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Testing of Strength of Recycled Aggregate Concrete using MicroSilica and its Applicability

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Abstract – This research paper highlights the results of experimental work done to evaluate the applicability of recycled aggregates in the production of fresh concrete. Three sets of concrete mixes undertaken for study are fresh concrete, recycled aggregate concrete and recycled aggregate concrete with MicroSilica as admixture. All mixes were designed for characteristic strength of M.20.Compressive strength of of concrete cubes was tested for 7 and 28 days. The effect of admixture (MicroSilica)on recycled aggregate concrete was studied. Compressive strength of frsh concrete(FAC), recycled aggregate concrete(RAC) and recycled aggregate concrete with admixture(RACA) are compared after 7 and 28 days. It is observed that the strength achieved by the recycled aggregate concrete with the addition of MicroSilica is better than the normal fresh concrete. So this study justifies the applicability of recycled aggregates in the production of fresh concrete using MicroSilica as admixture.

Keywords – Recycling, Recycled Aggregates, Recycled Aggregate Concrete, Admixtures, Fresh Concrete, Workability, Compressive Strength.

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I. INTRODUCTION

Concrete rubbles generated from construction and demolition waste comprises of sand,gravel,concrete,stone,bricks,wood,metals,glass ,plastic,paper etc; Recycling and reusing the waste (Recycled Aggregates) may save landfill space and also may reduce the natural resources (Virgin Aggregates) for the production of fresh concrete. Recently lot of research work is carried out on recycling and reuse of recycled aggregates as a part of waste management. Waste arising out of construction and demolition structures are increasing day by day and approximately 50% of this waste comprises of concrete rubbles which may be the good source of recycled aggregates. So, there is an urgent need to establish a technology to reuse recycled aggregates as a substitute to virgin aggregates in production of fresh concrete. Recycled aggregates were collected from different sources and the mixes were varied by replacement of virgin aggregates with recycled aggregates upto 100% by weight with or without admixture , MicroSilica . Results projects that the replacement of virgin aggregate by coarse recycled aggregate with MicroSilica upto 50% has better compressive strength as compared to the normal concrete but higher levels of replacement reduces the compressive strength.

II. RESULTS AND DISCUSSION

Testing programme was carried out replacing virgin aggregates by recycled ones with replacement percentages of 25%,50%,75% and 100% alongwith admixture MicroSilica. Concrete cubes were casted in moulds with machined faces of 15cmx15cmx15cm.Cubes were tested after 7 and 28 days. Various concrete mixes (Cement: Sand: Aggregates) in proportion 1:2.36:3.2 were taken with water cement ratio 0.55 . NCRA0 - Normal concrete with 0% replacement by recycled aggregates.NCRA10-Normal concrete with 10% replacement by recycled aggregates.NCRA0MS10-Normal concrete with 0% replacement by recycled aggregate and 10% addition of Microsilica .CF-Compaction Factor. It is observed that the strength achieved with the addition of Microsilica (10%) by weight of cement is less than the strength of normal grade concrete (NCRA0) and further study is carried out with same design mix with replacement of MicroSilica to 15%. Replacement ratio of recycled aggregates with virgin aggregates is maintained same and cube strength is tested after 7 and 28 days of curing at room temperature.

Table 1. Results of cube compressive strength with 10% MicroSilica

Sr. No.	Symbol	CF	Weight (Kg.)			Curing Period (Days)	Average Compressive Strength (MPa)
1	NCRA0	0.90	8.56	8.52	8.40	28	**26.07**
2	NCRA25	0.91	8.060	8.470	8.320		21.07
3	NCRA50	0.92	7.860	8.230	8.040		18.44
4	NCRA75	0.92	7.70	7.58	7.69		14.58
5	NCRA100	0.92	7.160	7.210	7.200		12.88
6	NCRA0MS10	0.91	8.020	7.970	7.880		27.10
7	NCRA25MS10	0.91	8.330	8.390	8.350		**22.51**
8	NCRA50MS10	0.91	7.990	8.170	7.970		21.55
9	NCRA75MS10	0.93	7.550	7.170	7.280		15.84
10	NCRA100MS10	0.91	7.90	7.74	7.69		13.33

Table 2. Results of cube compressive strength with 15% MicroSilica

Sr. No.	Designation	CF	Weight (Kg.)			Curing Period (Days)	Average Compressive Strength (MPa)
1	NCRA0	0.90	8.56	8.52	8.40	28	**26.07**
2	NCRA25	0.91	8.060	8.470	8.320		21.07
3	NCRA50	0.92	7.860	8.230	8.040		18.44
4	NCRA75	0.92	7.70	7.58	7.69		14.58
5	NCRA100	0.92	7.160	7.210	7.200		12.88
6	NCRA0MS15	0.91	8.050	8	7.950		**28**
7	NCRA25MS15	0.90	7.840	7.930	7.950		**27.77**
8	NCRA50MS15	0.89	7.850	7.980	7.920		**26.44**
9	NCRA75MS15	0.902	7.130	7.160	7.070		17.11
10	NCRA100MS15	0.907	8.190	8.130	7.990		14.88

Average compressive strength after 7 days of curing with 50% replacement of virgin aggregate by recycled ones is quiet greater than the normal grade of concrete NCRA0.

Table 3. Results of cube compressive strength with 15% MicroSilica

Sr. No.	Designation	CF	Weight (Kg.)			Curing Period (Days)	Average Compressive Strength (MPa)
1	NCRA0	0.90	8.31	8.43	8.30	7	**18.44**
2	NCRA25	0.91	8.18	8.41	8.11		15.36
3	NCRA50	0.92	7.95	7.96	8.03		13.83
4	NCRA75	0.92	7.69	7.580	7.750		11.22
5	NCRA100	0.92	7.470	7.310	7.530		10.30
6	NCRA0MS15	0.91	8.050	8	7.950		17.77
7	NCRA25MS15	0.90	7.840	7.930	7.950		**18.88**
8	NCRA50MS15	0.89	7.850	7.980	7.920		21.77
9	NCRA75MS15	0.902	7.130	7.160	7.070		13.55
10	NCRA100MS15	0.907	8.190	8.130	7.990		11.77

From Table 3 it is obvious that compressive strength decreases with the addition of recycled aggregates. Decrease in strength is due to the adhered mortar to recycled aggregates. Adhered mortar makes bonding with the new mortar which leads to poor recycled aggregate concrete performance which eventually leads to decrease in compressive strength. Increase in compressive strength of recycled aggregate concrete is obvious in percentage replacement ratio of 25% and 50% along with the admixture MicroSilica as compared to fresh concrete after 28days of curing. Gain in strength is due to the unhydrated mortar adhered to recycled aggregates and MicroSilica added as admixture.

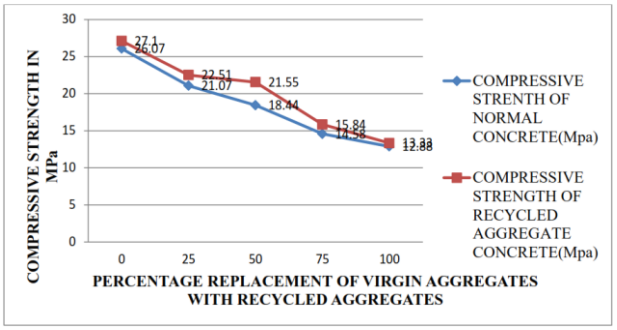

Figure 1. Relative 28 days compressive strength for Normal Concrete and Recycled Aggregate Concrete with 10% MicroSilica

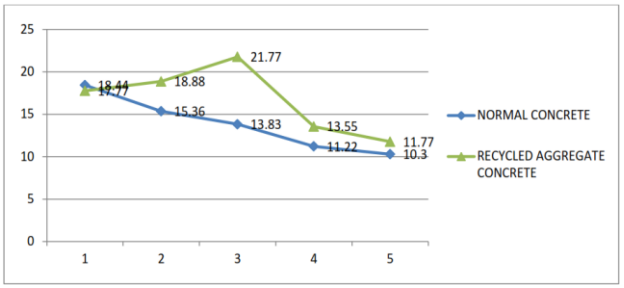

Figure 2. Relative 7 days compressive strength for Normal Concrete and Recycled Aggregate Concrete with 15% MicroSilica

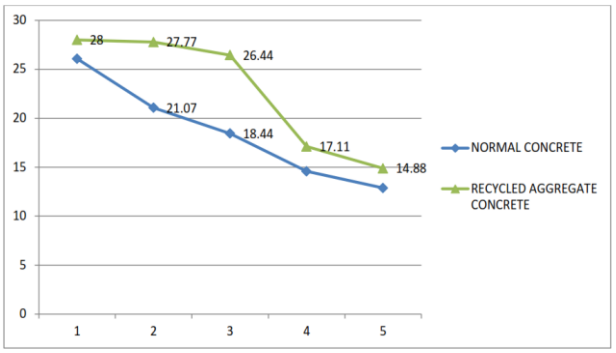

Figure 3. Relative 28 days compressive strength for Normal Concrete and Recycled Aggregate Concrete with 15% MicroSilica

III. CONCLUSION

Based on test results, recycled aggregate concrete with admixture MicroSilica is giving better compressive strength as compared to fresh concrete with replacement percentages of 25% and 50%.Recycled aggregate concrete mixes is giving bigger compressive strength as compared to fresh concrete at replacement percentages of 25% and 50% due to gel formation because of admixture MicroSilica. Workability decreases with percentage increase of recycled aggregates because of water absorption by the adhered mortar. Recycled aggregates can be termed as raw material which can be economic assets in future for the construction industry. Results are awesome and

recycled aggregates can be utilized for sustainable infrastructural development.

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