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Replacing of Aggregates by Rubber Aggregates in Concrete:an Experimental Investigation

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ABSTRACT: *Concrete is one of the most well known structure materials. The development business is consistently builds its uses and applications. Along these lines, it is required to discover elective materials to decrease the expense of cement. Then again, Non-biodegradable waste for example water bottles, cool beverage containers and dispensable glasses, destroyed or crumbed elastic and so on., is making a ton of issues in the earth and its removal turning into an incredible trouble. The goal of this paper is to research the utilization of elastic pieces as coarse total in the solid. Concrete tried with changing rates of elastic from 10 to half of typical totals. Compressive quality, split elasticity and flexural quality of cement is estimated and near examination is made.*
Keywords:*crumbedrubber,Concrete,Compressivestrength,Tensilestrength,Flexuralstrength*

I. INTRODUCTION

Duringthelastthreedecades,therehavebeendramaticchangesinthewayofthinkingaboutindustrialprocessesandtheapproachandevaluationofnewandinnovativematerials.Concrete,initsmostbasicform,isoneoftheworld'soldest buildingmaterial.Concreteisasubstancecomposedofonlyafewsimpleandcommonly

availableingredientsthatwhenproperlymixedandcured,maylastforcenturies.Concreteisanevolvingmaterial aswell.Newtechniquesandmethodsforselectingtherightquantitiesofthosesimplecomponentsarecontinuallybeingpresentedtothedesigncommunity.Newingredientstoincludeinconcretemixesarealsoconstantlybeingresearchedanddeveloped.

Ingeneral,concretehaslowtensilestrength,lowductility,andlowenergyabsorption.Concretealsotendstoshrinkandcrackduringthehardeningandcuringprocess.Theselimitationsareconstantlybeingtestedwithhopesofimprovementbytheintroductionofnewadmixturesandaggregatesusedinthemix.Onesuchmethodmaybetheintroductionofrubbertotheconcretemix.Shreddedorcrumbedrubberiswastebeingofnonbiodegradableandposesseverefire,environmentalandhealthrisks.

Rubberfilledconcretetendstohaveareductioninslumpanddensitycomparedtoordinaryconcrete.Thereductionisaround85%onslumphasbeenreportedwhencomparingwiththeconventionalconcrete[1,2].Concretecontainingrubberaggregatehasahigherenergyabsorbingcapacityreferredastoughness.Rostamietal.[3]reportedinvestigationonthecomparisonofthetoughnessofacontrolconcretemixturewiththatofarubbercontainingconcretemixture.Theresultsshowsthatthetoughnessisincreasedwhenrubberaggregatespresentintheconcrete.Eldinetal.[4]andfedroffetal.[5]exploredtheeffectofrubberchipsonthecompressivestrengthandflexuralstrengthofcrumbedrubberconcretemixes.BielandLee[6]experimentedwithaspecialcement(MagnesiumOxychloridetype)forthepurposeofenhancingthebondingstrengthbetweenrubberparticlesandcement.HernanadezOlivaresetal.[7]providedscanningelectronmicroscopephotosofrubber/cementinterface,aswellastheevaluationofthecomplexmodulus.Thestudiesmentionedintheaboveareanalyticaland/orlaboratorybasedexperimentalworkandthemajorfindingsareductilityofconcretecanbeincreasedby introducingtherubberintheconcrete.

Theobjectiveofthisstudyistotestthepropertiesofconcretewhenshreddedorcrumbedrubberusedasaggregatebypartialreplacementofnaturalaggregates.Theparametersofthisinvestigationincludethecompressivestrength,splittensilestrengthandflexuralstrengthofconcretespecimens.Cubesof150mmsizeforcompressivestrength,cylindersof size 150X300mmandbeamsizeforflexuretestis100X100X500mmarecastedforthetestingofconcrete.Theconcretehavingcompressivestrengthof30N/mm^2(M30)isusedandpercentagesofrubberaggregatesare10,20,30,40and50%ofnormalaggregates.Thenaturalaggregatesarereplacedbyrubberaggregatesonvolumebasis.Thestrengthperformanceofmodified concretespecimenswascomparedwiththeconventionalconcrete.

II. EXPERIMENTAL INVESTIGATION MATERIALS

Cement:

Physicalproperties	**TestResults**	**LimitsasperIS8112–1989**
Fineness(m^2/Kg)	296	225minimum
InitialSettingTime(min.)	140	30

FinalSettingTime(min.)	245	600
Soundness		
ByLechatelier(mm)	1.50	10
By AutoClave(%)	0.04	0.8
Compressivestrength		
3daysN/mm^2	32	23
7daysN/mm^2	41.3	33
28daysN/mm^2	59	43
Chemicalproperties		
*LSF	0.89	0.66to1.02
#AM(Al_2O_3/Fe_2O_3)	1.26	0.66
Insolubleresidue(%bymass)	1.20	3
Magnesia(%bymass)	1.30	6
SulphuricAnhydrate(Bymass)	2.18	3
TotalLossinIgnition(%)	1.56	5
TotalChlorides(%)	0.012	0.05
*LSF:LimeSaturationFactor #AM:RatiopercentageofAluminatothatofIronOxide		

TheOrdinaryPortlandCement(OPC)43gradeisusedinthisinvestigation.Thephysical&chemicalpropertiesof thecementareasshowninTable-1
Table1.PropertiesofCement

Aggregates:

Theaggregateconsistsofbothfineandcoarsecomponents.Thefineaggregate,whichoftenreferredtosand,isusuallynotacommerciallymanufacturedproductbutonethatistakendirectlyfromnature.Coarseaggregateisamaterialcommonlyproducedbycrushinglargerrock,separatingthecrushedportionaccordingtosize,andrecombininginacarefullycontrolledmanner.

FineAggregate:

ThelocallyavailableriversandfromKarimNagar,AndhraPradesh,India,isusedasfineaggregateintheconcrete designmix.Thespecificgravity,waterabsorptionandfinenessmodulusare2.62,0.3%and2.78respectively.Thesieveanalysisdataoffineaggregateispresentedin Table-2.

Table2.SieveAnalysisofFineAggregate

IS Sieve(mm)	Weightretained(gm)	%weightretained	Cumulative %weightretained	% passing	LimitsasperIS383–1970, IS2386–1963.
10	0	0	0	100	100
4.75	94	4.7	4.7	95.3	90–100
2.36	178	8.9	13.6	86.4	75–100
1.18	246	12.3	25.9	74.1	55–90
600	606	30.3	56.2	43.8	35–50
300	482	24.1	80.3	19.7	8–30
150	346	17.3	97.6	2.4	0–10
Totalcumulative% of weightretained			278.3		

CoarseAggregate:

Thecoarseaggregateusedintheexperimentalinvestigationisamixtureof20mmand10mmsizeaggregates.Theaggregatesareangularinshapeandfreefromdust.Thespecificgravity,waterabsorptionandfinenessmodulusare2.65,0.3%and7.18respectively.TheresultsofsieveanalysisofcoarseaggregateareshowninTable-3.

Table3.**SieveAnalysisofCoarseAggregate**

IS Sieve(mm)	Weightretained(gm)	%weightretained	Cumulative%weightretained	% passing	LimitsasperIS383–1970, IS 2386–1963
80	0	0	0	100	100
40	0	0	0	100	100
20	936	18.72	18.72	81.2	85–100
10	4044	80.88	99.6	0.4	0–20
4.75	20	0.4	100	0	0–5
2.36	0	0	100	0	0
1.18	0	0	100	0	0
600	0	0	100	0	0
300	0	0	100	0	0
150	0	0	100	0	0
Totalcumulative%ofweightretained			718.32		

Water:

Waterusedinconcreteisfreefromsewage,oil,acid,strongalkaliesorvegetablematter,clayandloam.Thewaterusedispotable,andissatisfactorytouseinconcrete.WatersamplecollectedfromborewellanditspropertiesareshowninTable-4.

Table4.Propertiesofwatersample

S.No.	Parameter	Results	LimitsasperIS456–2000
1	pH	6.3	6.5–8.5
2	Chlorides(mg/l)	45	2000(PCC) 500(RCC)
3	Alkalinity(ml)	6	<25
4	Sulphates(mg/l)	105	400
5	Florides(mg/l)	0.04	1.5
6	OrganicSolids(mg/l)	43	200
7	Inorganic Solids(mg/l)	115	3000

Shreddedorcrumbedrubber:

ThephysicalpropertiesofshreddedorcrumbedrubberaregiveninTable-5.

Table5.Propertiesofrubber

Compacteddensity	2.3to4.8kN/cum
Compactedunitweight	1/3ofsoil
Compressibility	3timesmorecompressiblethansoil
Density	1/3to1/2lessdensethanthegranularfill
Durability	Non-biodegradable

ModulusofElasticity	1/10ofsand
Permeability	Lessthan10cm/sec
Poisson’sRatio	0.2to0.3
Specificgravity	1.14to1.27
Thermalinsulation	8timesmoreeffectivethanthegravel
Unitweight	Halftheunitweightofgravel

MixProportions:
TheconcretemixisdesignedasperIS102621982,IS4562000andSP23.Table6presentsthequantitiesofmixproportionfor onecubicmeterofconcreteandonecementbag.

Table6.Quantitiesofmixproportion

MixConstituents	Foronem^{3}of concrete(kg)	For50kgcementbag(kg)
Cement	350	50
Water	147	21
Fineaggregate	719	103
Coarse aggregate20mm <10mm	712 474	102 68
Watercementratio	0.42	

Standardcastironmouldsofsize150x150x150mmforcubes,cylindersofsize150X300mmandbeamsizeforflexuretestis 100X100X500mmareusedinthepreparationofspecimens.TheexperimentalsetupisshowninFigure1and2.

Figure1Experimentalsetup

Figure2Specimenafterfailure

III. RESULTS & DISCUSSIONS

Theeffectofrubberaggregatesinunitweightofconcreteisdecreasedasthe%ofrubberincreasedasshowninFigure3.Almo st20.4%lossofweightat50%ofaggregatesreplacedwiththerubberaggregates.

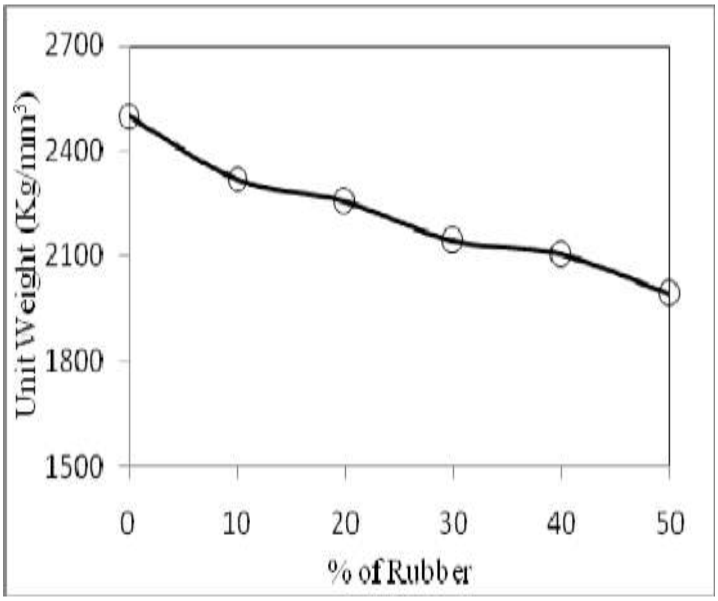

Figure3UnitWeight(Kg/m^3)ofconcrete

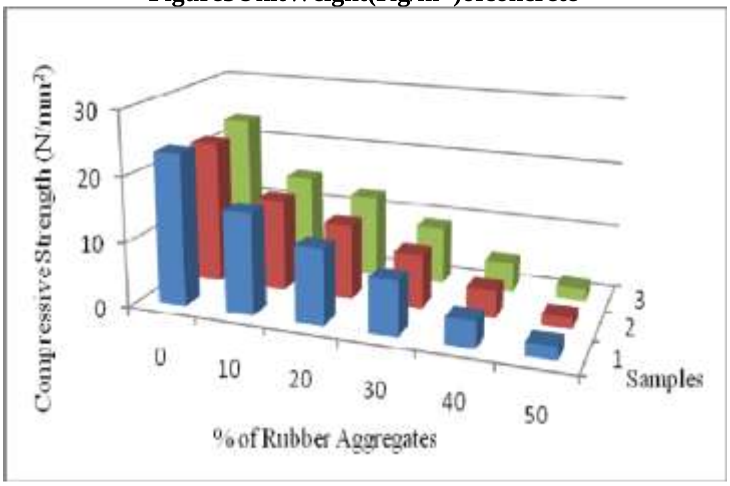

Figure4Compressivestrength(N/mm^2)ofconcreteat7daysage

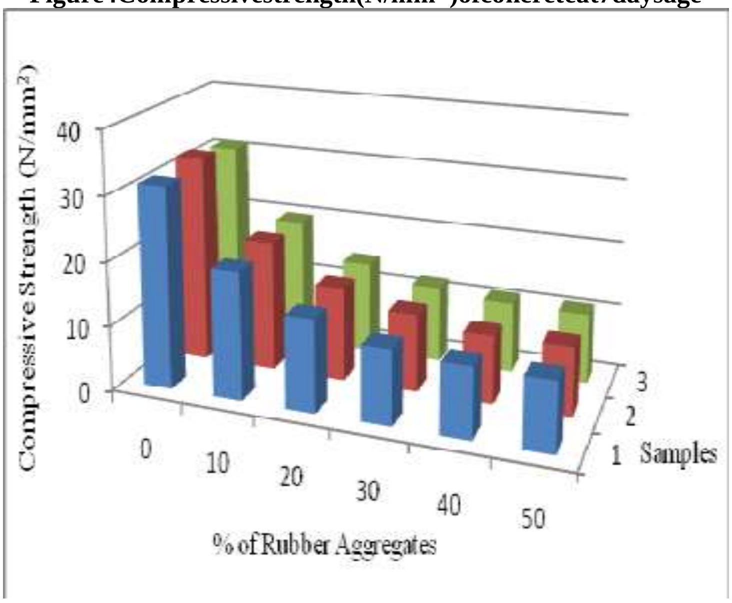

Figure5Compressivestrength(N/mm^2)ofconcreteat28daysage

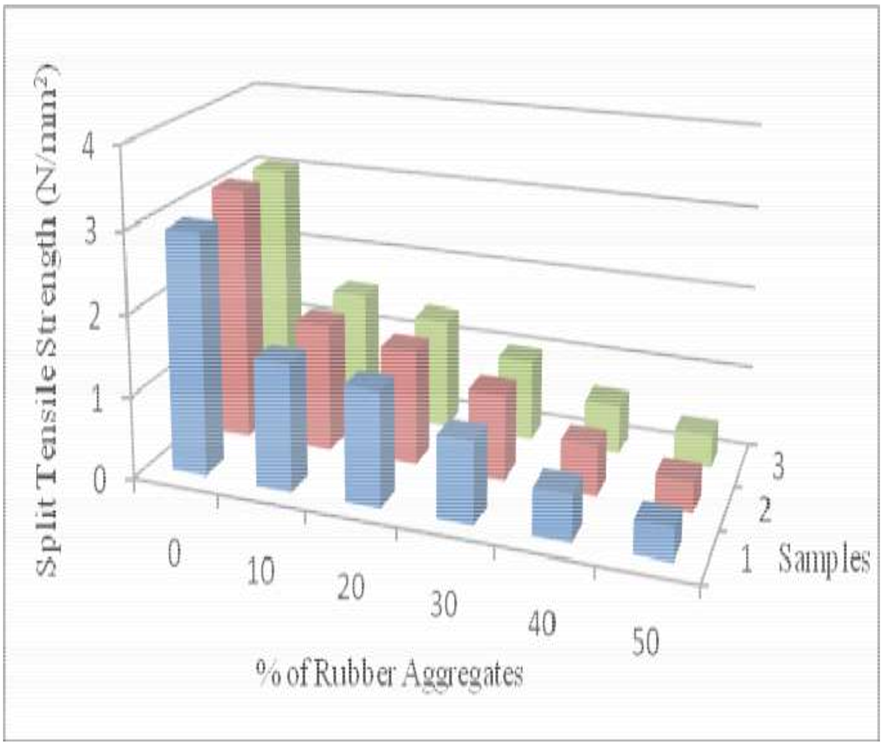

Figure6Splittensilestrength(N/mm^2)ofconcreteat7daysage

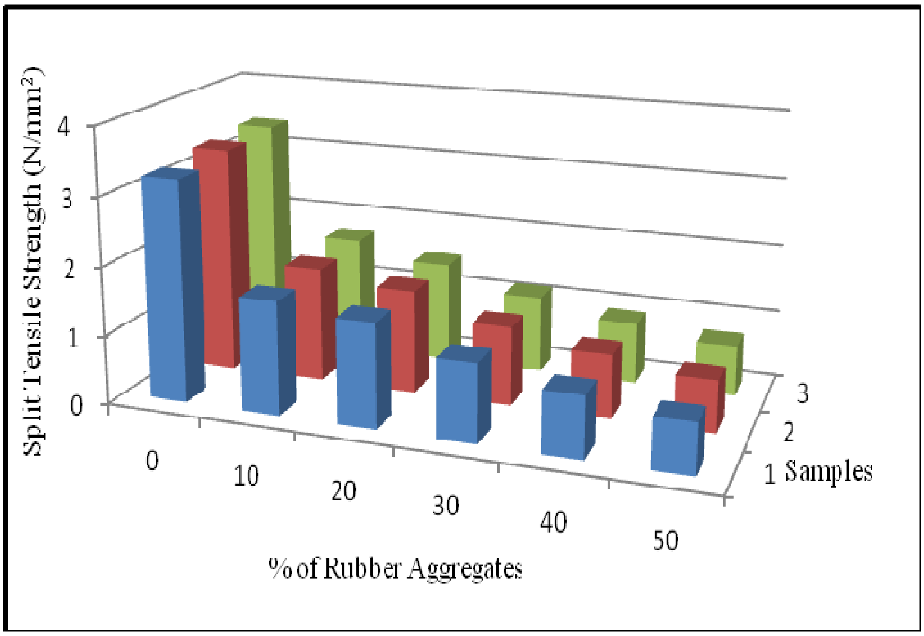

Figure7Splittensilestrength(N/mm^2)ofconcreteat28daysage

Compressivestrengthandsplittensilestrengthofconcreteisdecreasedasthepercentageofrubberaggregatesareincreased intheconcrete.Thepercentageof compressivestrengthlossis35.53for10%ofrubberaggregateandnearly91.98for50%ofrubberaggregatesattheageof7d ays.ThevariationscanbeobservedinFigures4to 7. Tableno.7showstheaveragecompressiveandsplittensilestrengthsofmodifiedandconventionalconcretes.

Table7AverageCompressiveandSplittensilestrengthsofconcrete

	Compressivestrength		Splittensilestrength	
%ofrubber	7Days	28Days	7Days	28Days
0	23.08	31.57	3.05	3.32
10	14.88	19.95	1.56	1.68
20	11.97	14.36	1.39	1.50
30	8.48	11.86	1.01	1.14
40	4.24	10.77	0.59	0.91
50	1.85	10.71	0.39	0.74

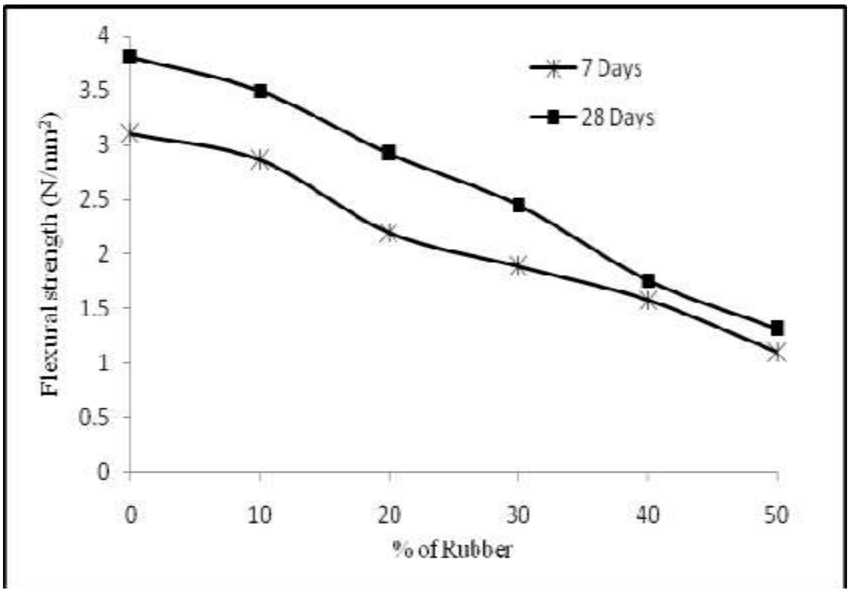

Figure8Flexuralstrength(N/mm^2)ofconcrete

TheflexuralstrengthofmodifiedconcreteasshowninFigure8isdecreasesaspercentageofrubberaggregatesincreases.

IV. CONCLUSIONS

Basedonthepresentandexperimentalinvestigationstudiesthefollowingconclusionscanbedrawn

1. Theunitweightofmodifiedconcreteisdecreasedapproximatelyby20.4%when50%ofaggregatesisreplacedbyrubberaggregates.
2. Thecompressivestrengthofconcreteisdecreasedasthepercentageofrubberaggregatesincreased.
3. Astherubbercontentincreasesintheconcretesplittensilestrengthdecreases.Itindicatesthestrainatfailureisincreased.Sothismixismoreenergyabsorbentmix.
4. Concretewithrubberaggregateshaveflexuralstrengthisalmost66%lessthantheconventionalconcrete.Howevermodifiedconcretehasmoreductilitywhencomparedtoconventionalconcrete.

Concretecontainingrubberaggregatesisstillnotrecommendedforthestructuralapplicationsanditcanbeusedwherestrengthisnotthecriteria.Thismixwillbeveryusefulinthelightweightconcreteapplications.

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