International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 09 | Sep 2021 www.irjet.net p-ISSN: 2395-0072

A STUDY OF STRENGTH CHARACTERISTICS OF FLYASH WITH COLD RESIN POLYMER AND COMPARISION OF FLYASH BRICKS WITH NOMINAL BRICKS

M. VISHNU PRIYA[1], CHUKKALURU RUKMUNNISA SULTANA[2], P. NAVEEN KUMAR[3]

ABSTRACT: Fly debris a waste produced by warm plants is a major climate issue. Fly debris might be a combined buildup of mud minerals present in coal. The high temperature made when coal consumed in nuclear energy stations changes the earth minerals into coal powder into a different intertwined fine particles of principally aluminum silicate creation The usage of fly debris utilizes modern waste as well as it upgrades more strength and sturdiness attributes . Thus fly debris ought to be treated as an asset material than modern waste. The current examination work is completed to foster another efficient way for creating fly debris composite blocks which will have higher compressive strength. Here the fly-debris is blended in with Cold setting sap at different extents and water treated at various temperatures to search out a response to the block business. The compressive strength, Hardness, water retention, Density and warm conductivity of the fly debris sap powder blocks got under ideal test conditions are 11.24 MPa, 47.37HV, 19.09% 1.68 g/cm3, and 0.055 W/mK separately.

The sliding wear conduct is additionally researched. The design property connections of these composites are concentrated on utilizing X-beam diffraction, FTIR investigation and examining electron microscopy. This undertaking likewise bargains about the strength qualities of fly debris blocks when contrasted with ostensible blocks and its uses for development. In the current review we are making three kinds of debris blocks in the distinctive level of concrete, for example, 3%, 5% and without concrete. Furthermore, subsequent to making these blocks different tests were performed, for example, compressive strength test, water retention test, blossoming, weight test, flexural strength, restricting strength underlying test and cost investigation and these outcomes were contrasted and regular blocks results. In the review it is tracked down that the compressive strength of fly debris block containing 5% concrete is 15.21 N/mm2 which is more than that of class I regular blocks by 63% around. Water Absorption of debris block added 5% concrete is 48% not exactly the ordinary block and the Effloresce esteem is half of the customary block. The flexural strength of fly debris block with 55% of fly debris is 63% more than that of ordinary block and furthermore the limiting strength is almost half more than that of customary block. The Effort has been made by making various extents of fixings having creation of fly debris, concrete, lime, gypsum and sand.

INTRODUCTION

The entire headway of a characteristic country depends upon the social affair worth of power and accordingly its use as energy. Our country, India needs colossal power resources for satisfy the suspicion for its occupant similarly as it's hope to be a made country by 2020. Oil based commodity has a huge effect in satisfying the requirement for impact age .Coal is seen as one of the world's generally extreme and by and large appropriated non-sustainable power source. Inside the world, India overpowers the third circumstance in the greatest production of coal and has the fourth greatest coal saves approx. (197 Billion Tons). It has been evaluated that 75% of India's full scale presented power is warm of which the part of coal is about 90%. Nearly around 600 Million tons of coal is made overall reliably, with Fly debris age is around 500 MT at (60-78 %) of whole debris conveyed .In India, the current time of FA is practically 180 MT/year and is conceivable to degree around 320 MT/year by 2017 and 1000MT/year by 2032..No vulnerability Indian coal has high debris content and low warmth regard. To satisfy the growing testing demands, many coal based thermal power plants have are constructed. In view of which enormous proportion of combusted development as Fly debris (80 %), and Bottom debris (20%) has been conveyed. The finely dispersed particle from the replicated coal is delivered out through the line gases which are withdrawn exactly through electrostatic precipitators and separators which are then assembled in the field of compartments. The speed of production of FA is high and it keeps growing an apparently interminable measure of an enormous number of years. The yearly formation of FA in China, India and US is approximated around 275 million metric tons. Regardless, not actually half of this is as often as possible in various districts. The best test before the getting ready and collecting undertakings is the expulsion of the excess incidental effects. The dangerous impact on the environment proposes the prerequisite for appropriate dumping of fly debris and legitimizes full use of FA whenever the situation allows. Incidental effects that are overall harmful, ignitable, ruinous or responsive have obstructing environment results. This huge issue requires a fruitful, money related and eco-obliging strategy to deal with the evacuation of the waiting industry Genuine side-effects.

The issue with safe expulsion of debris without impacting the environment, disturbing natural harmony and the tremendous accumulating district required are critical issues and troubles for secured and achievable headway of the country. Accordingly indispensable measures are being made continually by making extreme rules by the public power to totally utilize the debris.

Trial Work and Methodology

FLYASH WITH COLD RESIN

Fly debris has been used in various structure and present day applications for gigantic extension. Hereafter Consumption of this colossal proportion of fly debris essentially reduces the difficulties met by coal based TPPs for its dumping. Examination on the introduction of FA at various states is fundamentally required before its utilization for the gathering of square. To understand the properties components of FA, tests can't be performed on field space. There is no any substitute decision except for assessment lab test to review its importance. The assessment drove in lab gives a calculative method to manage direct a couple of limits that run over during preparing. Brief portrayal of such material used, model arranging and its depiction through SEM, XRD, and FTIR, Mechanical and surface properties like Compressive strength, Hardness and wear deterrent, Thermal conductivity assessment and others are spread out in present region.

Materials Used

1. Fly Ash: The Fly debris utilized in this endeavor was assembled from electrostatic precipitators of the prisoner power plant (CPP-II) in dry condition. The fine powders were oven dried at 110°C-160°C and kept in fixed shut container for soon.

2. Cold setting Resin and Binder: The powder and hardener utilized in the current assessment was given by Geosyn private Ltd. Kolkata.

Exploratory Methods

Game plan of Samples: The models were prepared by Powder metallurgy course.

Mixing: Three unmistakable weight paces of Fly debris and tar powder with (75%, 80% and 85%) and (25%, 20% and 15%) were taken independently. These constructions were mixed totally by a mechanical vibrator (Abrasion Tester Model PEI-300), to get a homogenous blend. Different manifestations of Fly debris close by tar powder are kept in three particular little size bottles. Around 6-10 little gets ready balls are kept inside for authentic mixing. Mixing was managed job the vibrator shows 1000 unrests which almost required five hours.

Compaction

The compaction tests were executed to make tube formed FA compacts. Round and empty die and punch having 15 mm width made of tempered steel are used to make barrel formed Fly debris compacts .Mixture of around 5 gm. was taken for each association. Then the punch and kick the can was cleaned with cotton followed by (CH3)2CO so all the buildup is wiped out from inside surface of the fail horrendously and outside surface of the punch. Then lubing was done to avoid remaining. The mix organized before was poured inside carefully. During the squeezing slight shaking was done to oblige the at most possible proportion of material. Finally the whole structure was presented to water controlled seal valve made tight, mounting was done coaxially. Breaking point of 6tons of weight was applied on it relaxed. At the point when the best weight was cultivated, the contraption was controlled off. The whole structure was free for 5 minutes which then followed by unloading. Decreased was jump started out from the pass on inside a comparative bearing as the strain and was kept in normal air for 1 day. The setting liquid (hardener) was applied on the external layer of the compacted tests with the assistance of a dropper, to set the as of late made compacts. The proportion of Hardener used was 1/6th or 1/fourth of the blend. Thusly as such twelve models for each union were made. All of the models was dried in open environment for 2 days. Water treatment Three models from each creation were calmed in water at 110 ℃ - 180 °c for 48 hours.

FLY ASH BRICKS

The Experimental work has been finished on gathering of Fly debris obstructs by updating the Mechanical strength of Required size 230X110X70mm as indicated by the close by interest and as per the IS 12894-2002 for the square estimations. The Test methods used for analyzing the testing of the square is ASTM C67.

1) Material used in Manufacturing:

Fly Ash (Class F) the erupting of harder, more settled anthracite and bituminous coal generally speaking gives Class F Fly debris .Class F Fly debris be pozzolanic in ordinary world, contain under 7% lime. Reflecting pozzolanic properties, the brilliant silica and alumina of Class F fly debris needs a setting up instrument, generally Portland cement, quicklime or hydrated lime when mixed in with water to act likewise which produces cementations compounds. On other hand, adding substance reagent basically sodium silicate to Class F debris can achieves the improvement aGeo polymer

Figure 4.2.1 class F Fly Ash

Gypsum:
Gypsum is an extremely delicate sulfate mineral made out of calcium sulfate get dried out, with the synthetic recipe CaSO4 2H2O. It is found in alabaster, a decorative stone

used in Ancient Egypt. It is the second mildest mineral on the Mohr's size of mineral hardness. It structures as a vanish mineral and as a hydration result of anhydrite. Gypsum is a typical mineral; with thick and broad dissipate beds in relationship with sedimentary rocks. Gypsum is saved from lake and ocean water, just as in underground aquifers, from volcanic fumes, and sulfate arrangements in veins. Aqueous anhydrite in veins is normally hydrated to gypsum by groundwater in close surface openness.

Figure 4.2.2.Gypsum

Cement: Cement is for the most part allude as a fastener, material that solidifies independently, and can be use to tie new materials. Interaction system has answer of value muck lime every now and again is unimaginable. According to the IS code 8112-1989, OPC-43 Grade detail is utilized and buy from Ultra-tech Cement providers.

Figure 4.2.3.Cement

To Find Out the Cement Quality, the Following Physical Properties of Cement Are Tested
1. Fineness of Cement
2. Consistency of Cement
3 .Initial and final setting time.
4. Soundness of Cement

Lime: Lime is an adaptable material in building development projects. Lime can be utilized to set up the building site by balancing out the dirt or remediating Brownfield destinations. Lime can be utilized in the development of stone work frameworks as a part of mortar or the workmanship unit. In the solidified state, lime items respond with carbon dioxide to recover calcium carbonate or limestone. Starting strength is needed in many applications; added substances like gypsum, concrete or pozzolan are blended in with lime in development applications.

Figure 4.2.4.Lime

Water: Water is a pivotal element of block as it really utilized for assembling of block. Subsequently it assists with restricting every one of the crude materials for giving legitimate blend. Water utilized for assembling of block ought to be liberated from debasements. Brilliant water is needed for the planning of different blend extents. The pH of water ought to be over the worth of 7 and liberated from natural and lewd matter fulfill the standard water quality for development IS 30.
2).Shade of the block: Grey.
3).Size of the block: 230X110X70mm.

Mix proportions

In the current examination, fly ash block is created with various blend organization

A. Lime (20%), Cement (5%), Sand (20%), Gypsum (5%) and Fly ash (half).
B. Lime (20%), Cement (3%), Sand (20%), Gypsum (5%) and Fly ash (52%).
C. Lime (20%), Cement (0%) Sand (20%), Gypsum (5%) and Fly ash (55%).

5).Making the Wooden Blocks for Pouring of the blend to get the obtain measurement according to the neighborhood interest.

Figure 4.3.1.Wooden Blocks

Figure 4.3.2.Sun Dried Samples

6).The examples were air dried for 2 days inside the form pit and afterward the blocks were taken out and

presented to daylight for sun dried for 3-4 days.

7). Water Curing of blocks was led by requiring the quantity of days 14 and 28 days, in the wake of relieving the blocks were sun dried for 5 days and taken for the testing.

Process Involved

Stage 1: Procurement of Raw Material:

Stage 2: Storage of Raw Material The limit of the material is huge for longer availability and use reason. If not, the wastage of material will be there and likely will not be used for extra usage.

Stage 3: Batches Mixing of Raw Material: When rough materials are mixed to major aggregate which is known for mixing the trimmings. At the point when the fuse clearly gets all out then further fundamental work be the Compacting the blend by the usage of instrument used in light of a legitimate concern for getting the astounding design with unparalleled building up also. Homogenized mortar of roller mix ought to be conceivable by vibro press or water fueled tension. As both mixing and compacting measure get completed reestablished the very immense factor to be done if the square not assuaged sensibly subsequently the reasonable supporting will not be cultivated and achieves crumbling of last introduction of the square by which it can't used for any sort of work which will be available. Sensible diminishing is incredibly basic for the squares to recover its fortitude. It should be diminished for a scope of 14 days. As it is ready from the waste material so it gets again the cementations property once sensible diminishing get wrapped up. Following the reestablishing practice blocks are made to expected for use.

Step.4 Drying and Curing of the Fly Ash Brick: Subsequent to making of square, it was put something aside for sun drying for 24hrs then square is dispensed with and put something aside for extra drying cooperation. Reestablishing infers watering the squares. This cycle is done after 48 hrs of gathering of squares. Squares should be wraps up through the going with appraisal s following 7, 14 and 28 days from reestablishing.

Weight Of Dry Block Weight of the square needs to taken to work out the dampness content. According to the development standards the block should show the 10% dampness content of its weight. On the off chance that the dampness content fulfills this test it will goes through the following test.

Size of Block: Sizes of block were checked for the droop test and to ascertain the compressive strength of block. Additionally through this test the consistency of the block was checked in six examples.

Soundness Test: This sound is done to discover that a reasonable ringing sound is delivered or not when the two blocks are hit with one another without breaking any of the two blocks. In the event that the blocks are not broken in the wake of hitting with one another and an unmistakable ringing sound is delivered then it implies the blocks are adequately solid.

FIGURE. 4.4. SOUNDNESS TEST

EXPERIMENTAL PROCEDURE

Determination of Mechanical Properties of Fly ash with Cold Resin

Hardness: Micro Indentation Hardness Tester (LECO, LM 248AT) as displayed in Figure 5.1.1., was utilized to discover the hardness upsides of the relative multitude of dry and wet examples utilizing 20 gf Load for an abide season of 15 seconds. Something like eight estimations was taken at various situations for each example to get steady outcomes.

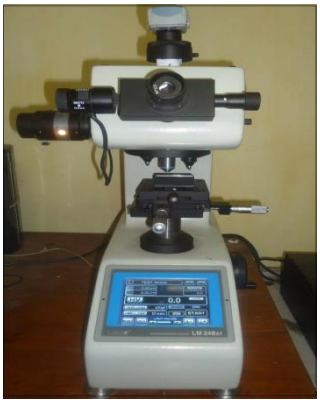

Fig.5.1.1. - Leco, LM 248AT Micro indentation Hardness Tester

Compressive Strength

To quantify the compressive strength of dry and wet examples INSTRON 1196. Preceding test, check length and measure breadth of the dry and wet examples were estimated exclusively by the guide of Vernier caliper. The tests were completed at room temperature (300 K)

with a standard crosshead speed of 1mm/min and the full scale range heap of 50 kN. This PC incorporated machine gives the Load versus relocation flags straightforwardly when the examples were exposed to tests.

Wear opposition and Friction

In this examination modernized Ball on Plate Wear Tester (TR-208-M1) as displayed in Figure - 3.2 was made to assess the wear execution and sliding contact opposition of the Fly ash compacts. The analysis was completed with the assistance of 4 mm precious stone indenter keeping the distinctive track span of 4 and 8 mm separately. Before wear, steady typical heap of 10 and 20N was applied. The indenter pivots on fly ash conservative with a standard speed of 20 rpm for various time-frames of 600s. Toward the finish of each test, misfortune in weight of the examples was noted. Results acquired are communicated as far as wear profundity, and grinding co-effective.

Thermal Conductivity :To quantify the warm conductivity of ash and tar powder blend, KD2 Pro analyzer as displayed in figure 5.1.3 was utilized and it observes ASTM Standard D5334-08 .It contains a handheld regulator and a different sensors that administrator can implant into practically any material. Single test of 6cm long and 0.127 mm breadth was embedded in a little plastic container loaded up with FA and pitch powder to discover the conductivity esteem. At least ten upsides of every arrangement were recorded to get the suitable outcome. KD2 Pro uses the transient line heat source instrument to assess the conductivity and diffusivity of the given blend. A prohibitive estimation fits time and temperature data with outstanding capacities through nonlinear strategy for least squares
procedure.

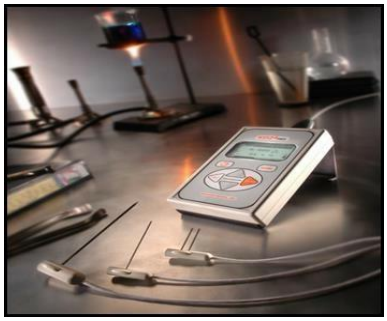

Fig.5.1.3 KD2 Pro Analyzer

RESULTSFOR FLYASH BRICK

Fineness of Cement

S. No.	Weight of sample taken (W) (In g.)	Weight of residue (R) (in g.)	% of residue	Average % of residue
1.	100	9	9	7.6
2.	100	8	8	
3.	100	6	6	

TABLE 6.6.FINENESS OF CEMENT

Percentage residue of cement sample by dry sieving is 7.6 percentages.

The given sample of cement contains less than 10% by weight of material coarser than 90 micron sieve. Therefore it satisfies the criterion as specified by IS code.

CONSISTENCY OF CEMENT

Sl. No.	Percentage	Initial Reading	Final Reading	Height not penetrated (in mm)
1	25	50	23	27
2	26	50	20	30
3	27	50	18	32
4	28	50	12	38
5	29	50	0	50

TABLE 6.7.CONSISTENCY OF CEMENT

The given sample has the consistency of 29%.Hence It Is Suitable as per IS Codes.

Setting Time Test:

The initial setting time is 30min.
The final setting time is 10h.

Soundness of Cement

Distance between pointers before boiling (D_1) in mm	29
Distance between pointers after boiling (D_2) in mm	13
Expansion of the cement = E_1 = (D_2. D_1) in mm	15
Average expansion of the cement in mm	2

Table 6.8.Soundness of Cement

Compressive Strength Test:

Type of specimen	Mean load at failure	Average compressive Strength (N/mm2)	% Increase Average compressive strength
Conventional brick	20.83	9.285	-
Fly ash brick (0%)	28.18	12.59	35%
Fly ash brick (3%)	31.47	14.1	51.8%
Fly ash brick (5%)	34.22	15.21	63.3%

As per the Table 6.8. And fig 6.13. The compressive strength of conventional brick is found to be 9.283 N/mm^2, for fly ash brick without cement is found to be 12.59 N/mm^2, fly ash brick with 3% cement is found to be 14.1 N/mm^2 and fly ash brick with 5% cement is found to be 15.2 N/mm^2.

Table 6.9.Compressive Strength Test

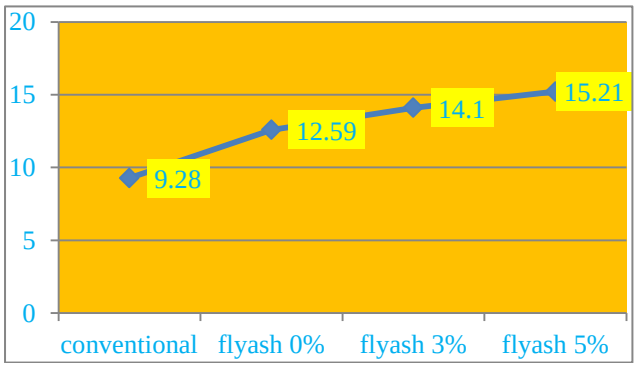

Figure 6.13.Compressive Strength Results

Water Absorption Test:

As per the Table 6.9 & Fig 6.14 the average absorbed moister content of conventional brick is found to be 10.45% , for fly ash brick without cement is found to be 7.63%, fly ash brick with 3% cement is found to be 6.06% and fly ash brick with 5% cement is found to be 5.41%.

Type Of Specimen	Mean Dry Weight	Mean Moist Weight	Avg Water Absorption	%decrease in water absorption
Conventional brick	3.12	3.45	10.45	-
Fly ash brick (0%)	2.57	2.77	7.63	27%
Fly ash brick (3%)	2.66	2.85	6.06	47%
Fly ash brick (5%)	2.83	2.99	5.41	48%

Table 6.10. Water Absorption Test Results

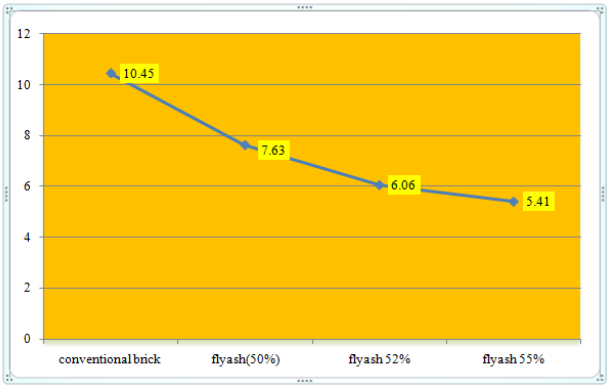

Figure 6.14.Water Absorption Results

Efflorescence Test:

The Efflorescence test of conventional brick, fly ash brick without cement, fly ash brick with 3% cement & fly ash brick with 5% cement and the result were compared in which grey or white deposits are slight to moderate in conventional brick, less than 10% on area in fly ash brick without cement, less than 8% on surface area in fly ash brick with 3% cement and less than 7% on surface area in fly ash brick with 5% cement.

Type of specimen	Water Effloresce %	% Decrease in Efflorescence
Conventional brick	15%	-
Fly ash brick (0%)	10%	5%
Fly ash brick (3%)	8%	7%
Fly ash brick (5%)	7%	8%

Table 6.11.Efflorescence Test Results

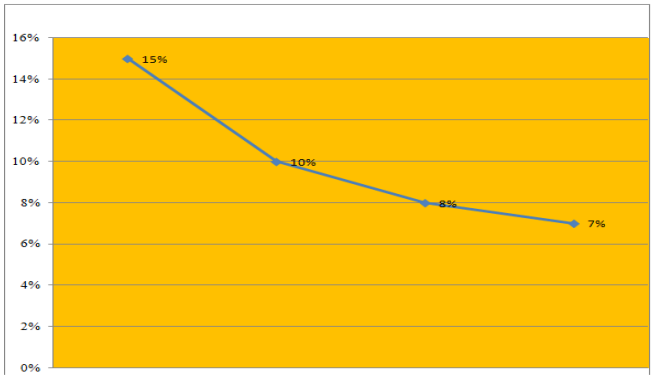

Figure 6.15.Effloroscence Test Results

Flexural Strength of Specimen

Types OF Brick	Flexural Strength of Brick on curing for 14days(N/mm^2)	Flexural Strength of Brick on curing for 28days(N/mm^2)
C Conventional 100%	1.904	2.442
F FA 50% + GY 5%	2.318	2.760
F FA 52% + GY 5%	2.343	2.794
F FA 55% + GY 5%	2.374	3.060

TABLE 6.12.Flexural Strength results

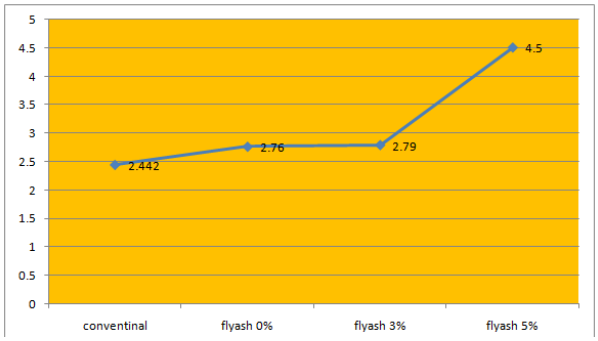

Figure 6.16. Flexural Strength of Brick

Binding Strength of Specimen

Types OF Bricks	Binding Strength of the bricks on curing for 28 days(KN)
Conventional Bricks	4.760
FA 50% + GY 5%	5.430
FA52 % + GY 5%	7.950
FA 55% + GY 5%	8.430

Table 6.13.Binding Strength of Specimen

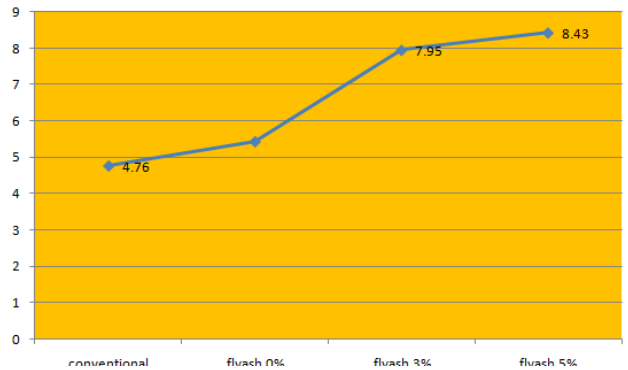

Figure 6.17.Binding Strength Results

COST OPTIMIZATION

The cost of materials required for 1m3 of brick using work using conventional bricks is considered for comparison of cost of brick with fly ash bricks as the cost of labor and other miscellaneous expenses are the same. The cost of bricks decreases with the utilization fly ash bricks as the volume of fly ash bricks are 2.5% more than that conventional bricks. Fly ash brick masonry in 1:7 cement mortars can replace conventional brick masonry in1:6 cement mortar and ash brick masonry in 1:5 can replace conventional brick masonry in 1:4 cement mortars thereby saving the consumption of cement and brick.

Type of Brick	Type of Cement mortar of Cement mortar	No. of bricks required for cum of	Qty. of cement required for cum of brick work in (kg)	Cost of brick Forcum of brick work (Rs.)	Cost of cement (Rs.)	Total cost (Rs.)	% age saving
Conventional brick masonry	1:04	500	96	2750	596	3346	
Fly ash Brick (0%) masonry	1:05	487	80	1461	496	1957	41.51
Fly ash Brick (3%) masonry	1:05	487	80	1694.7	496	2190.7	34.52
Fly ash Brick (5%) masonry	1:05	487	80	1860.3	496	2356.3	29.58

Table 7.1. Cost Optimization

CONCLUSIONS

In view of present assessment following end can be drawn:

1) Water treated compacts shows useful results on the hardness regards. Out of each dry more modest, FA with 85 wt. % has a predominant hardness worth of 44.08 HV. Much improvement in the hardness regard is cultivated when the composites are treated in water at 1100-1800C and this value rose to 47.37 HV. This expansion in hardness regard is a result of the presence of CSH and CASH inside the sight o f sogginess as obtained from XRD assessment.
2) With an augmentation in polymer extension (sap powder), the compressive strength of dry compacts decreases to a lower worth of 6.5 MPa. Blend of 75 wt. % FA shows lower regard. No basic reduction in Compressive strength is cultivated inside wet limited.
3) Wear examination of different composites can without a doubt be connected with the hardness regard. In both the dry and wet state, FA with 85 wt. % union shows favored security from wear over other two designs. Wear deterrent augmentations with extension in FA content. The co useful of scouring lessens with development in FA rate and seeks after a straight course for the term of the difficult period.

Added things. Of course, the abatement in earth use for the formation of conventional mud squares will help with guaranteeing the environment.
On Comparing Fly debris Bricks with Conventional Bricks, the Conclusions Are As Follows

- The compressive strength of fly debris block with 0% cement is 27% more than that of class I standard square yet when 3% cement is incorporated the fly debris block then compressive strength is 51.8% very than that of class I normal square and moreover when 5% cement included fly debris block then the

compressive strength is more than 63%.

- Water maintenance of fly debris block with 0% cement is 27% less when appeared differently in relation to that of customary squares and 42% less when diverged from standard square when 3% cement is added and 48% less when stood out from conventional square when 5% cement is added.
- The Efflorescence preliminary of standard square, fly debris block without concrete, fly debris block with 3% concrete and fly debris block with 5% concrete and the result were examined in which dull or white stores are slight to coordinate in common square, under 10% on surface district in fly debris block without concrete, under 8% on surface area in fly debris block with 3% concrete and under 7% on locale in fly debris block with 5% cement.
- The flexural strength of fly debris block with half of fly debris is 31% more than that of standard square ,for 52% fly debris flexural strength is 35% more than that of standard square, when 55% of fly debris is add flexural strength is 63% more than that of ordinary; block.
- The confining strength of fly debris with half of fly debris is 5.4KN and when 52% of fly trash is added strength is 7.395KN, when 55% of fly debris is added flexural strength is 8.43KN which is more than that of standard square i.e., 4.76KN.
- The cost of materials required for 1m3 of normal square is more than of fly debris blocks. So fly debris blocks are incredibly reasonable as they reduce measure of cement, measure of squares, and Cost of square all around saving the errand cost.
- Fly-Ash blocks are eco neighborly as it guarantees environment anyway protection of top soil and utilization of symptoms of coal or lignite used in thermal power plants. It is on numerous occasions more grounded than the traditional burned-through mud blocks. It accepts a critical part in the decrease of carbon dioxide a dangerous green house gas mass release of which is finding a way ways to remove the world's current circumstance from harmony.
- Being lighter in weight when appeared differently in relation to common squares, dead weight on the plan is diminished.

REFERENCES

1. Joshi RC, Lothia RP. Fly ash in concrete: production, properties and uses. In: Advances in concrete technology, vol. 2. Gordon and Breach Science Publishers; 1999.
2. Ahmaruzzaman M. A review on the utilization of fly ash. Prog Energy Combust 2010; 36:327–63.
3. Rai A.K., Paul B. and Singh G., A study on physico chemical properties of overburden dump materials from selected coal mining areas of Jharia coalfields, Jharkhand, India, Int. Journal of Environmental Sc., 1 (2011): pp. 1350-1360.
4. Sahay A.N., R&D initiatives in utilization of fly ash in coal sector, in: Proc. of Fly ash opportunity for Mining Sector, New Delhi, India, 2010, pp. 26-35.
5. Das S.K. and Yudhbir, Geotechnical properties of low calcium and high calcium fly ash, Journal of Geotechnical and Geological Engineering, 24 (2006): pp. 249-263.
6. Sinsiri T, Chindaprasirt P, Jaturapitakkul Ch. Influence of fly ash fineness and shape on the porosity and permeability of blended cement pastes. Int J Miner Metal Mat 2010; 17:683-690.

AUTHORS

1. **M. VISHNU PRIYA,**
M.Tech Scholar
Dept. of Civil Engineering,
SSSISE, VADIYAMPET
Anantapur.

2. **CHUKKALURU RUKMUNNISA SULTANA,**
Assistant Professor,
Dept. of Civil Engineering,
SSSISE, VADIYAMPET
Anantapur.

3. **P. NAVEEN KUMAR,**
Assistant Professor,
Dept. of Civil Engineering,
SSSISE, VADIYAMPET
Anantapur.