisal fibre in 0.5%, 1%, 1.5%, 2% and 2.5% of fly-ash. On applying tests for compressive and flexural strength, 2% of sisal fibre by weight of fly-ash has given the optimum results. Furthermore, conclusions have been drawn in the study**.**

Mr. Dilip Srinivas et al. [18] investigated the possibility of reuse of bagasse ash in Geo polymer Concrete by compressive strength of M25 grade plain concrete and flexural behavior of concrete member for 25 and 30 percent replacement by bagasse ash.

Prakul Thakur et al. [19] presented the bagasse ash and metakaolin is used to develop the geopolymer concrete. The fly ash based geopolymer concrete was prepared with bagasse ash and metakaolin which were used to replace fly ash at different percentages i.e. 10%, 20%, 30% and 40% to study the microstructure, mechanical and durability properties. Geopolymer Concrete was prepared with the use of alkaline solutions NaOH and Na2Sio3. Geopolymer concrete samples for bagasse ash and metakaolin based were cured at oven for 24 hours at 90˚C and then kept under room temperature for curing. Metakaolin contained geopolymer concrete has shown better mechanical and durability properties as compared with bagasse ash contained geopolymer concrete.

2.2. Effect of replacement/addition of Metakaolin:-

Erhan Guneyisi et al. [2] discussed the properties of SCMs with mineral admixtures. Portland cement (PC), metakaolin (MK), and fly ash (FA) were used in binary (two-component) and ternary (three-component) cementitious blends. Within the frame work of this experimental study, a total of 16 SCMs were prepared having a constant water-binder (w/b) ratio of 0.40 and total cementitious materials content of 550 kg/m3. Then, the fresh properties of the mortars were tested for mini-slump flow diameter, mini-V-funnel flow time, setting time, and viscosity. Moreover, development in the compressive strength and ultrasonic pulse velocity (UPV) of the hardened mortars were determined at 1, 3, 7,14, and 28 days. Test results have shown that using of FA and MK in the ternary blends improved the fresh properties and rheology of the mixtures when compared to those containing binary blends of Fly ash or Metakaolin.

Chayanee Tippayasam et al. [3] presented pozzolanic materials which were selected as source materials for making geopolymers into 4 different types. Sodium hydroxide concentration of 10 Molar (10MNaOH) and sodium silicate (Na2SiO3) solutions were used as alkaline activators by the mass ratio of Na2SiO3/NaOH at 1.5. The mixtures were cast in 25×25×25 mm. cubes. After casting, the geopolymers were cured at 80°C for 24 hrs. in an oven and then at room temperature for 7 days. The pozzolanic materials effects, the Si/Al molar ratio and the Na/Al molar ratio were studied and characterized. An X-ray fluorescence (XRF) was chosen to determine the percentages of silica and alumina in order to verify the proper ratio of the fly ash, Rice husk ash, Bagasse ash and Metakaolin. The study also included the impact on mechanical and physical properties such as compressive strength, water absorption, density and porosity.

Sabria Malika Mansour et al. [4] evaluated the performance of Algerian metakaolin on cement pastes. In the present work, several rheological tests were carried out at 20°C, by using the stress-controlled rheometer AR2000, on the fresh cement pastes incorporating 0%, 5%, 10%, 15% and 20% of Metakaolin. Effects of metakaolin on the rheological behavior of cement pastes were discussed. Rheological parameters such as viscosity, compliance, loss and storage shear modulus are evaluated by means of rheological techniques of both flow and creep/recovery tests (static mode) and oscillatory test (dynamic mode). Shear moduli allow to give information on the evolution of the paste structure related to practically interesting problems such as workability. The results obtained have shown that metakaolin improves the flowability and exhibits viscous rheological behavior of cement pastes over elastic behavior of control paste (0%metakaolin). Moreover, the creep/recovery test show that the addition of metakaolin exhibits a behavior of viscoelastic liquid of cement pastes compared to a viscoelastic solid behavior of control paste. The MK acts as filler and controls rheology.

Aiswarya S et al. [7] determined the compressive strength, split tensile strength and modulus of elasticity of normal cement concrete and concrete containing Nano-Metakaolin partially replacing cement at various percentages. The mixes were designed as per IS 10262-2009. The cement was replaced by Nano- Metakaolin at various percentages (2%, 4%, 6%, 8%, 10%, 12%,14%, 16%, 18% and 20%) for M20, M30, M40 and M50 grades. A comparison between the cost of Normal Concrete and concrete with Nano-Metakaolin is also made. It is found that partial replacement of cement with Nano-Metakaolin has a greater influence on the strength of concrete. The optimum percentage at which cement can be replaced with Nano-Metakaolin is found to be 10%.The variation in the 28th day, 35th day and 56th day compressive strength of different grades of concrete with various percentages of nano metakaolin are shown in figure 2, figure 3 and figure4 respectively.

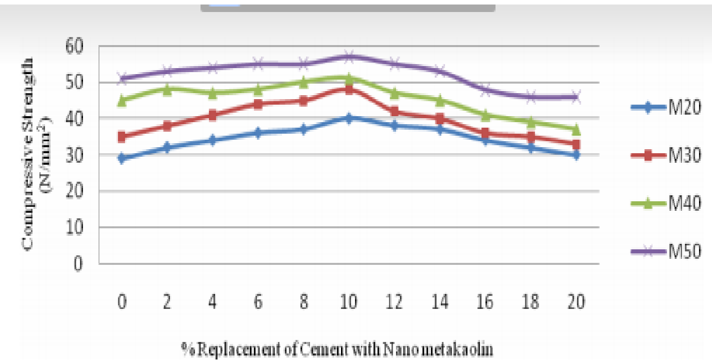

Figure 2. Compressive strength of Concrete at 28th day for Various Replacement percentages of nano Metakaolin.

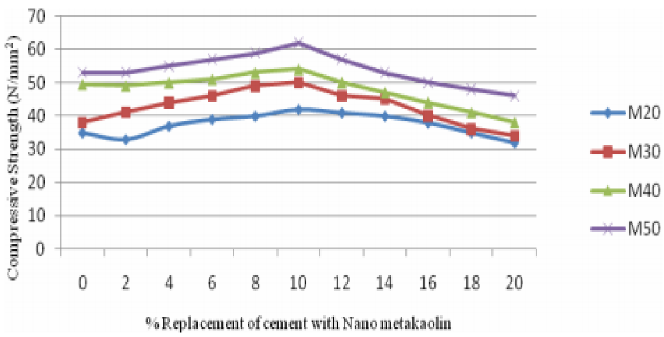

Figure 3. Compressive strength of Concrete at 35th day for Various Replacement percentages of nano Metakaolin.

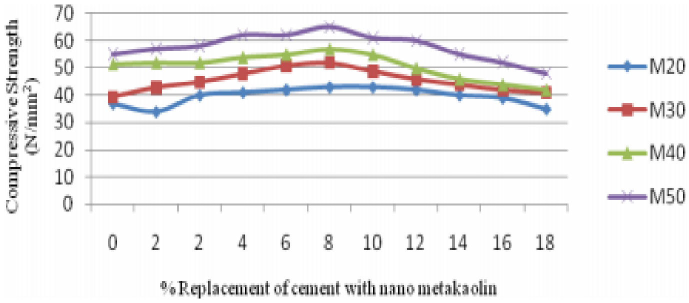

Figure 4. Compressive strength of Concrete at 56th day for Various Replacement percentages of nano Metakaolin.

Lisha Elson et al. [11] investigated the performance of concrete with the addition of Metakaolin and Recron -3s. Recron fibre is used in different percentages (0.5%, 1%, 1.5% & 2%) to the weight of concrete along with a constant percentage (5%) of Metakaolin for the production of this modified concrete. Various strength parameters like compressive strength, split tensile strength and flexural strength of modified concrete are studied and presented in this paper.

Erhan Guneyisiet al. [17] presented the results of an investigation on the use of metakaolin as a supplementary cementing material to improve the performance of concrete. Two metakaolin replacement levels were employed in the study: 10% and 20% by weight of the Portland cement used. Plain and Portland cement metakaolin concretes were designed at two water–cementitious materials (w/cm) ratios of 0.35 and 0.55. The performance characteristics of the concretes were evaluated by measuring compressive and splitting tensile strengths, water absorption, drying shrinkage, and weight loss due to the corresponding drying. The porosity and pore size distribution of the concretes were also examined by using mercury intrusion porosimetry (MIP). Tests were conducted at different ages up to 120 days. The results revealed that the inclusion of metakaolin remarkably reduced the drying shrinkage strain, but increased the strengths of the concretes in varying magnitudes, depending mainly on the replacement level of metakaolin, w/cm ratio, and age of testing. It was also found that the ultrafine metakaolin enhanced substantially the pore structure of the concretes and reduced the content of the harmful large pores, hence made concrete more impervious, especially at a replacement level of 20%.

Prakul Thakur et al. [19] presented the bagasse ash and metakaolin is used to develop the geopolymer concrete. The fly ash based geopolymer concrete was prepared with bagasse ash and metakaolin which were used to replace fly ash at different percentages i.e. 10%, 20%, 30% and 40% to study the microstructure, mechanical and durability properties. Geopolymer Concrete was prepared with the use of alkaline solutions NaOH and Na2Sio3. Geopolymer concrete samples for bagasse ash and metakaolin based were cured at oven for 24 hours at 90˚C and then kept under room temperature for curing. Metakaolin contained geopolymer concrete has shown better mechanical and durability properties as compared with bagasse ash contained geopolymer concrete.

2.3. Effect of replacement/addition of Fly ash:-

Erhan Guneyisi et al. [2] discussed the properties of SCMs with mineral admixtures. Portland cement (PC), metakaolin (MK), and fly ash (FA) were used in binary (two-component) and ternary (three-component) cementitious blends. Within the frame work of this experimental study, a total of 16 SCMs were prepared having a constant water-binder (w/b) ratio of 0.40 and total cementitious materials content of 550 kg/m3. Test results have shown that using of FA and MK in the ternary blends improved the fresh properties and rheology of the mixtures when compared to those containing binary blends of Fly ash or Metakaolin.

Chayanee Tippayasam et al. [3] presented pozzolanic materials which were selected as source materials for making geopolymers into 4 different types. Sodium hydroxide concentration of 10 Molar (10MNaOH) and sodium silicate (Na2SiO3) solutions were used as alkaline activators by the mass ratio of Na2SiO3/NaOH at 1.5. The mixtures were cast in 25×25×25 mm. cubes. After casting, the geopolymers were cured at 80°C for 24 hrs. in an oven and then at room temperature for 7 days. The pozzolanic materials effects, the Si/Al molar ratio and the Na/Al molar ratio were studied and characterized. An X-ray fluorescence (XRF) was chosen to determine the percentages of silica and alumina in order to verify the proper ratio of the fly ash, Rice husk ash, Bagasse ash and Metakaolin. The study also included the impact on mechanical and physical properties such as compressive strength, water absorption, density and porosity.

Anil Ronad et al. [10] proposed the expertimental investigation in which both fly ash and GGBS are utilized in making Geopolymer concrete. Alkaline solution used is comprises of sodium silicate (103 kg/m3) and Sodium hydroxide in the ratio of 2.5 sodium hydroxide of 10 molarity is used. Plain concrete is weaker in tension. Fibres are added to enhance the strength to the concrete to meet given serviceability requirements. Basalt fibre is considered a promising new material. It has good strength characteristics, resistance to chemical attack, sound insulation properties. Fibres are added to the geopolymer concrete in the range of 0.5% to 2.5% at 0.5% increments. Compressive and tensile strength of different mixes compared with reference mix (0% fibre). From the results it is concluded that addition of basalt fibres at an optimum content to the geopolymer concrete can increase both compressive and tensile strength.

M Jaya Kumar et al. [14] investigated the comparison of bagasse ash and fly ash-bagasse ash based geopolymer concrete. In which cement is fully replaced by pozzolanic material that is rich in silicon and aluminum like fly ash and bagasse ash referred to as “Geopolymer concrete” which is a contemporary material.. Trial 1 is cement replaced by 100% bagasse ash and trial 2 is cement replaced by 80% fly ash and 20% bagasse ash. This paper presents the strength and durability of fly ash-bagasse ash based geopolymer concrete.

Prakul Thakur et al. [19] presented the bagasse ash and metakaolin is used to develop the geopolymer concrete. The fly ash based geopolymer concrete was prepared with bagasse ash and metakaolin which were used to replace fly ash at different percentages i.e. 10%, 20%, 30% and 40% to study the microstructure, mechanical and durability properties. Geopolymer Concrete was prepared with the use of alkaline solutions NaOH and Na2Sio3. Geopolymer concrete samples for bagasse ash and metakaolin based were cured at oven for 24 hours at 90˚C and then kept under room

temperature for curing. Metakaolin contained geopolymer concrete has shown better mechanical and durability properties as compared with bagasse ash contained geopolymer concrete.

Yarra Tirupathi Naidu et al. [13] investigated the utilization of synthetic fibres in geopolymer concrete. In present advanced work Class F fly ash and ground granulated blast furnace slag (GGBS) are used in similar proportions (FA_50-GGBS_50) with alkaline activator solutions. Synthetic fibres (Polypropylene and Polyester fibres) are used at fibre dosage of 0%, 0.2%, 0.25%, 0.3%, 0.35% and 0.4% respectively and various advanced mechanical properties are experimentally studied. The various strength tests that are Compressive strength, Split tensile strength, Flexural strength. Compressive strength test was tested for the mixes with the various synthetic fibers replacement levels of 0%, 2%, 2.5%, 3%,3.5% &4%.The samples were tested after curing periods of 7, 28 and 90 days. Table 2 shows the Compressive strength test of GPC mixes at different curing periods. Table 3 shows the split tensile strength of GPC mixes at different curing periods.

Table 2. Compressive strength of GPC

Compressive strength, f'c (MPa)	7 Days	28 Days	90Days
0%	31.14	37.54	43.68
2%	32.03	42.18	45.03
2.5%	34.62	44.81	48.52
3%	35.56	46.82	52.64
3.5%	32.89	38.75	45.18
4%	30.12	37.86	44.74

Table 3. Split tensile strength of GPC

Compressive strength, f'c (MPa)	7 Days	28 Days	90Days
0%	2.67	3.52	3.76
2%	2.89	3.74	3.96
2.5%	3.21	3.87	4.24
3%	3.46	4.27	4.52
3.5%	3.23	3.81	4.14
4%	2.72	3.46	3.71

There was a significant increase in compressive strength, split tensile strength, flexural strength with the increase in percentage synthetic fibers from 0% to 0.3% in all curing periods. The optimum percentage of synthetic fibers obtained is 0.3% of its volume of concrete.

2.4. Effect of replacement/addition of PET Fibre:-

T.Subramani et al. [15] presented the utilization of waste material in concrete would be beneficial in order to find an alternative solution to reduce environmental pollution. One of the waste materials is polyethylene terephthalate (PET) which is a polyester material and is produced in large quantities. In this work fibres are simply cut from waste plastic bottles . The dimensions of PET fibres used are 30 mm long, 5mm width and 0.6mm thickness in the various percentages 0%, 2%, 4%, and 6% of fibre in total weight of concrete. In this study cubes, cylinders, beams specimens are proposed to be carried out and their compressive strength, split tensile strength, flexural strengths will be compared. Then optimum percentage of PET fibre is found out.

Vikas Thakur et al. [20] examine the possibility of using recycled plastic in concrete mix. PET fibres are partial replacement by weight of cement with percentage of 0%, 0.5, 1%, 1.5%, and 2%. PET fibre coated with epoxy binder .M40 grade of concrete use for mix deign of concrete. Total 90 sample of moulds specimen [1] made for testing and each sample has three moulds of specimen casted .After the testing average vale of specimen is calculated and shown in given tables. Strength is increase compare with the conventional concrete specimen's replacement of coated fibre. The testing of given specimen done in compressive machine and Flexural testing machine. The increase of percentages of bagasse ash coated fibre in concrete is increase the strength of concrete. The bonding strength of concrete is improve and cracks in concrete decrease use of coated fibres and reduces the plastic waste. Strength is increase with using bagasse ash coated PET fibers in concrete. The specimen was tested in compressive testing machine and flexural testing machine. After testing each sample were calculated average value .these all valves mention in figure 5, 6, 7.

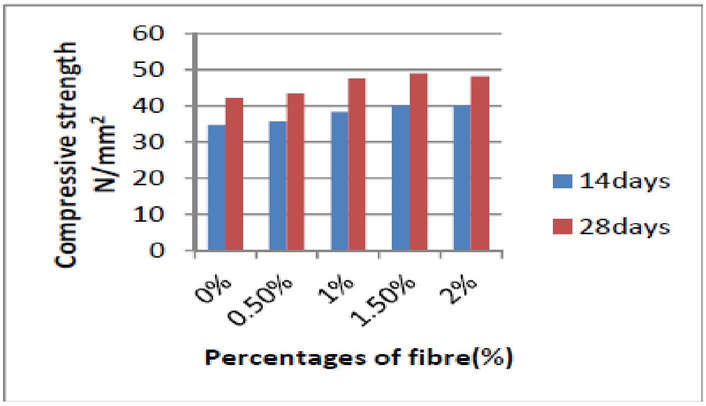

Figure 5. Compressive strength Vs coated Plastic fibres (%)

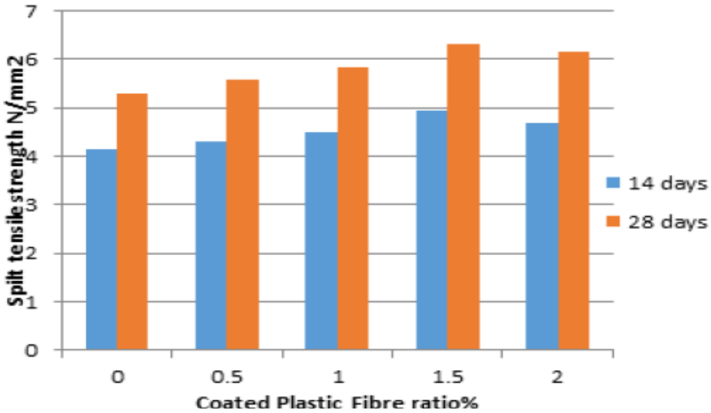

Figure 6 Spilt tensile strength VS coated fibre (%)

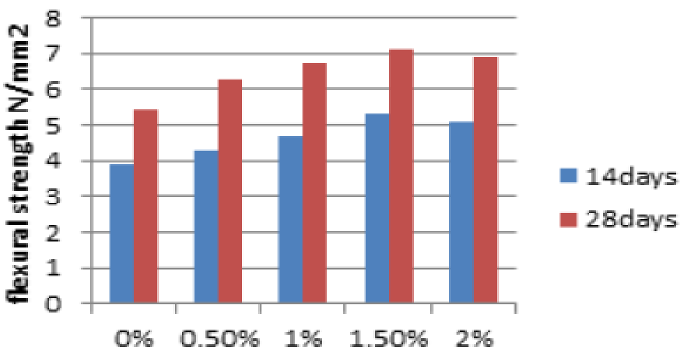

Figure7. Flexural strength Vs coated fibre (%)

Muhd Fadhil Nurruddin et al. [21] discussed the different methods of curing of geopolymer concrete and figures out the best method of curing. Experimental findings revealed that condition of curing has a good influence on the mechanical properties of geopolymer concrete. Conventionally, ambience temperature curing of geopolymer concrete result in low strength development at an early age, while higher temperature curing results in significant strength improvement. Similarly, extended curing time enhanced the geopolymerisation mechanism and achieved greater strength. However, longer duration of curing at an elevated temperature result in failure of the sample.

III. CONCLUSION

The current investigation reviewed various techniques of curing of geopolymer concrete. Several methods of curing have been attempted by various researchers which include oven heating, membrane curing, steam curing, hot gunny curing, hydrothermal curing, room temperature and water curing respectively. From the above mentioned methods, curing done in oven proved to be the more effective technique than room temperature curing for geopolymer concrete. Curing at higher temperature for geopolymer concrete brings a challenge as oven curing method is difficult to achieve at the construction site. Therefore, it limits the application of geopolymer concrete to only precast members. In addition, most of the researchers studied compressive strength only while other properties were not taken into consideration. Therefore, there is a scope of work needs to be done.

- The strength in compression of geopolymer concrete increases with the percentage of alkali liquid.
- When fine aggregates are replaced with bagasse ash (untreated) effectively with the varying proportion from 10% to 20%, it does not create any losses of workability and strength properties.
- The result of compressive strength shows that the strength of sample containing 10% and 20% bagasse ash increases at later days (28 days) as compared to7 days
- The most optimum and effective proportion of Nano-Metakaolin at which the cement can be replaced is 10%.
- The increase in Compressive strength varies from 5% to 38% for M20 concrete grade, 2% to 37% for M30 concrete grade, 3% to 13% for M40 concrete grade and 3% to 18% for M50 concrete grade.
- The increase in Split Tensile strength varies from 5% to 36% for M20 concrete grade, 2% to 13% for M30 concrete grade, 2% to 34% for M40 concrete grade and 2% to 26% for M50 concrete grade.
- The cost will be increased for 10% replacement and varies from 11% to 13% for all concrete grades. This increase in cost is negligible as compared to the enhancement in various strengths. Hence Nano-Metakaolin shall be opted in order to replace the cement effectively.

IV. REFERENCE

1. Dr. Tayyeb Akram, Shazim Ali Memon and Muhammad Iqbal," Utilization of Bagasse Ash as Partial Replacement of Cement", Advances in Cement Based Materials and Applications in Civil Infrastructure ACBM-ACI, At Pakistan, Vol.1, 2007.
2. Erhan Guneyisi, Mehmet Gesoglu," Properties of self-compacting mortars with binary and ternary cementitious blends of fly ash and metakaolin", Materials and Structures, Vol. 41, pp. no. 1519-1531,2008.
3. Chayanee Tippayasam1, Sansanee Boonsalee, Suvimol Sajjavanich,Chiara Ponzoni4,c, Elie Kamseu and Duangrudee Chaysuwan, "Geopolymer Development by Powders of Metakaolin and Wastes in Thailand", Advances in Science and Technology, Vol. 69, pp. no. 63-68,2010.
4. Sabria Malika Mansour, Mohamed Tahar Abadlia, Karim Bekkour, IbrahimMessaoudene," Improvement of Rheological behaviour of Cement Pastes by Incorporating Metakaolin", European Journal of Scientific Research, Vol.42 ,pp.442-452, 2010.
5. Prashant O Modani, M R Vyawahare," Utilization of Bagasse Ash as a Partial Replacement of Fine Aggregate in Concrete", Procedia Engineering , Vol. 51, pp. no. 25 – 29, 2013.
6. Mrs.U.R.Kawade, Mr.V.R.Rathi, Miss Vaishali D. Girge," Effect of use of Bagasse Ash on Strength of Concrete", International Journal of Innovative Research in Science Engineering and Technology, Vol. 2, pp. no. 2997-3000, 2013.
7. Aiswarya S, Prince Arulraj G, Anand Narendran, "Experimental Investigation On Concrete Containing Nano-Metakaolin", IRACST – Engineering Science and Technology: An International Journal (ESTIJ), Vol.3, pp. no. 180-187, 2013.
8. M. S. Chennakesava Rao, N. V. N. Prabath," Green Concrete using Agro Industrial Waste (Sugarcane Bagasse ASH)", International Journal of Soft Computing and Engineering (IJSCE), Vol. 5 pp. no. 86-92, 2015.
9. Jayminkumar A. Patel, Dr. D. B. Raijiwala, "Experimental Study on Use of Sugar Cane Bagasse Ash in Concrete by Partially Replacement with Cement", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 4, pp. no. 2228-2232, 2015.
10. Anil Ronad, V.B.Karikatti, S.S.Dyavanal," A Study On Mechanical Properties Of Geopolymer Concrete Reinforced With Basalt Fiber", International Journal of Research in Engineering and Technology, Vol. 05, pp. no. 474-478, 2016.
11. Lisha Elson, Dr. Sunilaa George," Performance of Concrete with Metakaolin and Recron Fibre", International Journal of Innovative Science, Engineering & Technology, Vol. 3, pp. no. 311-315, 2016.
12. Yasir Awad Allah Mohamed, Shihab Ali Khalifa, Salah Eldeen Fadoll Hegazi,Hassan Abd Elwahab," Effects of Sugarcane's Bagasse Ash Additive on Portland Cement Properties", International Journal of Sustainable Development Research, Vol. 3, pp. no. 85-89, 2017.
13. Yarra Tirupathi Naidu, V.Raji," Experimental Report on Strength Developed Synthetic Fibre Reinforced Geopolymer Concrete", International Journal of Engineering Research-Online, Vol. 5, pp. no. 131-139, 2017.

14. M Jaya Kumar, S E Kaarthic," Experimental Investigation on Fly Ash and Bagasse Ash Based Geopolymer Concrete", International Journal of Scientific & Engineering Research Vol. 8, pp. no. 54-59, 2017.
15. 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), Vol. 6, pp. no. 58-66, 2017.
16. Jainesh Chouhan, Prof. Pushpendra Kumar Kushwaha, "Feasibility Studies for Development of Cement Free Natural Fiber Reinforced Fly-Ash based Geo-Polymer Concrete", International Journal for Scientific Research & Development, Vol. 5, pp. no. 437-444, 2017.
17. Erhan Guneyisi, Mehmet Gesoglu, Kasım Mermerdas „" Improving strength, drying shrinkage, and pore structure of concrete using metakaolin", Materials and Structures, 2017.
18. Mr. Dilip Srinivas, Madankumar L, Madhusudan R, Dilipkumar N V, Sumantha S," Feasibility Analysis of use of Bagasse Ash for the Production of Geo Polymer Concrete", International Journal of Engineering Research & Technology (IJERT), Vol. 6, pp. no. 264-268, May - 2017
19. Prakul Thakur, Khushpreet Singh, Raju Sharma," An Experimental Study On Geopolymer Concrete With Bagasse Ash And Metakaolin: A Green Concrete", International Journal of Civil Engineering and Technology (IJCIET), Vol. 9, pp. no. 1066–1077, 2018.
20. Vikas Thakur, Jagdish Chand," Study Of Mechanical Properties Of Concrete Using Bagasse Ash Coated Pet Fibres", International Journal of Civil Engineering and Technology (IJCIET), Vol. 9, pp. no. 1215–1224, 2018.
21. Muhd Fadhil Nurruddin, Sani Haruna, Bashar S. Mohammed, Ibrahim Galal Shaaban ," Methods of curing geopolymer concrete: A review", International Journal of Advanced and Applied Sciences, Vol. 5, pp. no. 31-36, 2018.