iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** IV **Month of publication:** April 2018

DOI: http://doi.org/10.22214/ijraset.2018.4025

Comparative Study of Reactive and Modified Reactive Powder Concrete

V. Nandini[1], K. Sumithra[2], G. Divya[3], T. Saranya[4]
[1, 2, 3,] Student, [4] Assistant Professor Department of Civil Prathyusha Engineering College, Tamilnadu.

Abstract: Eactive powder concrete (RPC) is the type of cementitious composite materials developed by the technician division of Bouygues, in the early 1990s. The absence of coarse aggregate was considered by inventors to be key aspect for the microstructure and performance of RPC in order to reduce the heterogeneity between cement matrix and aggregate. Reactive Powder Concrete (RPC) is an high strength and high ductility composite material with advanced mechanical properties. The purpose of this investigation is to determine the strength variations in RPC and MRPC. MRPC is carried out with an introduction of graded aggregate (8-10mm) and deal with steel fibers as replacement of coarse aggregate. Our investigation also deals with the various applications of each mix based on cost analysis and to determine the suitable mix proportion. It is done by carrying a comparative study of RPC with cement, quartz sand, silica fume and modified RPC with cement, silica fume, quartz sand and superplasticizer partially replace with coarse aggregate and addition of steel fibre called as RPCCAF. Hot water curing is carried so that the quartz react with it and produce higher strength. So as to make this RPC more economical and feasible without much reduction in its mechanical properties.
Keywords: Quartz sand, steel fiber, hot water curing, cost analysis.

I. INTRODUCTION

Reactive powder concrete (RPC) is an cementitious composite which entirely differs from conventional concrete. Developed by P. Richard and M.. Cheyrezy. According to his theory, he eliminated coarse aggregate since it affects the homogeneity property. This type of concrete has enhanced mechanical and durability properties. The addition of supplementary material, elimination of coarse aggregates, very low water/binder ratio, additional fine steel fibers, hot water curing were the basic concepts on which it was developed. RPC structural elements can resist chemical attack, impact loading from vehicles and vessels, and sudden kinetic loading due to earthquakes. The mixing time was found to be shorter than for RPC without coarse aggregates. Formulations with and without coarse aggregate exhibited a similar behavior under compressive loading. Reactive Powder Concrete has higher durability, higher fatigue, and impact and abrasion resistances. Here, a cube of size 75 x 75 x 75 mm is used since there is a reduction in coarse aggregate utilization. Based on its strength and cost of RPC and MRPC in various mixes it can be applied in various areas.

A. Advantages of Rpc

1) Better alternative to HPC.
2) High Tension Ductile failure mechanism eliminates the need for reinforcing steel.
3) Improved seismic performance by reducing inertia loads with lighter members.
4) The main advantage that RPC has over standard concrete is its high compressive strength.

B. Disadvantages

1) NO CODE (no any formal worldwide document but is under research).
2) The mineral component causes cost.

C. Applications

1) RPC has found application in the storage of nuclear waste, bridges, roofs, piers, seismic-resistant structures and structures designed to resist Impact/blast loading.
2) Owing to its high compression resistance, precast structural elements can be fabricated in slender form to enhance aesthetics.

D. Objectives

1) To calculate best mix proportion.
2) To compare the compressive strength of RPC with and without coarse aggregate in different proportions with different materials.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IV, April 2018- Available at www.ijraset.com

3) To determine applications of various mix.

II. METHODOLOGY

To find the optimum mix proportion, mix design was done as per Richard an cheyrezy table. A cube size of 75 x 75 x 75 mm is used to make cube of various mixes. Mix ratio for different mixes is taken and calculated. Material was collected an properties are observed by various tests. Material are batched for mixing as per mix design and mixed uniformly. Fresh concrete tests are done by slum test. It is then casted in cube of 75 x 75 x 75 mm mould and compacted with a tamping rod. Air entrapped in the concrete will reduce the strength of the cube. Hence the cube must be fully compacted. Sand is replaced by silica fume, instead of coarse aggregate quartz sand is used and cement. A mix of ORPC, RPCCA with 30% replacement, 40% replacement and 50% replacement of quartz sand with coarse aggregate(8-10 mm) and RPCCAF with 30% replacement, 40% replacement and 50% replacement of quartz sand with coarse aggregate(8-10 mm). The specimen is allowed to hardened for 24hrs and cured. The specimens were exposed to hot water curing at (80°c - 90°c) for duration of 24, 48 or 72 hours at the age of 3rd and 7th day followed with air curing or water curing till 28 days . The compressive strength for various mixes is determined and cost analysis was done after arriving mix proportion by following P. Richard and M. Cheyrezy chart for mix proportion Compressive strength of specimens of various mixes was determined at 7 and 28 day.

III. MATERIALS

Silica fume is used for filling voids, Quartz are man-made engineered stone countertops. Superplasticizers, also known as high range water reducers, are chemical admixtures used where well-dispersed particle suspension is required. As a rule of thumb, small fibres tend to be used where control of crack propagation is the most important design consideration. Binding wire of length (813mm) are used which increases compressive strength.

IV. MIX DESIGN

Mix ratio as per P.Richard and M.cheyrezy are given in following table

	P. Richard and M. Cheyrezy[1]				S. A. Bouygues[3]	V. Matte[9]	S. Staquet[10]
	[1995]				[1997]	[1999]	[2000]
	Non fibred		12 mm fibres		25 mm fibres	Fibred	Fibred
Portland Cement	1	1	1	1	1	1	1
Silica fume	0.25	0.23	0.25	0.23	0.324	0.325	0.324
Sand	1.1	1.1	1.1	1.1	1.423	1.43	1.43
Quartz Powder	--	0.39	--	0.39	0.296	0.3	0.3
Superplasticizer	0.016	0.019	0.016	0.019	0.027	0.018	0.021
Steel fibre	--	--	0.175	0.175	0.268	0.275	0.218
Water	0.15	0.17	0.17	0.19	0.282	0.2	0.23
Compacting pressure	--	--	--	--	--	--	--
Heat treatment temperature	20°C	90°C	20°C	90°C	90°C	90°C	90°C

A. Mix Design of ORPC

Density of cement = 1440 kg/m^3
Density of silica fume = 600 kg/m^3
Density of quartz sand = 1120 kg/m^3

Weight of cement

= (1x 1.54/(1+0.25+ 1.1)) x 1440
= 943 kg

Weight of silica fume
= (0.25 x 1.54/ 2.35) x 600
= 98.25 kg

Weight of quartz sand
= (1.1 x 1.54/ 2.35) x 1120
= 807.35 kg

Weight of water
w-c ratio = 0.28
= 0.28 x 943
= 264kg

Weight of super plasticizer

= 1% of cement = 9.43kg

MATERIALS	Cement	Silica fume	Quartz sand	w/c ratio	Water	Super plasticizer
WEIGHTS (kg) for 1 m^3	943	98	807	0.28	264	9.43

B. Mix Design of MRPC

MATERIALS	Cement	Silica fume	Quartz sand	Aggregate (30%)	W/c ratio	Water	Super Plasticizer
WEIGHT (kg) for 1 m^3	943	98	565	242	0.27	255	9.43

MATERIALS	Cement	Silica fume	Quartz sand	Aggregate (40%)	W/c ratio	Water	Super Plasticizer
WEIGHT (kg) for 1 m^3	943	98	484	323	0.26	255	9.43

MATERIALS	Cement	Silica fume	Quartz sand	Aggregate (50%)	W/c ratio	Water	Super Plasticizer
WEIGHT (kg) for 1 m^3	943	98	404	404	0.25	255	9.43

C. Mix Design of RPCF

Density of cement = 1440 kg/m^3
Density of silica fume = 600 kg/m^3
Density of quartz sand = 1120 kg/m^3
Density of steel fibres = 7850 kg/m^3

Weight of cement

= (1x 1.54/(1+0.25+ 1.1+0.016)) x 1440
= 937 kg

Weight of silica fume

= (0.25 x 1.54/ 2.4) x 600
= 96 kg

Weight of quartz sand

= (1.1 x 1.54/ 2.4) x 1120
= 791kg
= 553 kg (30% deducted)
= 475 kg (40% deducted)
= 395 kg (50% deducted)

Weight of water
w-c ratio = 0.27
= 0.27 x 937
= 252.9 kg
Weight of super plasticizer
= 1% of cement
= 9.37kg
Weight of steel fibre
= (0.016 x 1.54/ 2.4) x 1120
= 11.5 kg

D. Mix Design of RPCCAF

MATERIALS	Cement	Silica fume	Quartz sand	Steel fibre	Aggregate (30%)	W/c ratio	Water	Super Plasticizer
WEIGHT (kg) for 1 m^3	937	96	553	11.5	237	0.25	255	9.43

MATERIALS	Cement	Silica fume	Quartz sand	Steel fibre	Aggregate (40%)	W/c ratio	Water	Super Plasticizer
WEIGHT (kg) for 1 m^3	937	96	475	11.5	316	0.26	255	9.43

MATERIALS	Cement	Silica fume	Quartz sand	Steel fibre	Aggregate (50%)	W/c ratio	Water	Super Plasticizer
WEIGHT (kg) for 1 m^3	937	96	395	11.5	395	0.25	255	9.43

V. TESTS & RESULTS

For testing of the concrete the test usually is of two types 1. material testing 2. strength testing.

A. Material Testing

First the materials must be tested for its property, there are various test available for testing the materials. They are

1) *Specific Gravity of Coarse Aggregate :* The specific gravity of coarse aggregate is determined by using pycnometer and the result was found to be 2.73.
2) *Specific Gravity of Fine Aggregate:* The specific gravity of coarse aggregate is determined by using pycnometer and the result was found to be 2.69.
3) *Initial and Final Setting Time of Cement :* Initial and final setting time is determined by vicat's apparatus and the result was found to be 560 min.
4) *Standard Consistency Test :* The standard consistency of a cement paste is determined by vicat's apparatus and the result was found to be 560 min.
5) *water Absorption Test :* To determine the water absorption of coarse aggregates as per IS : 2386 (Part III) 1963. It is determined by pycnometer an the result is 0.91%.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IV, April 2018- Available at www.ijraset.com

6) *Slump Test :* To determine theworkability of fresh concrete using slump test as per IS 1199-1959,the slump value was found to be 75.

B. Strength Testing

This type of testing is done to find the strength of a materials.

1) *Compressive Strength Of Concrete Cube :* The compression test of cube was determined by CTM equipment.

Compression test of a cube Calculations :

Surface Area of the cube = 5625 mm^2 (75^2)

Maximum load applied = 405 kN

Compressive strength of Concrete = P/A

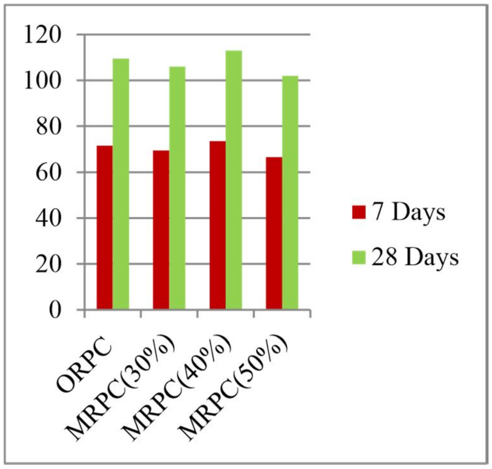
= 405x 10^3/(5625)

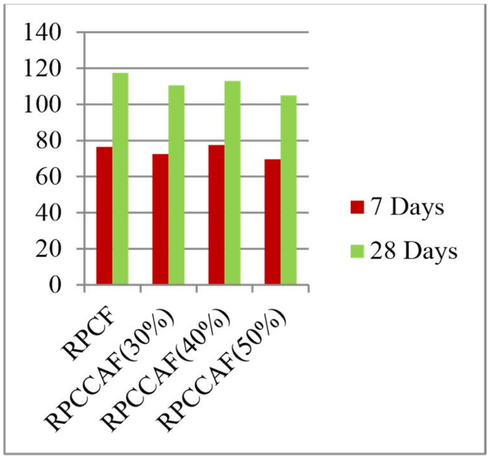
= 72 N/ mm^2

DESCRIPTION	Ultimate load (kN)		Compressive strength fck = P/A (N/mm^2)	
	7 days	28 days	7 days	28 days
ORPC	400	610	71.5	109.5
MRPC (30%)	389	603	69.5	106
MRPC (40%)	369	568	66.5	102
MRPC (50%)	416	640	73.5	113
MRPC with steel fiber	432	666	66.5	117
MRPC(30%) with steel fiber	412	625	72.5	110.5
RPCCAF (40%)	436	640	77.5	113
RPCCAF(50%)	395	597	69.5	105

C. Graphs

Compressive strength of RPC and MRPC in different proportions





Compressive strength of RPCCASF with different proportion

VI. CONCLUSION

In this Regard, the new mix and its application is found. MRPC with 40% replacement serves better than ORPC. MRPC with 50 % replacement can be used to store nuclear contaminants. RPCCAF has higher compressive than RPCCAF it can be used in seismic prone areas. Compressive strength of conventional concrete for 7days and 28days curing is found out. Graph is plotted comparing compressive strength of ORPC and MRPC in different proportions.

Material	ORPC	MRPC (30%)	MRPC (40%)	MRPC (50%)	RPCF	RPCCAF (30%)	RPCCAF (40%)	RPCCAF (50%)
Cost	15,866	15740	15680	15600	16250	16130	16080	16020

MRPC (40%) is a best mix since its compressive strength is high and cost is low it can be used in bridge walkways and nuclear contamination storage. RPCF has higher compressive strength than RPCCAF.

REFERENCES

[1] Richard P, Cheyrezy M H,"RPC with high ductility and compressive strengths of 200Mpa order".
[2] M.S.Shetty,"Concrete Technology".
[3] CONCRETE" Microstructure, Properties, and Materials" by P. Kumar Mehta and Paulo J. M. Monteiro. [6]Indian Standard "METHOD OF MAKING, CURING AND DETERMINING COMPRESSIVE STRENGTH OF ACCELERATED-CURED CONCRET TEST SPECIMENS", IS: 9013- 1978.
[4] Silica fumes Manual. ―ELKEM India Pvt. Ltd. Mumbai‖.
[5] Roux, N., Anreade, C., and Sanjuan, M.A., "Experimental Study of Durability of Reactive Powder Concretes," Journal of Materials in Civil Engineering, February, 1996.