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Waste Plastic Fibre Reinforced Concrete Using Red Mud: An Experimental Investigation

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ABSTRACT: *The field of concrete Technology is under going immense changes in nowadays. A wide range of kinds of cements are altering the development business. Among them the fiber fortified solid, ferro cement, polymer solid, prepared blend concrete and so forth are assuming significant job. The fiber fortified cement in which the strands are scattered haphazardly has numerous applications in structural designing field.*
The plastic is causing an ecological contamination since it is a non-biodegradable material. The plastics are causing the ecological contamination. The plastics being non biodegradable material don't rot and it even ruin the richness of land, comparatively another contamination causing modern waste is Red mud. Red mud is a buildup from aluminum manufacturing plants where bauxite is utilized as metal for the creation of aluminum. The removal of this red mud has become an issue to the businesses. Alongside this it causes ecological contamination
This Paper presents the consequences of waste plastic fiber strengthened solid when red mud is included it. Various rates of waste plastic strands are utilized in the solid containing red mud. The quality properties of waste plastic filaments fortified solid like Compressive quality, Tensile quality, Flexural quality and Impact quality are concentrated alongside functionality attributes.
Thefieldofconcrete
Keywords:*Fibrereinforcedconcrete,wasteplastic,Redmud,Strengthandworkabilitycharacteristics.*

I. INTRODUCTION

Plainconcreteisweakintensionandhaslimitedductilityandlittleresistancetocracking.Microcracksarepresentinconcreteandbecauseofitspoortensilestrength;thecrackspropagatewiththeapplicationofload,leadingtobrittlefractureofconcrete.Microcracksinconcreteareformedduringitshardeningstage.Adiscontinuousheterogeneoussystemexitsevenbeforetheapplicationofanyexternalload.Whentheloadisapplied,microcracksstartdevelopingalongtheplanes,whichmayexperiencerelativelylowtensilestrains,atabout2530%oftheultimatestrengthincompression.Furtherapplicationoftheloadleadstouncontrolledgrowthofmicrocracks.Thelowresistancetotensilecrackpropagationinturnresultsinalowfracturetoughness,andlimitedresistancetoimpactandexplosiveloading.Thelowtensilestrengthofconcreteisbeingcompensatedforinseveralways,andthishasbeenachievedbytheuseofreinforcingbarsandalsobyapplyingprestressingmethodsandtheintroductionoffibrestoformfibrereinforcedconcrete(FRC).Thefibrereinforcedconcreteisoneinwhichthefibresaredisperseduniformlythroughoutthemassofconcrete.Manytypesoffibreslikesteelfibers,GIfibres,glassfibres,andasbestosfibresetc.can beusedinthe production offibrereinforcedconcrete.
Alternativelywasteplasticcanbemadeuseinproductionoffibrereinforcedconcrete.Thisisanon-biodegradablematerial.Itiscausingenvironmentalpollutionindifferentways.Theplasticisanon-perishablematerial.Itcannotbedumpedinsoil.Ifdumpedinsoilitcausessoilpollution.Itcannotbedisposedinwater.Ifdisposedinwater,itcauseswaterpollution.Itcannotbeburntalso.Ifburnt,itcausesairpollutionbyreleasingmanytoxic gases.Formanycountriesthedisposingofplasticisbecominga bigheadache.
Redmudisawasteproductofaluminiumindustry,whichusesbauxiteasore.Thisredmudiscausingtheproblemofstoringanddisposaltothealuminiumindustry,thisredmud is alkalineinnaturewithlittlecementationsproperty.
Therearemanyindustrialwastes,whicharecausingenvironmentalpollution.Thesafedisposaloftheseindustrialwastesisabigproblemtotheindustrialistaswellastoenvironmentalist.Theseindustrialwastes,ifusedinbuildingconstructionasaconstructionmaterial,itis welcomingstep

II. MATERIALS USED

Cement: OrdinaryPortlandCement-53gradewasusedhavingaspecificgravityof3.15anditsatisfiestherequirementsofIS:12269-1987specifications.Thephysicalpropertiesoftestedcementaregiven inTable2.1

Table2.1:PhysicalpropertiesOrdinaryPortlandCement-53grade(IS:12269-1987)

Properties	Results	PermissiblelimitasperIS:12269-1987
Fineness	30.3m^2	Shouldnotbe morethan22.5m^2/N
Normalconsistency	30	-

Specificgravity	3.15	-
SettingTime a. Initial b. Final	115Min .	Shouldnotbelessthan30MinShouldnotbemorethan600Min
Soundnesstest a. Le-chatexpansion	1 0.09	10mmmaximum0.8%maximum
Compressivestrengthofmortarcubesfor a. 3days. b. 7days. c. 28days	35.5N/mm^2 47.0N/ 2	Shouldnotbelessthan27N/mm^{2}Shouldnotbelessthan37N/mm^{2}Shouldnotbelessthan53N/mm^2

Coarseaggregates: Thecrushedstoneaggregatewerecollectedfromthelocalquarry.Thecoarseaggregatesusedintheexperimentationwere10mmanddownsizeaggregateandtestedasperIS:383-1970and2386-1963(I,IIandIII)specifications.Theaggregatesusedwerehavingfinenessmodulus1.9.SieveanalysesofcoarseaggregatearegiveninTable.2.2and physicaland mechanicalpropertiesoftestedcoarseaggregatesaregiven inTable2.3

Table2.2:Sieveanalysisofcoarseaggregate(IS:383-1970)

IS sievesize	Weightretained(grams)	Cumulativeweight retained(grams)	Cumulative%weightretained	Cumulative %	ISI permissiblelimit
12.5m	0	0	0	100	100
10mm	0	0	0	100	85-100
4.75m	1860	1860	93	7	0-20
2.36m	93	1953	97.65	2.35	0-5
Pan	47	2000	-	-	-
Total	2000	-	190.65	-	-

Finenessmodulus=190.65/100=1.90

Table2.3:Physicalandmechanicalpropertiesofcoarseaggregate(IS:2386-1963)

Properties	Results	PermissiblelimitasperIS:2386-1963
Impactvalue	15.50%	Shouldnotbe morethan30%usedforconcrete
Crushingvalue	25%	Shouldnotbemorethan30%forsurfacecourseand45%otherthanwearingcourse
Specificgravity	2.65	Inbetweenrange2.6-2.8
Moisturecontent	0.16%	-

Fineaggregates: LocallyavailablesandcollectedfromthebedofriverBhadrawasusedasfineaggregate.Thesandusedwashavingfinenessmodulus2.96andconfirmedtogradingzone-IIIasperIS:383-1970specification.SieveanalysisoffineaggregatearegiveninTable2.4andphysicalpropertiestestedforfineaggregatearegiveninTable 2.5

Table2.4:Sieveanalysisoffineaggregate(IS:383-1970)

IS sievesize	Weightretained(grams)	Cumulativewe	Cumulative%weightretained	Cumulative %	GradingzoneIII
10	0	0	0	100	100
4.75	5	1	99	-	90-100
2.36	44	45	09	91	85-100
1.18	30	75	15	85	75-100
600µm	50	125	25	75	60-79
300µm	185	310	62	38	12-40
150µm	120	430	86	14	0-10
Pan	70	500	-	-	-
Total	500gm	-	296	-	-

FinenessModulus:296/100=2.96

Table2.5:Physicalproperties offineaggregate(IS:2386-1963)

Properties	Results	PermissiblelimitasperIS:2386-1963
Organicimpurities	Colourless	Colourless/StrawColour/DarkColour
Siltcontent	0.7%	Shouldnotbe morethan6-10%
Specificgravity	2.63	Shouldbebetweenthelimit2.6-2.7
Bulkingofsand	16%	Shouldnotbe morethan40%
Moisturecontent	0.65%	-

Redmud: Theredmudusedinexperimentationwasobtainedfrom IndianAluminiumCompany(INDAL)Belgaum.Asthenameitselfsuggestsredmudisrustredcolour.ItspHvalueexceeds11therebyrevealingitsalkalinenature.Thedensityofredmudisbetween0.026-0.032gm/mm^{3}andwithanatomicweightof13.Chemicalandphysicalpropertiesofredmud are given inTableNo.2.6

Table2.6: Chemicaland physicalpropertiesofredmud

Chemicalcomposition		Physicalproperties	
Fe_2O_3	40-	Color	Reddishbrown
SiO_2	8-10%	Grainsizedistribution	Clayey
TiO_2	13-14%	Reactiontowater	Becomesstickyexhibitsincreaseincohesion
Ammonia	17-	Specificgravity	3.08
CaO	3-4%	Moisturecontent	12.03%
Na_2O	4-5%	Percentageoffiner	99%
		Bulkdensity	21.87KN/m^3
		PHvalue	10.58

*Datatakenfromtheproductioncentre

Fibres: Thewasteplasticfibreswereobtainedbycuttingwasteplasticpots,buckets,cans,drumsandutensils.Thewasteplasticfibresobtainedwereallrecycledplastics.Thefibreswerecutfromsteelwirecutteranditislabouroriented.Thethicknessofwasteplasticfibreswas1mmanditsbreadthwaskept5mmandthesefibreswerestraight.Thedifferentvolumefraction offibres and suitableaspectratiowereselected and usedin thisinvestigation.Physicalpropertiesofthesefibresaregiven inTable2.7

Table2.7:Physicalproperties ofwasteplasticfibres

Length(l)mm	Breadth(b)Mm	Thickness(t) mm	Percentageofelongation	Tensilestrength(MPa)	Moduluselasticity(MPa)	Waterabsorption	Specificgravity
150	25	1	15.56	15.52	113.90	Nil	1.28

Water: Ordinarypotablewaterfreefromorganiccontent,turbidityandsaltswasusedformixingand forcuringthroughouttheinvestigation.
Superplasticizer: Toimparttheadditionaldesiredproperties,asuperplasticizer(ConplastSP-430)wasused.Thedosageofsuperplasticizeradoptedintheexperimentationwas1%(byweightofcement).

III. EXPERIMENTAL PROCEDURE

Concretewaspreparedbyadesignmixproportionof1:1.435:2.46withaW/Cratioof0.48whichcorrespondtoM20gradeofconcrete.Thedifferentvolumefractionofwasteplasticfibresusedintheexperimentationwere0%,0.5%,1%,1.5%,2%,2.5%,3%,3.5%,4%,4.5%and5%.Wasteplasticfibreshavinganaspectratio40(thickness=1mm,length=40mmandbreadth=5mm)wereadded.Theredmudwasused15%byweightofcement.Allthespecimenswerecastandtestedafter28daysofcuringasperISspecifications.Beforetheconcretewaspouredinthemoulds,theconcretewastestedforitsworkabilitythroughslump,compactionfactorandpercentageflow andVee-Beedegree.
Thecompressivestrengthtestspecimenswereofdimension150X150X150mm.Thetensilestrengthtestspecimenswereof150mmdiameterandlength300mm.indirecttensiontest(Braziliantest)wasconductedoncylindricalspecimenstofindoutthetensilestrength.Flexuralstrengthtestspecimenswereofdimension100X100X500mm.Twopointloadingwasadopted,duringtestingofflexuralspecimensonaspanof400mm.Impactstrengthtestswereofdimension250X250X30mm.Amildsteelballweighing1.008kgwasdroppedfromaheightofonemeterontheimpactspecimen,whichwaskeptonthefloor.T

hecarewastakentoseethattheballwasfellonthemidpointofspecimeneverytime.Thenumberofblowsrequiredtocausefirstcrackandfinalfailurewerenoted.Fromthesenumbers ofblows,theimpactenergywascalculated asfollows.
Where, m= mass oftheball
w= weightoftheball=1.008kgg= Accelerationdueto gravityh = Heightofthedrop=1m
Impactenergy=mghN
= w/gx gx h x N
= whN(N-m)
N= Averagenumberofblows to causethefailure.

IV. EXPERIMENTALRESULTS

Thefollowingtablesgivethedetailsof the experimentalresults

4.1 Compressive StrengthTest Results

ThefollowingTableNo.4.1givesthecompressivestrengthtestresultsofwasteplasticfibrereinforcedconcretewiththeadditionofdifferentvolumefractionofwasteplasticfibresand15%redmud (byweightofcement)

Table 4.1: Compressivestrengthtestresultsofwaste plasticfibrereinforcedconcretecontainingredmud

Percentag eaddition offibres	Specime nidentifi cation	Weight ofspeci men(N)	Densi ty(kN /m^3)	Average density(kN/m^3)	Failur eload (kN)	Compressi vestrengt h(MPa)	Averagecom pressiveStren gth(MPa)	Percentageincrease ordecreaseofcompr essivestrength w.r.t ref.mix
0 (Refmix)	A	88.5	26.22	26.27	520	23.11	23.4	---
	A	89	26.37		520	23.11		
	A	88.5	26.22		540	24		
0.5	B	86	25.48	25.72	530	23.55	24.58	+5
	B	87	25.77		580	25.77		
	B	87.5	25.92		550	24.44		
1	C	87	25.77	25.57	550	24.44	25.33	+8
	C	86	25.48		560	24.88		
	C	86	25.48		600	26.67		
1.5	D	86.5	25.62	25.22	620	27.55	26.51	+13
	D	84.5	25.03		560	24.88		
	D	84.5	25.03		610	27.11		
2	E	83.5	24.74	24.84	620	27.55	28.73	+23
	E	83.5	24.74		650	28.88		
	E	84.5	25.03		670	29.77		
2.5	F	83.5	24.74	24.68	600	26.66	26.66	+14
	F	82.5	24.44		620	27.55		
	F	84	24.88		580	25.77		
3	G	82.5	24.44	24.59	538	23.77	24.58	+5
	G	83	24.59		560	24.88		
	G	83.5	24.74		560	24.88		
3.5	H	82.5	24.74	24.34	526	23.37	23.5	+1
	H	81	24		520	23.11		
	H	82	24.29		540	24		
4	I	81.5	24.14	24.19	500	22.22	22.07	-6
	I	82.1	24.29		510	22.66		
	I	81.5	24.14		480	21.33		
4.5	J	81.5	24.14	24.04	460	20.44	20.44	-13
	J	81	24		420	18.66		
	J	81	24		500	22.22		
5	K	79.5	23.55	23.75	400	17.77	17.32	-26
	K	81	24		350	15.55		
	K	80	23.7		420	18.66		

4.2 Tensile StrengthTest Results

ThefollowingTableNo.4.2givesthetensilestrengthtestresultsofwasteplasticfibrereinforcedconcretewiththeadditionofdifferentvolumefractionofwasteplasticfibresand15%redmud (byweightofcement)

Table4.2:Tensilestrengthtestresultsofwasteplasticfibrereinforcedcontainingredmud

Percentage addition offibres	Specimenidentification	Failureload(kN)	Tensilestrength(MPa)	Averagetensilestrength(MPa)	Percentageincreaseordecreaseoftensilestrength w. r.tref.mix
0 (Refmix)	A	150	2.12	2.3	---
	A	180	2.54		
	A	160	2.26		
0.5	B	160	2.26	2.35	+2
	B	160	2.26		
	B	180	2.54		
1	C	170	2.4	2.44	+6
	C	180	2.54		
	C	170	2.4		
1.5	D	190	2.68	2.63	+14
	D	180	2.54		
	D	190	2.68		
2	E	190	2.68	2.82	+23
	E	200	2.82		
	E	210	2.97		
2.5	F	200	2.82	2.68	+17
	F	180	2.54		
	F	190	2.68		
3	G	190	2.68	2.49	+8
	G	160	2.26		
	G	180	2.54		
3.5	H	160	2.26	2.07	-10
	H	130	1.83		
	H	150	2.12		
4	I	120	1.69	1.73	-25
	I	120	1.69		
	I	130	1.83		
4.5	J	120	1.69	1.55	-33
	J	100	1.41		
	J	110	1.55		
5	K	80	1.13	1.31	-43
	K	100	1.41		
	K	100	1.41		

4.3 Flexural StrengthTest Results

ThefollowingTableNo4.3givestheflexuralstrengthtestresultsofwasteplasticfibrereinforcedconcretewiththeaddition ofdifferentvolumefractionofwasteplasticfibresand15%redmud (byweightofcement)

Table4.3: Flexuralstrengthtestresults ofwasteplasticfibrereinforcedconcretecontainingredmud

Percentage addition offibres	Specimenidentification	Failureload(kN)	Flexuralstrength(MPa)	Averageflexuralstrength(MPa)	Percentageincreaseordecreaseofflexuralstrength w.r.tref.mix
0 (Refmix)	A	10.4	4.16	4.05	---
	A	9.6	3.84		
	A	10.4	4.16		
0.5	B	11.2	4.48	4.37	+8
	B	10.4	4.16		

	B	11.2	4.48		
1	C	11.2	4.48	4.69	+16
	C	12	4.8		
	C	12	4.8		
1.5	D	12	4.8	5.12	+26
	D	12.8	5.12		
	D	13.6	5.44		
2	E	14.2	5.68	5.41	+34
	E	12.8	5.12		
	E	13.6	5.44		
2.5	F	12.8	5.12	5.33	+32
	F	13.6	5.44		
	F	13.6	5.44		
3	G	12.8	5.12	5.12	+26
	G	12.8	5.12		
	G	12.8	5.12		
3.5	H	12	4.8	4.9	+21
	H	12	4.8		
	H	12.8	5.12		
4	I	11.2	4.48	4.48	+11
	I	11.2	4.48		
	I	11.2	4.48		
4.5	J	9.6	3.84	3.94	-3
	J	9.6	3.84		
	J	10.4	4.16		
5	K	8.8	3.52	3.41	-16
	K	7.2	2.88		
	K	9.6	3.84		

4.4 **Impact StrengthTest Results**

ThefollowingTableNo4.4givestheimpactstrengthtestresultsofwasteplasticfibrereinforcedconcretewiththeadditionofdifferentvolumefractionofwasteplasticfibresand15%redmud (byweightofcement)

Table4.4: Impactstrengthtestresults ofwasteplasticfibrereinforcedconcretecontainingredmud

Percentageadditionoffibres	Specimenidentification	Numberofblowsrequiredtocause		Averagenumberofblowsrequiredtocause		Impactstrength(N-m)required tocause		Percentageincreaseordecreaseofimpactstrength w. r.tref.mix	
		firstcrack	finalfailure	firstcrack	firstcrack	first crac	finalfailur	firstcrack	finalfailure
0 (Refmix)	A	12	16	13.33	17	79.98	102	---	---
	A	14	17						
	A	14	18						
0.5	B	14	21	15	21.66	90	130	+13	+27
	B	15	22						
	B	16	22						
1	C	17	22	17.66	23.66	105.96	142	+32	+39
	C	18	25						
	C	18	24						
1.5	D	20	26	20.66	27.66	123.96	166	+55	+63
	D	21	28						
	D	21	29						
2	E	24	31	24.66	32.33	148	194	+85	+90
	E	24	32						
	E	26	34						
	F	20	27						
2.5	F	19	28	19.66	27.67	117.	166	+47	+63

	F	20	27			96			
3	G	18	24	18.67	25.34	112	152	+40	+49
	G	19	26						
	G	19	26						
3.5	H	16	20	17	20.33	102	122	+28	+20
	H	17	20						
	H	18	21						
4	I	15	19	15.66	19.66	94	118	+18	+16
	I	16	20						
	I	16	20						
4.5	J	15	17	14.66	17	88	102	+10	0
	J	15	18						
	J	14	16						
5	K	14	17	12.33	15.66	74	94	-8	-8
	K	12	16						
	K	11	14						

4. 5. WORKABILITYTEST RESULTS

ThefollowingTableNo4.5givestheoverallresultsofworkabilityofwasteplasticfibrereinforcedconcretewiththeadditionofdifferentvolumefractionofwasteplasticfibresand15%redmud(byweightofcement)

Table4.5:Workabilitytestresults ofwasteplasticfibrereinforcedconcretecontainingredmud

Percentageadditionoffibres	Workabilitythrough			
	Slump(mm)	Compactionfactor	Percentageflow	Vee-Beedegree(sec
0(Refmix)	0	0.92	5.6	34
0.5	0	0.91	5.6	35
1	0	0.91	5.5	35
1.5	0	0.91	5.5	39
2	0	0.91	5.3	45
2.5	0	0.91	5.3	52
3	0	0.9	5	60
3.5	0	0.9	5	65
4	0	0.89	4.6	95
4.5	0	0.89	4.4	125
5	0	0.89	4.1	240

V. OBSERVATIONSANDDISCUSSIONS

Basedonexperimentationconductedthefollowingconclusioncanbedrawn.Ithasbeenobservedthatthecompressivestrengthofwasteplasticfibrereinforcedconcretewithredmudincreasesasthepercentageoffibresinitincreasesupto2%.Theadditionoffibresbeyond2%willdecreasethecompressivestrengthofwasteplasticfiberreinforcedconcretei.e.the wasteplasticfibrereinforcedconcretewithredmudshowsmaximumcompressivestrengthwhen2%fibresareused.Therefore,thehighercompressivestrengthcanbeachievedwiththeadditionof2%ofwasteplasticfibresand15%redmud(byweightcement)andthe percentageincreasein thecompressivestrengthis23%.

Ithasbeenobservedthatthetensilestrengthofwasteplasticfibrereinforcedconcretewithredmudincreasesasthe percentageoffibresinitincreasesupto2%.Theadditionoffibresbeyond2%willdecreasethetensilestrengthofwasteplasticfiberreinforcedconcretei.e.thewasteplasticfibrereinforcedconcretewithredmudshowsmaximumtensilestrengthwhen2%fibresareused.Therefore,thehighertensilestrengthcanbeachievedwiththeadditionof2%ofwasteplasticfibresand15%redmud(byweightcement)andthepercentageincreaseinthetensilestrengthis 23%.

Ithasbeenobservedthattheflexuralstrengthofwasteplasticfibrereinforcedconcretewithredmudincreasesasthepercentageoffibresinitincreasesupto2%.Theadditionoffibresbeyond2%willdecreasetheflexuralstrengthofwasteplasticfiberreinforcedconcretei.e.thewasteplasticfibrereinforcedconcretewithredmudshowsmaximumflexuralstrength when2%fibresareused.Therefore,thehigherflexuralstrengthcanbeachievedwiththeadditionof2%ofwasteplasticfibresand15%redmud(byweightcement)andthepercentageincreaseintheflexuralstrength is 34%.

Theimpactstrengthofwasteplasticfibrereinforcedconcretewithredmudincreasesasthepercentageoffibresinitincreasesupto2%.Theadditionoffibresbeyond2%willdecreasetheimpactstrengthofwasteplasticfiberreinforcedconcretei.e.thewasteplasticfibrereinforcedconcretewithredmudshowsmaximumimpactstrengthwhen2%fibresareused.Th

erefore,thehigherimpactstrengthcanbeachievedwiththeadditionof2%ofwasteplasticfibresand15%redmud(byweight cement)andthepercentageincreaseofimpactstrengthforfirstcrackandforfinalfailureare47%and 90%respectively Thismaybeduetothefactthat2%additionofwasteplasticfibresmayfitinandinterlocktheaggregatesthere byincreasingthestrengthcharacteristicsThusitcanbeconcludedthatthehigherstrengthcharacteristicsofwasteplasticfibr ereinforcedconcretewithredmudcanbeobtainedwith2%additionoffibresinit.
Ithasbeenobservedthattheworkabilityofwasteplasticfiberreinforcedconcretedecreasesasthepercentageoffibresin itincreases.Thisisobviouslybecauseoflessflowofconcretewithmorefibrecontent.Thusitcanbeconcludedthatastheperc entagesofwasteplasticfibresincreasetheworkabilitydecreases.

VI. CONCLUSIONS

1. Itcanbeconcludedthatthehigherstrengthcharacteristicsofwasteplasticfibrereinforcedconcretewithredmudcanb einducedwith2%additionoffibresinit.
2. Higherpercentageadditionsofwasteplasticfibresreducetheworkabilitycharacteristicsofwasteplasticfibrereinfo rcedconcrete

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