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A Study on Properties of Self-Compacting Concrete with Manufactured Sand as Fine Aggregate: A Critical Review

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Abstract: *This paper present a literature review related to use of manufactured sand in SCC. The use of alternative aggregate like manufactured sand is a natural step in solving part of depletion of natural aggregates. The investigation on alternative material for self- compacting concrete making started in recent times. Concrete made from manufactured sand waste as fine aggregate will be studied for workability, compressive strength, Split tensile strength and Flexural strength. Further, study of its durability will ensure greater dependability in its usage. So here in this project, manufactured sand has been used as replacement of fine aggregate by different percentage for making concrete of M- 25 and M-30. The percentage replacement will be 0%, 10%, 20%, 30%, 40%, 50% with natural fine aggregates. Cubes, beams and cylinders will be casted and tested compressive strength, Split tensile strength, and flexural strength as well as for durability properties. Optimum replacement of manufactured sand can be used in structural concrete.*

Key words: *Manufactured Sand; Self-compacting concrete; Workability; Compressive strength; Literature review; etc…*

I. Introduction

Every years waste material deposited in huge quantity on valuable land. This problem of utilization waste material can be solved up to certain level if people start use of it. Here, they had studied about use of waste Manufactured Sand as partial replacement of fine aggregate in self-compacting concrete. The Self-Compacting Concrete is the modern concrete which does not require compaction and vibration for placing of it," It is able to flow under its own weight and completely filling formwork and achieving full compaction even in closely spaced Steel designed.'' The harden SCC has same engineering properties and durability as tradition vibrated concrete. It is also eco-friendly. Self-Compacting Concrete was first developed in japan in early 1980. The flowability is the main property of SCC so that it can be placed under its own weight without any type of mechanical vibration and compaction. In order to make SCC of high fluidity without bleeding or segregation during the transportation or placing, the use of high powder content, super plasticizers (SP) and viscosity modifying admixtures (VMA) used for making this type of concrete. However, the cost of this type of concrete is slightly higher than normal vibrated concrete.

A. Manufactured Sand

Manufactured sand is obtained from the raw material. After washing the raw material the manufactured sand is separated by sieve size 1.18 of raw material. Raw material is washed for taking out the clay material which is useful for making the tiles. In the raw material about 10% is clay which is supplied to the ceramic factories. From the raw material different size of manufactured sand are separated by different size of sieve. Sand size of 30 meshes to 80 meshes (500 micron) is used in the glass industries. Sand size 1.18mm to 600 micron can be used in making concrete mix as the partial replacement of fine aggregate. The first industrial uses of crystalline manufactured were probably related to metallurgical and glass making activities a few thousand years BC. It is a key raw material in the industrial revolut ione specially in glass, foundry and ceramic industries. Nowadays silicon n is used in i n formation technology products like plastic of computer mouse and providing the raw material for silicon chips. For industrial pure deposits of manufactured sand capable of yielding products of at least 95% manufactured are required.

B. Use of M- Sand

- Glass
- Foundry casting
- Ceramics
- Filtration

- Specialist building applications
- Sports and leisure
- Sand blasting and other abrasives.
- Pigments


II. Literature Review

Benchaa Benabed, El-Hadj Kadri, Lakhdar Azzouz, Said Kenai [1] had used different types of sand as replacement of fine aggregate like crushed sand, river sand, dune sand and mixture of all sand. Different inert fillers and supplementary cementitious materials they have added. The slump flow, V-funnel flow time and viscosity measurement tests were used to study the rheological properties. The experimental results indicate that the rheological properties and strength improve with mixtures of crushed and river sands but decrease with mixtures of crushed and dune sands especially for higher dune sand content. The slump flow time decreased with the increase in limestone fines content whereas V- funnel flow time increased. The V-funnel flow time has a direct relationship with viscosity as the increase in V- funnel flow time increases the viscosity of mortar.

Prakash Nanthagopalan, Manu Santhanam [2], performed fresh and hardened tests on SCC made from context, the influence of the paste composition and paste volume on the fresh and hardened concrete properties of SCC using Msand was evaluated. The results of J-ring test revealed that apart from paste volume, paste composition and aggregate characteristics also influence the passing ability of SCC. As expected, the w/p ratio had a good correlation with the compressive strength of SCC for a given cement/fly ash ratio. The compressive strength of mixes developed in this study ranged from 25 MPa to 60 MPa.

Brahim Safi, Mohammed Saidi, Ahmed Bellal, Ali Mechekak, Kamel Toumi [3] ,had studied about use of seashells as partial replacement of fine aggregate for making SCC. An experimental study was conducted to evaluate the properties in the fresh (fluidity and flowability) and hardened properties (bulk density, porosity/water absorption, flexural and compressive strength and elastic modulus) of self-compacting mortars (SCMs) with the partial and total substitution of sand (S) by seashells crushed at different ratio (Sh/S = 0%, 10%, 20%, 50% and 100%) by weight. . The macro structural study by optical microscope of the interfacial zone (seashells– binder) has shown that there is a good adhesion between seashell and cement paste and the angular form of the seashells has significantly improved the distribution of this latter in the cementitious matrix. A very lighter decrease (practically inconsiderable) of compressive strength of mortars was noted as a function the replacement level the sand by crushed seashells whatever of curing age. For 50% substitution of sand by the seashells, gave a flexural strength of 10 MPa. The reduction compressive strength of mortars is about 12% compared to the reference mortar.

Diego Carro-Lopez , Beleen Gonzalez- Fonteboa , Jorge de Brito, Fernando Martinez- Abella ,Iris [4]

Gonzalez-Taboada , Pedro Silva had studies the effect manufactured sand. Manufactured sand (Msand) produced by crushing rock deposits is being identified as a suitable alternative source for river sand in concrete. The main objective of this study is to explore the possibility of using Msand in SCC. The powder and aggregate combinations were optimized by using the particle packing approach, which involves the selection of combinations having maximum packing density. From the results, it was observed that relatively higher paste volume is essential to achieve the required flow for SCC using Msand, as compared to river sand. The present investigation was conducted to explore the possibility of 100% replacement of river sand by using Msand. In this of incorporating fine recycled aggregates on the rheology of self-compacting concrete over time (at 15, 45 and 90 min). The fine fraction of the natural aggregates was replaced at 0%, 20%, 50% and 100% with recycled sand. The fresh- state properties were studied by empirical tests (slump- flow, J-Ring, L-Box) and fundamental ones in an ICAR rheometer. The mixes with 50% and 100% recycled sand lost their SCC characteristics at 90 min. contrarily the mix with 20% replacement maintained suitable passing and filling ability. The causes of this trend were an initial increase of plastic viscosity and afterwards an increase of yield stress. The compressive strength of the 50% and 100% replacement mixes decreased Significantly and that of the 20% replacement mix less than 10%. The mixes with 100% incorporation of recycled sand totally lost their SCC characteristics at 90 min and this loss of passing and filling ability also partly occurred at 45 min. In the 50% recycled sand mix, the effect was not so severe but the loss of properties was strongly noticeable after 45 min. This radical change of properties is produced by the very high absorption of the recycled sand that removes water from the paste to such an extent that it changes the rheology of concrete to a vibrated concrete, no longer a SCC.

Rafat Siddique, gurpreet Singh, Rafik Belarbi, Karim Air-Mokhtar, Kunal [5] , In this paper they had investigated about use of foundry sand as partial replacement of fine material in design of self- compacting concrete in two grades of concrete. Two concrete mixtures (M20 & M30) were designed to have 28-day compressive strength of 30 MPa and 40 MPa. Then, fine aggregate (natural sand) was replaced with five percentages (0%, 5%, 10%, 15%, and 20%) of SFS by weight. Comparative performance of both types of concrete (M20 & M30) was investigated by measuring compressive strength, splitting tensile strength, modulus of elasticity, chloride permeability, and ultra-sonic pulse velocity up to the age of 365 days. Partial replacement of sand with SFS (up to 15%) increases strength properties such as compressive, splitting tensile strength, and modulus of both types (grades M20 & M30) of concrete. USPV value increased with the increase in spent foundry con- tent in both types of concrete. Spent foundry sand can be suitably used for both the grades of concrete.

S.C. Kou, C.S.Poon [6], had studied on the fresh and hardened properties of self-compacting concrete (SCC) using recycled concrete aggregate as both course and fine aggregates were evaluated. Three series of SCC mixtures were prepared with 100% coarse recycled aggregates, and different levels of fine recycled aggregates were used to replace river sand. The SCC mixtures were prepared with 0, 25, 50, 75 and 100% fine recycled aggregates, the corresponding water-to-binder ratios (W/B) were 0.53 and 0.44 for the SCC mixtures in Series I and II, respectively. The SCC mixtures in Series III were prepared with 100% recycled concrete aggregates (both course and fine) but three different W/B ratios of 0.44, 0.40 and 0.35 were used. Different tests covering fresh, hardened and durability properties of these SCC mixtures were executed. The results indicate that the properties of the SCCs made from river sand and crushed fine recycled aggregates showed only slight differences. The slump flow and blocking ratio of the RA-SCC mixtures increased with increasing fine recycled aggregate content. The initial slump flows of all the RA-SCC mixtures prepared were at least 760 mm. The addition of R- FA resulted in an increase in slump flow and blocking ratio. The compressive and tensile splitting strengths of the RA-SCC mixtures prepared without the addition of fly ash decreased with increasing fine recycled aggregate content. The maximum compressive and tensile splitting strength were achieved by using 25–50% fine recycled aggregates as a replacement of river sand.

M Valcuende, F Benito, C Parra, I Minano [7], performed shrinkage evolution with age in self- compacting concretes (SCC) in which part of the fine aggregate was replaced by granulated blast furnace slag (GBFS) as sand. Seven types of SCC were made with a w/c ratio of 0.55 and different slag contents. The results show that replacing sand by GBFS gives rise to mixes with higher pore volume but with slightly finer porous structure (smaller median pore and threshold diameters). At early ages slag SCCs have similar compressive strength to that of the reference concrete, although in the long term their strength increases as a result of slag reactivity. We also observed that the higher the slag content, the higher were both autogenously and drying shrinkage and consequently also total shrinkage. In comparison with the reference concrete, the increase in total shrinkage was found to be of the order of 4% and 44% when 10% and 60%, respectively, of the sand was replaced by slag. At early age, slag SCCs show similar compressive strength to the reference SCC. However, at 365 days, due to slag reactivity, the higher the quantity of sand replaced by slag the higher the concrete's compressive strength tends to be. Due to their higher porosity, SCCs with slag are less stiff and lose water faster. This leads to higher drying shrinkage.

Wang Her Yung, Lin Chin Yung, Lee Hsien Hua [8], had studied in use of waste tire rubber as a recycled part of the fine aggregate by waste tire rubber powder sieved through #30 and #50 sieves to make SCC. Part of the fine aggregate was replaced with waste tire rubber powder that had been passed through sieves at volume ratios of 5%, 10%, 15% and 20%, respectively, to produce cylinder specimens and obtain the optimal replacement value. The results showed that when 5% waste tire rubber powder that had been passed through a #50 sieve was added, the 91 day compressive strength was higher than the control group by 10%. Additionally, the shrinkage was higher with an increase in the amount of waste rubber, and reached its maximum at 20%. The addition of 5% waste tire rubber powder brought about a significant increase in anti-sulfate corrosion. Using waste tire rubber powder can enhance the durability of self-compacting rubber concrete. The compressive strength of SCRC was the best when 5% of the waste tire rubber powder that had been used. The shrinkage of concrete with rubber powder was small, but larger than ordinary concrete. When more rubber powder was added, the change in length also increased.

S.C. Kou, C.S. Poon [9], had studied about effect on properties of SCC when recycled glass aggregate are used as partial replacement of fine aggregate. RG was used to replace river sand (in proportions of 10%, 20% and 30%), and 10 mm granite (5%, 10% and 15%) in making the SCC concrete mixes. The experimental results showed that the slump flow, blocking ratio, air content of the RG–SCC mixes increased with increasing recycled glass content. The compressive strength, tensile splitting strength and static modulus of elasticity of the RG–SCC mixes were decreased with an increase in recycled glass aggregate content. The slump flow, blocking ratio, air content of the RG–SCC mixes increased with increase in recycled glass content. The initial slump flows of all the SCC mixes prepared in this study were at least 750 mm. The blocking ratios varied from 0.84 to 0.88. The compressive strength, tensile splitting strength and static modulus of elasticity of the RG–SCC mixes decreased with an increase in recycled glass content.

Brahim Safi, Mohammed Saidi, Djamila Aboutaleb, Madani Maallem [10] , had studied the possibility of recycling waste plastic as a fine aggregate instead of sand in the manufacturing of the self-compacting mortars. The sand is substituted with the plastic waste at dosages (0%, 10%, 20%, 30% and 50% by weight of the sand).The physical (bulk density, porosity, water absorption and ultrasonic pulse velocity testing) and mechanical (bulk compressive and flexural strength) properties of SCMswere evaluated and a complementary study on micro-structural of the interface of cementitious matrix and plastic waste. The measurements of physical and mechanical properties show that, in term of the density for materials, the mortars with 50% of plastic waste give better results than other proportion of the waste. The measurements of physical and mechanical properties show that, in term of the density for materials, the mortars with 50% of plastic waste give better results than other proportion of the waste. The fresh properties of SCC also improved using plastic waste. Reduction in the compressive strength was between 15% and 33% for mortar containing 20–50% plastic waste.

Mehmet Gesoglu, Erhan Guneyisi, Hatice Onzur Oz, Ihsan Taha, Mehmet Taner Yasemin [11], had studied explain about the properties of self- compacting concretes (SCCs) produced with recycled coarse aggregates (RCAs) and/or recycled fine aggregates (RFAs) compared to SCCs with natural aggregates (NAs). The SCC mixtures were designed with a constant slump flow of 680 ± 30 mm and two water/binder (w/b) ratios of 0.3 and 0.43. Manufactured fume (SF) was also used at two replacement levels of 0% and 10%. Hardened properties of the SCCs were evaluated in terms of compressive strength, splitting tensile strength, static modulus of elasticity, and net flexural strength after 56 days of water curing. Failure mechanism of the concretes was also monitored via three-point bending test on the notched beams. The results indicated that failure occurred throughout the recycled aggregates (RA) which in-turn decreased the mechanical properties of SCC. SCC with both fine and coarse RAs (RCA+ RFA) had relatively worse performance than those with only RCA or RFA such that the reduction in strength was about
30% as compared to normal SCC mixes. The SCRAC with RCA + RFA showed the lowest compressive strength value such that these mixes showed a reduction of up to 30.9% as compared to the corresponding reference mixes.

Esra Emam Ali, Sherif H. Al-Tersawy [12] , had done research on utilization of waste glass in SCC. Self- Compacting Concrete (SCC) may lead to evolution of a more quality controlled concrete, assuring a better workability and avoiding human errors with regard to mixing and workability issues. On the other hand, it resolves the problem of noise and vibration during installation. The object of this research work is to study the effect of using recycled glass waste, as a partial replacement of fine aggregate, on the fresh and hardened properties of Self-Compacting Concrete (SCC). A total of 18 concrete mixes were produced with different cement contents (350, 400 and 450 kg/m3) at W/C ratio of 0.4. Recycled glass was used to replace fine aggregate in proportions of 0%, 10%, 20%, 30%, 40%, and 50%. The experimental results showed that the slump flow increased with the increase of recycled glass content. On the other hand, the compressive strength, splitting tensile strength, flexural strength and static modulus of elasticity of recycled glass (SCC) mixtures were decreased with the increase in the recycled glass content. The slump flow, flow ratio, and V-funnel of recycled glass SCC mixes increases with the increase of recycled glass content. The flow ratios varied from 0.83 to 0.89. The compressive strength, splitting tensile strength, flexural strength, and static modulus of elasticity of recycled glass SCC mixes decrease with the increase of recycled glass content.

Griselda Sua-iam, Natt Makul [13] , This research paper contain study of properties of SCC when recycle alumina is replaced as fine aggregate. They studied the feasibility of using alumina waste (AW) as a partial replacement for the fine aggregate in self-compacting concrete. The mixtures were designed to produce a controlled slump flow diameter. The fine aggregate was replaced with up to 100% AW by weight. The rheological and mechanical properties of the SCC mixtures were evaluated based on slump flow, J-ring flow, blocking assessment, V-funnel, air content, compressive strength, and ultrasonic pulse velocity measurements. There was some segregation in V- funnel tests and an increase in blocking in J-ring tests. AW mixes containing higher cement contents (550 kg/m3) had substantially lower V-funnel flow times and minimal blocking, while increased alumina content tended to increase V-funnel flow times and blocking. The compressive strength decreased at higher water–cement ratio and increased with increasing AW content up to 75%.

Mehmet gesog Lu, Erhan Guneyisi, Turan Ozturan, Hatice Oznur Oz, Diler Sabah Asaad [14] , had studied on replacement of fine and coarse aggregate with lightweight fly ash aggregate in SCC. Lightweight aggregates were produced by cold bonding pelletization of 90% fly ash and 10% Portland cement by weight in a tilted revolving pan at ambient temperature. The workability of SCLCs was quantitatively evaluated by slump flow time and diameter, V-funnel flow time, and L-box height ratio. Moreover, compressive strength of hardened SCLCs was measured at 28 and 90 days. It was found that all of the SCLCs have good deformability, passing ability, and resistance to segregation. Increasing replacement level for LWFA and/or LWCA simultaneously decreased density and increased the flowability. It is very clear from the test results that all the mixes satisfy the requirements of SCC with respect to EFNARC. All the mixes are assumed to have good filling ability, passing ability and resistance to segregation. It was observed that increasing the replacement ratio of LWA resulted in a gradual increase in the L-box height ratio of SCLCs mixes. Moreover, the height ratio reached to 1.0 for MC100, revealing the highest fluid behavior.

Yun Wang Choi, Dae Joong Moon, Yong Jic Kim, and Mohamed Lachemi [15], had performed the development of lightweight aggregate concrete using fine aggregate that is manufactured from recycled waste polyethylene terephthalate (PET) bottles. The results of the first phase showed that the WPLA had a density of 1390 kg/m3, a water absorption of 0% and a bulk density of 844 kg/m3. WPLA fineness modulus (F.M.), however, was 4.11, which is higher than the F.M. of river sand. The results of the second phase showed that for the mortar, in which the WPLA was used as a fine aggregate, the flow value increased, while In comparison to the control concrete, the 28- day WPLA concrete compressive strength decreased by 5%, 15% and 30%, with an increase of WPLA content of 25%, 50% and 75%, respectively. e the compressive strength decreased proportionally to the addition of WPLA with elapsed time. The slump of WPLA concrete increased proportionally to the increase in the proportion of WPLA in the mix, regardless of the value of water-to-cement ratio (0.45, 0.49 and 0.53). For 25%, 50% and 75% WPLA concrete mixes, the compressive strength decreased, respectively, 6%, 16% and 30% on average when compared with the control concrete, regardless of the W/C (45%, 49% and 53%).

K.S. Johnsirani, Dr. A. Jagannathan, R. Dinesh Kumar [16] , had performed an experimental investigation on self- compacting concrete (SCC) with fine aggregate (sand) replacement of a Quarry Dust (QD) (0%, 25%, 50%, 75%, 100%) and addition of mineral admixtures like Fly Ash (FA) and Manufactured Fume (SF) & chemical admixtures like super plasticizers (SP). After each mix preparation, 45 cubes specimens and 45 cylinders specimens are cast and cured. The specimens are cured in water for 3, 7 & 28 days. The slump, V- funnel and L-Box test are carried out on the fresh SCC and in harden concrete compressive strength and split tensile strength values are determined. Attempts have been made to study the properties of such SCCs and to investigate the suitability of Quarry Dust to be used as partial replacement materials for sand in SCC. The results of the hardened properties of SCC such as compressive strength and split tension strength had shown that the higher strength has been obtained for SCC_25% mix of about 34.62 Mpa and 2.36 Mpa respectively. While fine aggregate replacement of quarry dust increases with the gradual decreases in the strength values after replacement of 25% of quarry dust. In the case of 100% replacement of quarry dust there will be highly decrease in the compressive strength of cube and split tensile strength of cylinder.

Krishna Murthy.N, Narasimaha Rao A.V, Ramana ReddyI, Vand Vijaya sekhar Reddy.M [17] , had studied on the mix design process on self-compacting concrete. In this paper presents an experimental procedure for the design of self-compacting concrete mixes. The relative proportions of key components are considered by volume rather than by mass. A simple tool has been designed for self-compacting concrete (SCC) mix design with 29% of coarse aggregate, replacement of cement with Metakaolin and class F fly ash, combinations of both and controlled SCC mix with 0.36 water/cementitious ratio(by weight) and 388 liter/m3 of cement paste volume. Self- compacting concrete mix design tool is developed based on the key proportions of the constituents. This tool is very simple and user friendly for the self-compacting concrete mix design. It can be used for the SCC mix with or without blended cement and coarse aggregate with or without coarse aggregate blending. This tool can also be enhanced for multi blended cements with more additives and also useful for Self-compacting mortar design.

J.V Kerai, S.R. Vaniya [18], had studied about use of manufactured sand in normal vibrated concrete. Concrete made from manufactured sand as partial replacement of fine aggregate they had studied for workability, compressive strength, tensile strength, and modulus of elasticity. They use manufactured sand as partial replacement of fine aggregate by different percentage for making concrete of grade M-20. The percentage replacement will be 0%, 10%, 20%, 30%, 40%, 50%, 60%, & 70% with natural fine aggregate by its weight. They prepare cubes, cylinders, beams and finally slump test, compressive strength test, splitting tensile strength test and flexural strength test will be conducted to obtain the necessary results. A large no. of

trial mixes are required to select the desired optimum replacement of fine aggregate by manufactured sand. There is not much more difference in slump of 50% manufactured sand concrete and normal concrete. Up to 50% replacement of fine aggregate with manufactured sand has not much more reduction in compressive strength of concrete. By the replacement of manufactured sand in concrete, flexural strength was decreases from 0% to 30% and then increases in 40% & 50% compared to 30%, then after decrease the flexural strength in 60% & 70% replacement. Flexural strength decreases from 2.54% to 16.57%. By the replacement of manufactured sand in concrete, split tensile strength was decreases from 0% to 30% and then increases in 40% & 50% compared to 30%, then after decrease the split tensile strength in
60% & 70% replacement. Split tensile strength decreases from 5.39% to 19.78%.

III. Conclusion

[1] This literature papers deals with – (1) use of waste material in concrete (2) Partial replacement of waste material with fine aggregate in SCC (3) tests of fresh and hardened properties of SCC made with that materials.
[2] Using crushed sand, river sand, and mixture of both sand slump flow increases v-funnel time increased. Increasing the limestone fines content up to 10–15%, improved the compressive strength of mortar. For higher limestone fines content, the compressive strength decreased gradually.
[3] Manufactured sand (Msand) produced by crushing rock deposits used for making SCC. The results of J-ring test revealed that aggregate characteristics also influence the passing ability of SCC. The compressive strength of mixes developed in this study ranged from 25 MPa to 60 MPa.
[4] The F.A. replaced by crushed seashells has slightly decreased the fluidity of self-compacting mortars. The flow recorded for the mortars containing 100% crushed sea- shells, was 610 mm. A very lighter decrease of compressive strength noticed.
[5] SCC mixes that include fine recycled aggregates with 100% recycled sand totally lost their SCC characteristics at 90 min and this loss of passing and filling ability. The mix with 20% recycled sand showed a reduction of 8% of compressive strength at 28 days, whereas the one with 100% recycled sand had a reduction of 47%.
[6] SCC made with spent foundry sand (up to 15%) increases strength properties such as compressive, splitting tensile strength (grades M20 & M30) of concrete. influence of spent foundry sand is more noticeable in case of M20 grade of concrete. Inclusion of spent foundry sand enhanced chloride permeability resistance of concretes.
[7] SCC mixes made with recycled CA and FA has showed increase in slump flow. The maximum compressive and tensile splitting strength were achieved by using 25–50% fine recycled aggregates as a replacement of river sand.
[8] Replacing sand by slag used in this research gives rise to mixtures with higher total pore volume and slightly finer pore structure, with smaller median pore size and threshold diameter. Due to their higher porosity, SCCs with slag are less stiff and lose water faster. This leads to higher drying shrinkage.
[9] The compressive strength of SCC made with waste tires was the best when 5% of the waste tire rubber powder was used. The shrinkage was small, but larger than ordinary concrete.
[10] The slump flow, blocking ratio, air content of the recycled glass SCC mixes increased with increase in recycled glass content. The compressive strength, tensile splitting of the RG–SCC mixes decreased with an increase in recycled glass content. The drying shrinkage of the RG– SCC mixes decreased with an increase in the recycled glass aggregate content.
[11] The plastic waste type can be used successfully as a fine aggregate in SCC. The fresh properties of SCC also improved using plastic waste. Reduction in the compressive strength was between 15% and 33% for mortar containing 20–50% plastic waste.
[12] The 56-day compressive strength of the SCC made with recycled aggregate was adversely affected with increase in RCA and/or RFA. Lowest compressive strength value such that these mixes showed a reduction of up to 30.9% as compared to normal SCC.
[13] The slump flow, flow ratio, and V-funnel of recycled glass SCC mixes increases with the increase of recycled glass content. The flow ratios varied from 0.83 to 0.89. The compressive strength, splitting tensile strength, flexural strength, and static modulus of elasticity of recycled glass SCC mixes decrease with the increase of recycled glass content.
[14] In SCC made with recycled alumina, to maintain flowability, constant increase in SP required. The compressive strength decreased at higher water– cement ratio and increased with increasing AW contentup to 75%.
[15] SCC made with rounded light weight aggregate has better filling ability, passing ability and segregation resistance. There is decrease in compressive strength at 28 days.
[16] Using recycled waste polyethylene terephthalate bottles the density of SCC was 1390 kg/m3,

which was about 47% lower than that of SCC with river sand. The slump of WPLA concrete increased proportionally to the increase in the proportion of WPLA in the mix. For 25%, 50% and 75% WPLA concrete mixes, the compressive strength decreased, respectively, 6%, 16% and 30%.

[17] In SCC made with quary dust has satisfactory results in slump flow test, V-funnel test and L-box test and has a gradual decreases in the strength values after replacement of 25% of quarry dust. In the case of 100% replacement of quarry dust there will be highly decrease in the compressive strength.

[18] There is not much more difference in slump of 50% manufactured sand concrete and normal vibrated concrete. Up to 50% replacement of fine aggregate with manufactured sand has not much more reduction in compressive strength of concrete. Above 50% replacement of fine aggregate with manufactured sand has rapid loss of compressive strength. split tensile strength was decreases from 0% to 30% and then increases in 40% & 50%.

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