Scientific Journal of Impact Factor (SJIF): 5.71

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 5, Issue 12, December -2018

A REVIEW PAPER:EVALUATION OF CONCRETE PROPERTIES DUE TO PARTIAL REPLACEMENT OF CEMENT

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Abstract: *Concrete is a group or combination of various material like binding material (cement+ fly ash, bentonite) fine aggregate (sand), coarse aggregate and water. Today development cost is high with utilizing ordinary materials because of inaccessibility of characteristic materials. This issue can be understood by aggregate replacing of cement with various materials which isn't helpful as far as required properties. Because of this impediment of inaccessibility of material which assumes the crucial job of solid we just have the decision of halfway substitution of solid fixings by waste materials. Over 3.3 billion tons of concrete were devoured all-inclusive in 2010 dependent on overview of world coal affiliation and furthermore bond creation produces CO2 into the environment which is unsafe to the nature. In the event that we can halfway supplant the concrete with the material with attractive properties then we can spare normal material and lessen outflow of CO2 into the climate. This modern waste dumping to the closest site which ruins the land and climate and also it additionally influences the feel of the urban condition, so utilization of this waste material in cement is savvy and in addition earth well-disposed approach to discard waste. The essential goal of this examination is to choose the waste material which gives attractive properties with cement. This examination incorporates a past examination done on the mechanical and synthetic properties of concrete created utilizing halfway substitution of cement by waste materials.*

Keywords: *Cement; bentonite; Ground granulated blast-furnace slag; silica fume; steel fibers; recycled waste glass; recycled coarse aggregates.*

I. INTRODUCTION

Concrete assumes the job of a folio, a substance that settles and solidifies and may tie selective materials with it. The word "cement" originates from Roman, UN office used the expression "creation cementitious" to adorn brick work taking elegant solid that contained shake with calcified lime as fastener. Volcanic fiery remains and little grained block additives (surkhi) that were extra to the calcified lime to get a water powered cover later rose as cimentum, cäment, and cement. Cement is broadly utilized by people and it is second biggest material after water utilized by individuals. In view of ongoing review aggregate sum of cement is utilized amid the money related year of 2012 247 MT and it increments up to 550 MT for monetary year 2020.

According to FBR Pakistan, cost of bentonite per ton in Pakistani Rupees (Rs.) is 6000 (~$44.77/ton), whereas costs of cement concerning is Rs. 12000 per ton (~$89.55/ton). Addition of bentonite as partial replacement of cement leads to significant savings. It also fills the principles of property development. These savings can be significantly increased if in hydraulic structures such as dams concrete containing bentonite is used, where thousands of tons of cement are usually used, depending on the length, width and height. Almost 11% of the total price (including construction prices that may not remain constant with the infrastructure system) can be saved by substituting 25% of the cement with bentonite. If we use bentonite in primary school buildings, in villages and cities it can end in a net saving of 5 % of the total building cost. This saving can be hyperbolic significantly by substitution of 40% cement by bentonite, because in traditional brick masonry solely 20 to 30% of ultimate strength of the masonry is really used.

Amid creation of cement and hydration procedure of concrete carbon dioxide is delivered experimental examination it has been demonstrated that 1 ton of clinker creates around 1 Ton of CO2. This C02 creation causes genuine ecological harms, so the way-2 fractional substitution of cement by fitting material. Way-2 is very straightforward in light of bunches of references are accessible and in addition enough proper material is likewise accessible.

For doing this exploration writing overview is required and this paper is based on literature review.

II. LITERATURE REVIEW

Many of researchers have done their research work on concrete. This paper covers some of the research papers based on partial replacement of cement.

A. Junaid Akbar et al. Carried out research work on the effects of bentonite for durability and Compressive strength in concrete. He used bentonite as partial replacement by weight of cement. During his first part of research work he examined the potential use of bentonite for the compressive strength in High Performance concrete (HPC). For this, he

has made an HPC batch of 6000psi. For concrete cylinders ASTM192 was used and for Strength ASTM39 by UTM. In the results, he has seen that 7,14,28,56 and 91 days strength of bentonite samples were 77.03, 69.39, 76.07, 83.31 and 90.03 percent respectively as for control sample. From these results he concluded that to produce durable and reliable concrete Bentonite can be used in structural concrete as a partial replacement, by weight of cement. Bentonite can be utilized in cements where last stages quality is required on the grounds as Bentonite results in poor early stage compressive strength however give great outcomes in later stage. Now in the second part of his research work he tested out the durability of concrete. For this purpose, he used solution containing 50 g/l of Na2SO4 as the batch was introduced to a cycle of wetting and drying in sulfate ironic atmosphere. From result it was clear that concrete containing Bentonite offered great sulfate resistances.

B. Shazim Ali Memon et al. Carried out research work on employment of Pakistani bentonite in concrete as partial replacement of cement. For this purpose, he used the proportion of bentonite (3%, 6%, 9%, 12%, 15%, 18% and 21% by weight of cement) while the amount of cementitious material, water to cementitious material ratio, fine aggregates and coarse aggregate contents were kept constant. For Different tests like X-Ray Diffraction, laser particle size analyzer, consistency test, workability, Density of fresh concrete, strength activity index (SAI), compressive strength and water absorption were determined according to ASTM-C187-98, C109/C, C39/C-03, C624-97.Main aims were to produce low cost concrete by using bentonite that will reduce energy usage and greenhouse gases related to cement production as well as to improve the durability of the concrete. From experimental results he concluded that using bentonite as pozzolan is not only environmentally friendly but also beneficial both technically and financially. The density, workability and water absorption of concrete lowered with the use of bentonite as partial replacement of cement. After 28 days, the Strength activity index of all mixes containing bentonite was higher than control mix. Comparative compressive strength analysis showed that at 28^{th} day and after 56 days of curing, bentonite mixes showed higher strength than control mix. Mixes containing bentonite performed better against acid attack than control mix. Low cost concrete can be produced using bentonite as partial replacement of cement in concrete without compromising on strength parameters.

C. J.Mirza et al. Used Pakistani bentonite(21 °C) which was heated at (150 °C, 250 °C, 500 °C, 750 °C and 950 °C) conditions, and then used in mortar cubes, concrete cylinders and concrete beams as a partial replacement for Ordinary Portland cement (OPC). For this purpose, used bentonite proportions for mortar were 20%, 25%, 30%, 40%, 50% and 100% by mass for compressive strength test. For resistance of sulfate attack the mortar cubes which contained bentonite were immersed in 2% magnesium sulphate (MgSO4) and 5% sodium sulphate (Na2SO4) solutions for desired curing period of 28 days. After that, the percentage of replaced OPC test mortar for masonry bond strength of OPC mortars brick prisms were 20%, 25% and 40% of bentonite. For Concrete cylinders, the percentage of replaced bentonite proportions were 20%, 25%, 30%, 40% and 50% (heated to 150 ^{o}C) by mass. For Concrete beams he used 25% of bentonite by replacement of OPC to determine modulus of rapture or flexural strength of concrete. The tests and experiments conducted were strength activity index (ASTM C618,2008), X-ray diffraction (XRD), compressive strength of OPC and bentonite mortars and concretes (ASTM C109,2007c), water absorption (ASTM C642), resistance to sulfate attack and masonry bond strength tests on mortar specimens, modulus of rapture (ASTM C78-1994). Thus, the results he obtained were that SAI of mortars containing 150 ^{o}C heated bentonite was slightly higher than control mix for 7 and 28 days. For OPC mortars containing 25% and 30% bentonite and heated upto 150 ^{o}C the compressive strength gained was 19.6 MPa and 20.9 MPa respectively. It showed that these mortars can be used as low-cost construction material. Mortar cubes which were soaked in 2% MgSO4 and 5% Na2SO4 solution gained a considerable improvement in sulfate attack resistance due to increased bentonite content. During this research work another thing found was that modulus of concrete containing bentonite is lower than control concrete beams. That was further increased as percent bentonite substitution was increased, as the ductility ratio of bentonite concrete beams were larger than that of control beams. Thus, during earthquakes, it could give good energy dispersion. For the bond strength of OPC mortars in brick masonry which were same as that of mortars having bentonite of 20% and 25% heated to 150 ^{o}C, thus it could be used as low-cost construction materials.

D. Sumitha Y et al. Examined the fresh and hardened state properties of M40 mix concrete by using Bentonite clay, silica fume and Ground-granulated blast furnace slag as partial replacement of cement. He used various percentages of bentonite clay (5%, 10% and 15%) as partial replacement of cement in M40 grade concrete. Then 10% silica fume was used as partial replacement of cement. After that 50% GGBS was used for experimental work. With 10% silica fume different percentages (5%, 10%, and 15%) of bentonite clay were used. At the end with GGBS 50% different percentages (5%, 10% and 15%) of bentonite clay were used as partial replacement of cement. Hardened state properties were conducted by compressive strength, split tensile and flexural strength tests. In the end workability of concrete was decreased by addition of bentonite, which decreased further after the addition of 10% of silica fume that was added to concrete. No effect on workability was found by the addition of 50% GGBS. In case of 10% silica fume with various percentages of silica fume, there was no effect on compressive strength and flexural but spilt tensile strength was higher than control mix.

E. Amritha E.K et al. Has evaluated the properties of bentonite concrete with and without steel fiber. She made mix design of M30 grade concrete and carried out various tests like Workability of concrete mix, compressive strength, split tensile strength and flexural strength. He has used various percentages of bentonite 5%, 10%, 15%, 20% and 25% as replacement of cement by weight. Hooked end steel fibers content was also introduced with different percentages of bentonite concrete varied as 0.5%, 1% and 1.5% of the total concrete weight. Specimens were cured for 28 days. Compression strength for 7, 28, and 56 days of bentonite concrete and 7, 28 days of steel fiber reinforced concrete. Finally, the results concluded were compressive strength was increased as the curing period increased. After 56 days strength was higher than control mix this was due to the pozzolanic behavior which generally increases during time. With 15% bentonite and steel fibers used the strength also increased in 7 to 28 days. Split tensile strength was increased slightly as compared to the control mix. When steel fiber was introduced with 15% of bentonite it increased the tensile strength as well. Flexural strength of steel fiber with 15% bentonite was also increased than the control mix.

F. Abhinav Kumar et al. Has investigated strength properties of concrete using bentonite as partial replacement of cement and recycled waste glass as partial replacement of fine aggregates. Generally, two types of mixes were made. First normally controlled mix and other by using different percentages (5%, 10% and 15%) of bentonite as partial replacement of cement and 0%, 10%, 15% and 20% crushed glass as partial replacement of fine aggregates. All the tests were carried like compression strength test and flexural strength test. Workability found to be decreased as replacement of bentonite as partial replacement of cement and recycled waste glass as fine aggregates in concrete mix. By the addition of 15% waste glass with 0% cement compressive strength was 1.6% higher than control mix. With partial replacement of bentonite by 10% and fine aggregates with 0% increased compressive strength was 0.27% as that of controlled mix. Finally, he found the maximum compressive strength when partial replacement of bentonite was 10% and 10% for waste glass as fine aggregates was 20.33 N/mm2 for 7 days and 42.44 N/mm2 for 28 days.

G. S.Afzal et al. Assessed the early-age autogenously shrinkage strains in concrete using bentonite clay as internal curing technique. In which he addressed the controlling techniques of autogenous deformation that occurs in high performance concrete. Cement causes the autogenous shrinkage so he replaced cement with bentonite as partial replacement. The amounts or percentages he used of bentonite were 5%, 10%, 15% and 20% by weight. The specimens were sealed to monitor relative humidity. He has done different types of experiments like Differential Thermal Analysis (DTA) and Thermo-Gravimetric Analysis (TGA), Scanning Electron Microscope (SEM)/ Energy Dispersive X-Ray tests (ED-XRF). He concluded that use of bentonite reduced linear shrinkage of high strength concrete. In the presence of bentonite clay the relative humidity was not lowered than 80%. He observed that bentonite in mortars possessed higher thermal stability. Autogenous shrinkage was controlled with the usage of 10% bentonite clay. Bentonite clay in concrete could be exposed to fire/heat due to its better thermal stability at higher temperatures.

H. M. Chandrakanth et al. Has experimental studied on concrete with bentonite as mineral admixture. He used different percentages of mineral admixture bentonite clay 0%, 5%, 10%, 15% and 20% as partial replacement of cement. He has designed M20 grade concrete. He observed Compressive strength, split tensile strength and flexural strength for the required purpose. He has resulted that workability decreased as bentonite clay is increased from 0 to 20% in concrete. By the addition 5% bentonite clay, concrete achieved higher compressive strength than other percentages. He showed that when 5% bentonite clay was added to concrete it gained higher compressive strength than different percentages. He also noticed that when 5% bentonite clay was added to concrete, higher flexural strength and higher split tensile was achieved as compared to other percentages.

I. B.Parveen Kumar et al. [9]has worked to find out the collectively effectiveness of bentonite and fly ash on strength of concrete. Cement was replaced with 5%, 7.5%, 10%, 12.5% and 15% of calcium bentonite and with 5%, 7.5%, 10%, 12.5%, 15% fly ash respectively. He has investigated the potential use of calcium bentonite and fly ash with replacement of cement in concrete. He casted M30 design mix and studied compressive, split tensile strength for 3,7 and 28 days compared with conventional concrete. He concluded that compressive strength increased by the addition of calcium bentonite and fly ash at the initial stages. He noticed that optimum strength was obtained at level of 15% at the replacement of OPC. Compressive strength improved at content level of 15% for mix design at 3 and 28 days. Split tensile strength was also increased at 15% of calcium bentonite and fly ash for 3, 7 and 28 days.

J. Shipla P V et al. Has done experimental work on physical and strength properties of concrete by partially replacing cement with calcium bentonite and fine aggregates with steel slag. Concrete specimens were prepared with different percentages of calcium bentonite (05 to 20%) as partially replaced with cement and fine aggregates with 40% of steel slag. Different tests were carried out like strength properties (compressive strength, tensile strength, flexural strength) and non-destructive test (Ultra Sonic Pulse Velocity) and Durability test (Acid attack). All the tests were carried out. The results showed that higher compressive strength (23.29%) was achieved with 10% replacement of cement with CB and 40% replacement of sand with steel slag than plain concrete. Strength reduction of concrete with 10% CB and 40% SS showed 6.43% and 1.2% on 7^{th} and 28^{th} day respectively compared to 0% CB and 40% SS. With 15% CB and

40% SS of concrete showed 1.89% strength reduction on 28th day as compared with 0% CB and 40% SS. Strength reduction was also decreased 1% with 10% CB in the mix than 0% and 40% SS of the mix. Concrete with 10% CB and 40%SS showed 17.96% lesser weight loss in acid attack test than the plain concrete and with 0% and 40% SS of concrete 10.45% showed lesser weight loss. With calcium bentonite and steel slag concrete has good quality as showed by UPV test. To solve the crack problems in concrete for replacement of 10% the degree of damage was 26.17%.

K. W-H.Haung et al. Has investigated the properties of cement-fly ash grout admixed with bentonite, silica fume, or organic fiber. He has replaced 30% fly ash by mass of cement in grout. He has individually mixed three additives bentonite, silica fume and polypropylene fiber for the improvement of grouts properties. He determined the bleeding, flowability and setting time of freshly mixed grouts. After that determined pore size distribution, unconfined compressive strength and water permeability of grouts for 120 days of curing. Grouts mixed ratios were (water/cement + fly ash) 0.5, 0.7, 0.9 and 1.1. The initial setting time of mixes (0.5 and 1.1) were from 5 to 9 hours and final setting time ranged from 7 to 11 hours respectively. The compressive strength was increased by the addition of 5% silica fume. Grout mix of silica fume with water/solid ratio of 0.5 has higher compressive strength than control grout in early 7 days. By the usage of 30% class F fly ash in mixes produced economical grouts with high compressive strength. Bleeding can be reduced by addition of bentonite. But due to porosity, bentonite should be 1% used as admixture with water/solid ratio below 0.7. With the addition of silica fume in grouts showed reduced bleeding, improved flowability, higher strength and low permeability as compared to non-silica fume grouts.

L. ShwetaPuri et al. Has reported the findings of experimental study to investigate the structural behavior of concrete with different replacement level of ordinary Portland cement by bentonite and natural coarse aggregate by reused coarse aggregates. The structural properties like workability, compressive strength of M30 grade mix were studied. Various amount of replacement of cement 5%, 10%, 15% with bentonite and natural coarse aggregates with 15%, 30% and 45% with recycled coarse aggregates were done. The results showed that with 10% replacement by bentonite and 30% by recycled coarse aggregates in concrete mix the compressive strength was increased as compared to controlled mix, on further replacement with bentonite at 15% and recycled coarse aggregates at 45% the compressive strength decreases. The Maximum Compressive strength was found at replaced 10% of bentonite with recycled coarse aggregates at 30% was 26.78 MPa for 7 days, 38.93 MPa for 28 days and 42.01 MPa for 56 days. The Split tensile strength increases by the replacement at 10% and 30% as compared with the control mix. Also, for Flexural strength, same results as earlier described were found by 10% bentonite and 30% recycled coarse aggregates to that of control mix. From SEM images the partially replaced concrete containing 10% bentonite and 30% of recycled aggregates a very dense and continuous C-S-H gel formation resulted in improved strength.

III. CONCLUSION

Today we tend to live in the globe jam-packed with directed growth and evangelistic for still additional contentment and simplicity. This leads to innovation and revolutions in each and every field, but it also has negative effects on surroundings as resources get used up and polluted to totally different natural sources measure occurred. So, after conducting all these research and experimental work we tend to conclude that if, we will cut back or recycle some material in field of concrete production that is high now-a-days then it for the most part impact surroundings and results in pollution free. Thus, as complete from on top of literature review, we will tend to research additional in direction of partly replacement sand, cement and aggregate up to most optimum level. We will tend to reuse or introduce stuff as its choice. After studying all these experimental work papers it's clear that positive and favorable results will be obtained if additional analysis work and study is dispensed in this field and by using regionally raw materials bentonite and other wastes like glass waste, marble dust powder, GGBS, Fly ash, Silica fume etc. as partial replacement in place of concrete ingredients, it may prove beneficial economically than ancient concrete and question of damping of such waste created by totally different industries will also be resolved. This waste additionally produces air and land pollution by damping therefore by the addition or usage of these materials in concrete we will save our atmosphere and land. Main goal is to manufacture economical and environment-friendly concrete with all desired characteristics and strength that one obtains by regular concrete ingredients.

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