

Enhancement of solidarity properties of reused concrete aggregates utilizing admixtures

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Abstract

The aim of this study is to build the settled concrete properties made up of reused concrete blend, by utilizing kind of normally utilized and basically possible admixtures. Utilizing various proportions of reused concrete blend includes an unsafe effect for the properties of solidified cement. Consequently, customary admixture is utilized to improve new and solidified solid properties. Admixtures utilized were both characteristic and compound. The regular aggregate utilized is (fly ash) and substance ones are (polycarboxylate and PVF). Properties of solidified cement were resolved during this examination with regards to the Indian code IS 456:2000.[9] Concrete solid properties were determined by estimating compressive quality at seven days and twenty eight days for each sample. The admixtures increase the quality of cement at same workability. The focus on this study is to work out the characteristic strength of reused blends and furthermore the effect of regular (fly ash) and substance (polycarboxylate and PVF) admixtures on reused aggregate concrete, which can give a higher comprehension on the properties of cement with reused aggregate, as a substitute material to coarse mixture in basic concrete. The aim of this venture is to work out and analyze the quality of cement by utilizing different extent of reused aggregates with various types of admixtures. Reused cement might be produced using assortment of different sources. The basic is destruction ones. Various sources of waste include natural events like seismic tremors, torrential slides, and tornadoes; human causes like war and bombarding; and structural failures.

Keywords: Admixtures, Characteristic strength; Recycled aggregate; Fly Ash; Polycarboxylate; Polyvinyl Fluoride.

1. Introduction:

The structure business has the ability to act in an exceedingly respective way. From one viewpoint it's to be considered as a transparent generator of a phenomenal amount of residue and on the contrary hand, its long tradition characterizes its capacity of reusing not exclusively its own waste however additionally the waste from elective parts of business. As indicated by the World Commission on Environment and Development (WCED) "economical improvement could be an advancement that meets the requirements of this while not trading off the power of future generation to satisfy their own needs" [1]. There's an inspiring examination development with pertinence of the mechanical execution of reused aggregate concrete (RCA) that appears that the standard of RCA is satisfactory to be utilized as essential concrete. Notwithstanding what might be normal, the replacement level of regular aggregate with reused aggregate and therefore the strength properties of RCA are still under scrutiny, since a decent variation in the results are revealed. Waste cement might be produced using assortment of different sources. The most well-known source of getting reused aggregates are destruction sites, a few solid structures like buildings, extensions, walkways and streets are annihilated after a selected amount of time for either purpose of replacement or landscape change. [10] We can moreover

get reused aggregates by catastrophic events like quakes, torrential slides and tornadoes and also human causes like wars or structure disappointments. All of these add to gigantic amounts of waste cement. The little structure of RCA is impressively extra mazed than that of typical concrete since it fuses two styles of surface progress zones, one between the RCA and in this way the new mortar and a second between the RCA and along these lines the followed mortar. The past mortar consolidates different scaled down scale breaks, molded all through RCA creation, it additionally, has high consistence, so it transforms into the most fragile relationship in RCA and its quality is that the highest limit of quality of cement of concrete. Since the mortar-aggregate bond quality will expand, the concrete quality also will increase. The presence of the followed mortar is crucial since reused blends envelop 65–70% by volume of regular coarse aggregate and 30–35% by volume of previous concrete paste. [2] To support the properties of RCA, it's elementary to expand a treatment method that is skilled to dispose of the followed mortar at such level that reduces the negative impacts. When all is said in done, RCA is of lower quality than NA (regular aggregate). RCA have higher water absorption value and lower densities. The workability of RCA ranges from three to fifteen. The presence of the mortar brings down the thickness estimations of the reused aggregates (2200–2400 kg/m³). Aside from the mechanical and durability properties, the monetary parts of the RCA are of equivalent significance. The potential natural and monetary edges may improve RCA picture to the overall population and lift its use.[11]

2. Literature Review:

In this section different written works on quality and sturdiness of reused total cement fused with fly debris, Polycarboxylate, PVF has been reviewed and following realities are accounted for. Accessible distributed writing on reused total cement is likewise quickly looked into.

V. Corinaldesi and G. Moriconi(2001), Concrete examples were industrial facility made by completely trade characteristic totals with reused totals from a devastating plant during which scrap from building destruction was ground. Various concretes were prepared by silica smoke or fly debris as an incomplete fine blend substitution and by abuse an acrylic compound fundamentally based super plasticizer to understand the prefixed usefulness. Three sorts of reused blend concrete were processing plant made with consistent water/concrete (0.40) and in this way a similar ongoing usefulness (liquid consistency). A reference concrete was conjointly prepared by characteristic blends with steady molecule size dispersion in light of the fact that the reused total, and having a water/concrete of 0.56 and an undifferentiated from liquid consistency. The outcomes got demonstrate that attributable to mineral expansion and W/C decrease, reused totals might be utilized instead of common totals since cements with comparative compressive quality might be acquired. The work of the reused totals with debris substitutions conjointly has imperative cost and natural favors over ordinary cement.

Rahal, K. (2007), this paper reports the consequences of a test concentrate on some of the mechanical properties of reused blend concrete (RAC) when contrasted with those of the customary characteristic blend solid (NAC). Ten blends of cement with target compressive 3D shape quality beginning from twenty to fifty MPa were thrown utilizing conventional or reused coarse totals. The occasion of the 3D shape compressive quality and furthermore the backhanded shear quality at ages of 1, 3, 7, 14, 28 and 56 days, the compressive quality, the endure most extreme compressive pressure and furthermore the modulus of versatility tried by utilizing solid chambers at 28 days are accounted for. The outcomes show that the 28-day 3D square and chamber compressive quality, and furthermore the circuitous shear quality of reused blend concrete were on the normal 90% of these of common blend concrete with same blend extents. For concrete with chamber compressive qualities somewhere in the range of 25 and 30MPa, the modulus of versatility of RAC was exclusively 3% not as much as that of NAC. The patterns inside the improvement of compressive and shear quality and furthermore the endure top worry in reused blend concrete were much the same as those in normal blend concrete [3]

Brito, Jorge de, Robles, Ricardo (2010), In this paper, a methodology for forecast of semi perpetual properties of reused total cement is given, upheld an escalated writing audit of worldwide exploratory battles on this kind of condition well disposed cement. The approach given depends on the past assurance of the most properties of the totals (thickness and water assimilation), essential and reused, coarse and fine, and rather the 7-day compressive quality of cement made with those totals. The system is legitimate, bolstered a graphical examination of the preeminent vital properties of solidified cement (compressive quality, modulus of versatility, tearing and flexural solidness, shrinkage, creep, water assimilation, and carbonation and chloride infiltration profundity). It's over that the approach will anticipate the semi changeless exhibition of reused blend concrete as contrasted and a comparable run of the mill solid which this expectation can be utilized to adjust auxiliary style to the present material.

Kou, S., Poon, C., and Agrela, F. (2011), this paper presents the consequences of a research facility concentrate on the exhibition of characteristic and reused total solid prepared with the consolidation of different mineral admixtures together with silica exhaust (SF), Met kaolin (MK), fly debris (FA) and Ground coarse impact rubbish (GGBS). The compressive and discordant elasticity, drying shrinkage, chloride molecule entrance and ultrasonic heartbeat speed (UPV) of the solid blends were resolved. The check results, when all is said in done, demonstrated that the joining of mineral

Admixtures improved the properties of the reused mix cements. SF and MK added to each the short and semi lasting properties of the solid, though FA and GGBS indicated their accommodating outcome just when a relatively since quite a while ago set time. As way in light of the fact that the compressive quality ponders, the substitution of concrete by 10 percent of SF or 15% of MK improved each mechanical and toughness execution, while the substitution of concrete by 35% FA or 55% GGBS wilted the compressive quality, anyway improved the strength properties of the reused mix cements. Also, the outcomes show that the commitments of the mineral admixtures to execution improvement of the reused blend concrete are higher than that to the common mix concrete.

Duan, Z. H., Kou, S. C., and Poon, C. S. (2013), Recycled totals are entirely unexpected in sythesis and properties contrasted and characteristic totals, driving it difficult to foresee the exhibition of reused total cement and style their blend extents. Their paper means to call attention to the potential significance of fake neural systems (ANNs) to anticipate the compressive quality of reused total cement. ANN model is made, prepared and tried utilizing 146 available arrangements of data acquired from sixteen entirely unexpected uncovered writing sources. The ANN model created utilized fourteen information parameters that included: the mass of water, concrete, sand, regular coarse blend, reused coarse mix utilized in the combo styles, water to solidify quantitative connection of solid, fineness modulus of sand, water ingestion of the totals, immersed surface-dried (SSD) thickness, most extreme size, and pollution substance of reused coarse mix, the substitution quantitative connection of reused coarse mix by volume, and furthermore the consistent of different solid example. The ANN model, run during a Matlab stage, was utilized to foresee the compressive quality of the reused mix concrete. The outcomes demonstrate that ANN can possibly be utilized as an instrument for anticipating the compressive quality of reused mix solid prepared with fluctuated assortments and wellsprings of reused totals.

Behera, M., Bhattacharyya, S. K., Minocha, A. K., Deoliya, R., and Maiti, S. (2014), The issues of manageability is of prime concerns recently as we will in general utilize incredible measure of regular assets for assembling materials like cement. Consumption of common assets is one in everything about property gives that we need to manage in an affordable way. The ongoing pattern in lodging industry is to utilize the decision gracefully of development materials which may substitute the work of virgin materials so as to decrease natural effect as far as vitality utilization, contamination, squander removal and a worldwide temperature alteration. On the contrary hand, the waste created from the destruction of past structure and development movement might involve concern wherever the planet. Hence, utilize and apply of those squanders may downsize the utilization of characteristic assets and it additionally can serve

towards the interest of environmental factors. The current paper gives a fast remaining of reused blend concrete made out of reused blend, sums up and fundamentally examinations some of the premier imperative investigation discoveries in the course of recent years with respect to the texture perspectives. It conjointly makes an endeavor to explain the methodologies for the better exhibitions, recognizes the holes inside the current information and underlines the clarifications why this promising innovation has not gotten wide acknowledged by the advancement business. The reasonable issues with utilization of reused blend in concrete are referenced.

Silva, R. V., de Brito, J., and Dhir, R. K. (2015), this paper gives a logical writing survey, in light of the recognizable proof, evaluation, decision and blend of distributions concerning the aftereffect of consolidating reused totals, sourced from development and destruction squanders, on the quality of cement. It recognizes fluctuated affecting perspectives related with the work of reused totals like substitution level, size and root, just as blending technique, compound admixtures, augmentations and quality advancement after some time. during this paper, evaluated values, exploitation the Euro code a couple of method to see the quality after some time, were contrasted and the specific estimated values, demonstrating next to no relationship and in this way new coefficients are anticipated. This paper conjointly presents the association between the pliable and compressive qualities as indicated by Euro code a couple of. The outcomes counsel that, regardless of the substitution level, type, and nature of the reused blend utilized, the following reused concrete will in general display a similar relationship to it of the relating normal blend concrete.

Silva, R. V., de Brito, J., and Dhir, R. K. (2016), gives a logical writing audit, bolstered the ID, examination, decision and combination of the confirmation of 121 productions uncovered over a measure of forty three years from 1973 to 2015, identifying with the aftereffect of joining reused totals, sourced from handled development and destruction squander, on the modulus of versatility of cement. It distinguishes various impacting viewpoints identified with the work of reused totals like substitution level, size and root, besides as aggravating strategies, presentation of the following cement to entirely unexpected ecological conditions, utilization of compound admixtures and increases, and advancement of the modulus of versatility after some time. An applied math investigation on the grouped data is moreover gave with the point of understanding

3. Material and Experimental details:

3.1. Materials:

- i. Portland Pozzolana Cement (Grade 53PPC): Portland Pozzolana Cement, "Result of future", is set up by a completely machine-driven, dry producing strategy utilizing cutting edge innovation under severe quality confirmation at all phases of producing with the help of the "mechanical" framework. PPC is production line made by bury pounding very much consumed OPC clinker with gypsum and pozzolanic materials like force station fly ash or silicious earths.
- ii. Natural Coarse Aggregate (10mm): Development aggregate might be a general classification of coarse particulate material utilized in development, together with sand, rock, squashed stone, slag, reused concrete and geosynthesis aggregates. Aggregates are the preeminent all around mined minerals inside the world. Aggregates are a component of materials like cement and black-top cement; the aggregates are support to highlight solidarity to the composite material.
- iii. Recycled Coarse Aggregate (20mm): Reused blend is made by squashing concrete, and for the most part asphalt to recover the aggregates. Reused blend is utilized for a few capacities. The main market is street base.
- iv. Recycled fine aggregate: Reused sand is a byproduct of squashed blocks, tiles, concrete

and so forth it is reasonable for use as a base for concrete paving and path as it compacts down strong. It is likewise valuable for filling in channels around pipes yet it is too coarse to even think about filling around electrical lead.

- v. Admixtures utilized – fly ash, PVF (polyvinyl fluoride), Polycarboxylate (super plasticizer):
- Dose of admixtures-0.6% by weight of concrete
 - Water-Cement proportion - 0.55
 - Size of form 150*150*150 mm³.

3.1.1. Material Tests:

3.1.1.1. Sieve Analysis: A strainer investigation (or degree test) is a training or system used to survey the molecule size appropriation (likewise called degree) of a granular material by permitting the material to go through a progression of sifters of continuously littler work size and gauging the measure of material that is halted by each strainer as a small amount of the entire mass.[4]

The results for sieve analysis test on the recycled aggregates are shown below in Table 1. The percentage passed lies within the range of acceptance criteria as shown in.

Table 1. Sieve analysis of the recycled aggregate

Size if sieve	Percentage of aggregate passed	Acceptance percentage as per IS-2386 Part 1
40mm	100%	100
20mm	90%	85-100
10mm	4.3%	0-20
4.75mm	1%	0-5

3.1.1.2. Water Absorption Test:

Water absorption gives a concept on the inner structure of aggregate. Aggregates having additional absorption are additional porous in nature and are typically thought of unsuitable, unless found to be acceptable supported by strength, impact and hardness tests.

3.1.1.3. Bulk Density:

The bulk density or unit weight is that the weight per unit volume (mass per unit volume or density). A void in unit volume of aggregates is the area between particles in aggregate mass not occupied by solid minerals.[5]

3.1.1.4. Specific Gravity:

Specific Gravity is defined as the magnitude relation of Weight of aggregate to the weight of equal Volume of water. The specific gravity of aggregate is measure of strength or quality of the material. Aggregates having low relative density are usually weaker than those with high relative density. This property helps in a very general identification of aggregates.

3.1.1.5. Silt content:

Silt content could be a fine material that is a smaller amount than 150 micron unit. It is unstable within the presence of water. If we have a tendency to use loose sand for bonding, it'll cut back the strength and cause rework. Excessive amount of silt, not solely reduces the bonding of cement and fine aggregates however additionally affects the strength and sturdiness of labor.

3.1.1.6. Crushing Value Test:

Aggregate crushing value test on aggregate offers a relative measure of the resistance of an aggregate crushing under gradually applied compressive load. Coarse aggregate crushing value is that the share by weight of the crushed material obtained when test aggregates are

subjected to a fixed load below standardized conditions. Aggregate crushing value may be a numerical index of the strength of the aggregate and it is employed in construction of roads and pavements. Crushing value of aggregates indicates its strength. Lower crushing value is suggested for roads and pavements because it indicates a lower crushed fraction under load and would provides a longer service life and a additional economical performance[6]

3.1.1.7. Impact Value Test:

The property of a material to resist impact is thought as toughness. Thanks to movement of vehicles on the road the aggregates are subjected to impact leading to their breaking down into smaller items. The aggregates ought to have adequate toughness to resist their disintegration thanks to impact. This characteristic is measured by impact value test .The aggregate impact value is a measure of resistance to fast impact or shock, which can dissent from its resistance to gradually applied compressive load.

3.1.1.8. Abrasion Value Test:

Abrasion check is applied to check the hardness property of aggregates. The principle of Los Angeles abrasion test is to search out the share wear because of relative rubbing action between the mixture and steel balls used as abrasive charge.

The data for the above defined material tests are shown below in table 2.

Table 2. Material Test Results for Recycled Aggregate

Experiments	Recycled Stone Dust	Recycled Aggregate	Acceptance Criteria
Water Absorption	4.50	0.86	
Bulk Density	1.78	1.37	
Specific Gravity	2.63	2.78	
Silt Content	8.80	3.00	Should not exceed 8% for sand.
Crushing value		30	Should not exceed 45% for sand.
Impact value		31.89	Should not exceed 45% for sand.
Abrasion value		35.1	50%

3.2. Test Conducted On hardened Concrete: (Compressive Strength Test):

In this test properties of solidified cement were resolved by the Indian code IS 456:2000. Solidified solid properties were controlled by estimating compressive quality at 7 days and 28 days for every example. Four distinct examples were readied and their compressive quality was thought about. For every sample, 3 shapes of size 150*150*150 (mm³) were readied utilizing various admixtures. [7]

Size of the mould: **15cm*15cm*15cm.**

Area of the example (determined from the mean size of the example): **225cm²**

Anticipated most extreme burden: **Fck x Area x F.S**

Range to be chosen ought to be more noteworthy than **20N/mm²**

Most extreme burden applied: **560KN**

After curing the element for making the plan of cement blends of M₃₀ grade was accomplished for reused fine and coarse aggregate. Concrete 3d squares of 24 examples were casted by blending the various extents of fly ash` as acquired in the structure blend. The usefulness of cement blends was estimated by the slump tests. Curing of concrete blocks for 7 days and 28 days was finished. 3D shapes of cement of size 150 x 150 x 150 mm of every single structured evaluation were tried for pounding quality toward the finish of 7 days and 28 days. The specimens were de molded following 24 hours of casting and curing at 27 ± 2 °C until the test age. Thus, second and third admixtures PVF and polycarboxylate are utilized and compressive strength was measured by end of seven and twenty eight days. The pressure test on the example is directed utilizing UTM (Universal Testing Machine). [8]

3.3. Concrete Mix Design For M₃₀ :

Estimation of materials and admixtures used in the study is given in table 3 and 4.

Table 3.Quantity of material used

MATERIALS	QUANTITY.(for 24 samples)
Cement (natural)	43.6kg
Coarse Aggregate (natural)-10mm	75kg
Fine Aggregate (recycled)	65.52kg
Coarse Aggregate (recycled)	75kg

Table 4.Quantity of Admixtures used

ADMIXTURES	QUANTITY
Fly Ash	265.79gm
Polyvinyl Fluoride (PVF)	262.7gm
Polycarboxylate	200ml

4. Experimental Results:

4.1. Effect on Compressive Strength (F_{ck}) of Recycled Aggregate Concrete using no Admixture:

The result we got after performing compressive strength test on the specimen (C_0) after 7 and 28 days is shown in table 5

Table 5

Sample	Admixture added	Percentage of Admixture added	Water binding ratio	Maximum load (in KN)		Compressive Strength(N/mm^2)	
				After 7 days	After 28 days	After 7 days	After 28 days
1	zero admixture	0.6	0.55	499.5	751.5	22.20	33.40
2	zero admixture	0.6	0.55	464.625	709.65	20.65	31.54
3	zero admixture	0.6	0.55	395.325	528.525	17.57	23.49

The mean of compressive strength we got after 28 days on specimen C_0 is $29.47N/mm^2$

4.2. Effect on Compressive strength of Recycled Aggregate Concrete Using Polycarboxylate as Admixture:

The result we got after performing compressive strength test on the specimen (C_1) after 7 and 28 days is shown in table 6

Table 6

Sample	Admixture added	Percentage of Admixture added	Water bidding ratio	Maximum Load (in KN)		Compressive Strength (N/mm^2)	
				After 7 days	After 28 days	After 7 days	After 28 days
1	Polycarboxylate	0.6	0.55	616.5	882.9	27.40	39.24

2	Polycarboxylate	0.6	0.55	499.27	768.825	22.19	34.17
3	Polycarboxylate	0.6	0.55	700.42	656.1	31.13	29.16

The mean of compressive strength we got after 28 days on specimen (C_1) is **34.19N/mm²**

4.3. Effect on Compressive strength of Recycled Aggregate Concrete Using PVF (Polyvinyl Fluoride) as Admixture:

The result we got after performing compressive strength test on the specimen (C_2) after 7 and 28 days is shown in table 7

Table 7

Sample	Admixture used	Percentage of Admixture added (by percent weight of cement)	Water cement ratio	Peak load (in KN)		Compressive Strength (in N/mm ²)	
				After 7 days	After 28 days	After 7 days	After 28 days
1	PVF	0.6	0.55	711.52	792.225	31.89	35.21
2	PVF	0.6	0.55	576	884.25	25.60	39.3
3	PVF	0.6	0.55	542.475	722.25	24.11	32.1

The mean of compressive strength we got after 28 days on specimen C_2 is **35.53N/mm²**

4.4. Effect on Compressive strength (C_3) of Recycled Aggregate Concrete Using Fly ash as Admixture:

The result we got after performing compressive strength test on the specimen (C_3) after 7 and 28 days is shown in table 8

Table 8

Sample	Admixture Used	Percentage of Admixture added (by percent weight of cement)	Water Cement ratio	Peak load (in KN)		Compressive strength (in N/mm ²)	
				After 7 days	After 28 days	After 7 days	After 28 days
1	Fly ash	0.6	0.55	510.52	852.3	22.69	37.88
2	Fly ash	0.6	0.55	652.72	745.2	29.01	33.12
3	Fly ash	0.6	0.55	630.45	860.625	28.08	38.25

The mean of compressive strength we got after 28 days on specimen C₃ is **36.41N/mm²**

4.5. Graphical Representation of Experimental Results:

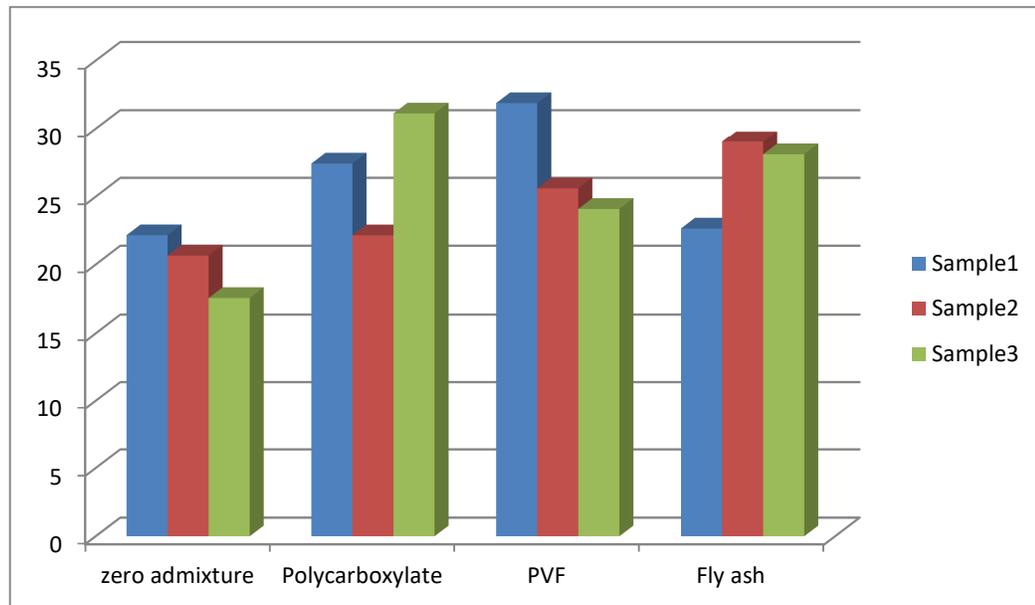


Fig.1. Graphical Representation of Results after 7 days

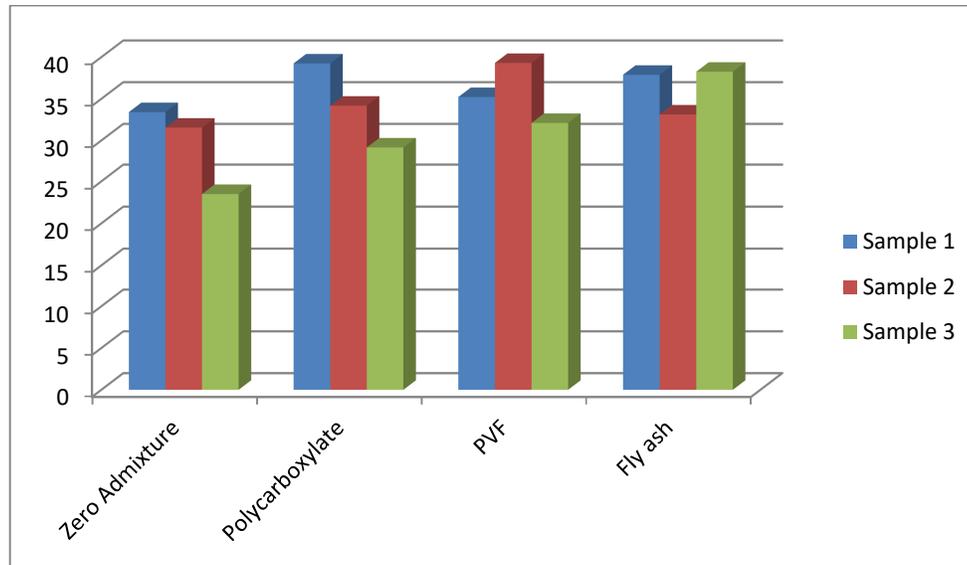


Fig.2. Graphical Representation of Results after 28 days

4. Conclusion:

In accordance with the experimental phase carried out in this study, the conclusions obtained are:

- i. The admixtures added to RCA in this project have a decent and clear effect on progress of compressive quality of new and solidified cement by a huge sum.
- ii. The utilization of PPC (Portland Pozzolana Cement) rather than OPC (Ordinary Pozzolana Cement) has helped in expanding the compressive quality of Recycled Aggregate mixture.
- iii. Utilization of Polycarboxylate as admixture expanded the normal compressive quality of Recycled Aggregate Concrete by about **34.19%**.
- iv. Utilization of Polyvinyl fluoride (PVF) as admixture expanded the normal compressive quality of Recycled Aggregate Concrete by about **35.53%**.
- v. Utilization of Fly Ash as admixture expanded the normal compressive quality of Recycled Aggregate Concrete by about **36.41%**.
- vi. From the above insights, obviously all the admixtures positively affect RCA regarding its quality. In any case, fly ash delivered greatest increment in quality followed by Polyvinyl Fluoride (PVF) and afterward Polycarboxylate.
- vii. From the above insights, it very well inferred that utilization of admixtures can upgrade the quality properties of RCA. In any case, the measure of Recycled Aggregate Concrete utilized in this work was half which isn't satisfactory and should be diminished so as to get more quality. As per this examination, it is prescribed to utilize 30% RCA and 70% NA (Natural Aggregate) so as to be utilized in significant development extends alongside the admixtures.

- viii. Recycled blend concrete will be more fragile than concrete combined with natural aggregate because of the presence of previous mortar on the mix surface. This could be corrected by adding extra concrete to the mix.
- ix. From the above insights, it is found out that utilization of admixtures will upgrade the quality properties of RCA. In any case, the quantity of Recycled mix Concrete utilized in this work was fifty percent and should to be diminished in order to instigate a great deal of solidarity. Per this investigation, it's guided to utilize thirty percent of RCA and seventieth natural component (Natural Aggregate) in order to be utilized in significant developments
- x. The quality of Recycled blend is often intensified by ever-changing the strategy of utilization. Utilization of Heating and Rubbing system will yield higher prompts terms of solidarity of Recycled mix.
- xi. The solidified thickness of cement made by reused blends will be lower on account of the lower thickness of the reused aggregate itself.
- xii. The flexural lastingness of cement made by reused aggregates will be under indistinguishable cement made with virgin aggregates. This can't be as basically salaried for by including concrete, as are regularly in a difficult situation the misfortune in compressive quality.
- xiii. There's a stamped increment in drying shrinkage once by reused aggregates in concrete. This ought to be taken into account.
- xiv. The modulus of elasticity of cement made by Recycled totals is way under natural cement made by virgin aggregates. This is regularly on account of the physical properties of the aggregates utilized.

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