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"Utilization of solid Waste in construction"

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ABSTRACT: AsTweTareTlivingTinT21stTcentury ,TnewTtechnologiesTareTbeingTinventedTinTalm ostTeveryTsectorTtoTmakeThumanTlifeTfastTand Teasier.TBesideTthisTweTareTstillTfindingTtheTs olutionsTtoTproblemsTrelatedTtoTourTenvironme nt,TenergyTandTnaturalTresources.ThereTisTaTgr owingTawarenessTinTIndiaTaboutTextensiveTda mageTbeingTcausedTtoTtheTenvironmentTdueTto TaccumulationTofTwasteTmaterialsTfromTindustr ialTplants,TpowerThouses,TcollieryTpitsTandTde molitionTsitesTandTitThasTbecomeToneTofTtheT majorTenvironmental,TeconomicalTandTsocialTis sues.TWasteTmaterialTisTtheTmaterialTunused,Tu nwantedTandTrejectedTasTworthlessTintoTtheTen vironmentTinTourTsocietyTasTwhole.TWasteTma terialsTcomingToutTofTindustryTnowadaysTisTpo singTaTgreatTenvironmentalTproblemTinTdisposi ngTthemTintoTtheTair,TwaterTandTonTtheTland. TBut,TwithTproperTutilizationTofTtheseTmaterial sTinTconstructionTindustryTwillTgreatlyThelpTth eTsocietyTtoThaveTaTbetterTandTpleasantTenvir onment.TInTthisTstudyTaTquestionnaireTsurveyTt argetingTexpertsTfromTconstructionTindustryTwa sTconductedTinTorderTtoTinvestigateTtheTcurren tTpracticesTofTtheTusesTofTwasteTandTrecycled TmaterialsTinTtheTconstructionTindustry.TThisTs tudyTpresentsTanTinitialTunderstandingTofTtheTc urrentTstrengthsTandTweaknessesTofTtheTpractic eTintendedTtoTsupportTconstructionTindustryTin TdevelopingTeffectiveTpoliciesTregardingTusesTo fTwasteTandTrecycledTmaterialsTasTconstruction Tmaterials.

KeywordsT:T NaturalTResources,TWasteTMateri als,TConstructionTIndustry

CHAPTER 1

IntroductionT

1.1 TBackgroundT

TheTraditionalTconstructionTmaterialsTs uchTasTconcrete,bricks,ThollowTblocks,TsolidTbl ocks,TpavementTblocksTandTtilesTareTbeingTpro ducedTfromTtheTexistingTnaturalTresources.TThi sTisTdamagingTtheTenvironmentTdueTtoTcontinu ousTexplorationTandTdepletionTofTnaturalTresou rces.TMoreover,TvariousTtoxicTsubstancesTsuchT asThighTconcentrationTofTcarbonTmonoxide,Tox idesTofTsulfur,ToxidesTofTnitrogen,TandTsuspen dedTparticulateTmattersTareTinvariablyTemittedT toTtheTatmosphereTduringTtheTmanufacturingTpr ocessTofTconstructionTmaterials.TTheTemissionT ofTtoxicTmattersTcontaminatesTair,Twater,Tsoil,f lora,TfaunaTandTaquaticTlife,TandTthusTinfluenc esThumanThealthTasTwellTasTtheirTlivingTstand ard.

IndiaTproducesTanTenormousTamountTo fTdifferentTtypesTofTwasteTmaterialsTasTbyprod uctsTfromTdifferentTsectorsTlikeTindustrial,Tagri cultural,Tetc.TTheseTwasteTmaterialsTifTnotTdep ositedTsafelyTitTmayTbeThazardous.TTheTamou ntTandTtypeTofTwasteTgeneratedTincreasesTwith TincreaseTinTpopulation.TTheseTwastesTremainT inTtheTenvironmentTforTlongerTdurationTsinceTi tTisTunused.TTheTwasteTdisposalTcrisisTaroseTd ueTtoTtheTcreationTofTnonTdecayingTwasteTmat erials.TOneTsolutionTtoTthisTcrisisTliesTinTrecy clingTwasteTintoTusefulTproducts.TResearchTint oTnewTandTinnovativeTusesTofTwasteTmaterials TisTcontinuallyTadvancing.TInTIndia,TresearchTi sTcurrentlyTunderwayTtoTexamineTtheTpotential TforTuseTofTsomeTlocallyTavailableTwastesTinT roadTconstruction.

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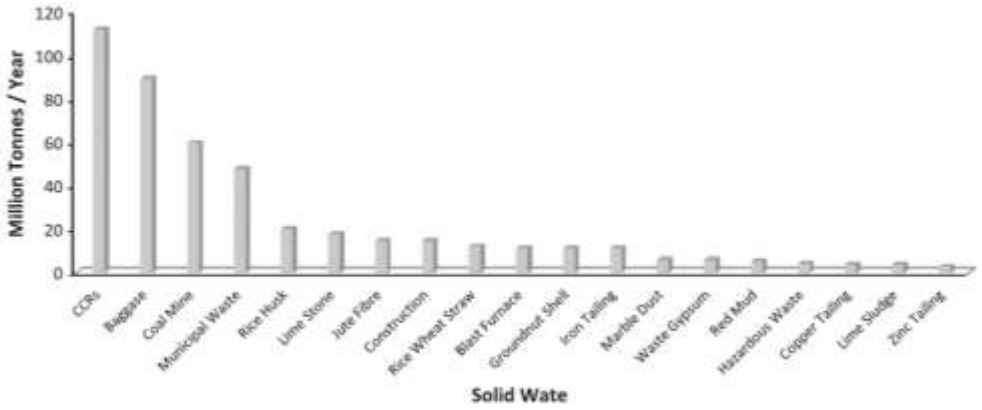

T

FigureTNoT1.TStatusTofTSolidTWasteTGenerationTinTIndia T(MillionTTonnes/Year)

1.2 Introduction

InTourTcountry,TthereTisTaTgreatTdemandTforTconstructionTmaterialsTinTcivilTengineering

field.TSo,TitTisTaTveryTdifficultTproblemTforTavailabilityTofTmaterials.TTheTresearchers

haveTdevelopedTtheTwasteTmanagementTstrategiesTtoTapplyTforTreplacementTofTmaterialsTforTtheirTspecificTneed.TTheTcostTofTconstructionTmaterialsTisTincreasingTdayTbyTdayTbecauseTofThighTdemand,TscarcityTofTrawTmaterials,TandThighTpriceTofTenergy.TFromTtheTstandpointTofTenergyTsavingTandTconservationTofTnaturalTresources,TtheTuseTof

alternativeTconstituentsTinTconstructionTmaterialsTisTnowTaTglobalTconcern.TForTthis,TtheTextensiveTresearchTandTdevelopmentTworksTtowardsTexploringTnewTingredients

areTrequiredTforTproducingTsustainableTandTenvironmentTfriendlyTconstructionTmaterials.TTheTpresentTstudyTinvestigatesTtheTpotentialTuseTofTvariousTsolidTwastesTinTtheTproductionTofTconstructionTmaterials.TodayTtheTenvironmentalTissuesTsuchTasTfloodTlevelsTdueTtoTtheTillegalTexplosionTofTwasteTintoTtheTrivers,TresourcesTareTdepletionTfromTtheTearthTandTillegalTexplosionTofThillTslopesTareTevidentTinTtheTmetroTcities.TInTIndiaTinfrastructuralTfacilitiesTareTincreasedTdueTtoTtheTconstruction,TrefurnishingTandTexplosionTofTbuildings,Tbridges,Trunways,Tflyover,Troads,Tfactories,Tindustries,ThospitalsTandTotherTsimilarTformulations.

1.3 NeedTofTthisTprojectT

ThereTisTanTexpressionTforTlongTthatTsaysT"killingTtwoTbirdsTwithToneTstone".TWellThereTisTwhereTitTappliesTinTourTresearchTtoday,ThereTweTareTfocusingTonTusingTwasteTasTaTprimaryTorTsecondaryTmaterialTinTourTconstruction,TbecauseTourTenvironmentTisTfullTofTwasteTtodayTconsideringTtheTnewTinnovativeTwaysTofTproductionTisTincreasingTdayTbyTdayTandTitsTwasteTafterTuseTisTposingTdangerTtoTourThealthTandTtheTenvironment.TButTbyTutilizingTwasteTinTconstructionTweTcanTbeTableTtoTachieveTtwoTthingsTatTtheTsameTtime,ToneTisTthatTweTcanTnowTreduceTtheTconcentrationTofTwasteTinTourTvariousTenvironmentsTandTtheTsecondTisTthatTweTcanTproduceTorTconstructTaTstructureTofThighTperformanceTwithTwaste-baseTmaterialsTasTlongTasTtheyTareTthoroughlyTtestedTandTsometimesTstabilizedTtoTproduceTanTexcellentTmaterialTthatTcanTwithstandTtheTtestTofTtime.T

SinceTweTcannotTstopTorTreduceTourTproduction,TthereTisTalwaysTsomethingTweTcanTdoTtoTminimizedTwasteTconcentrationTinTourTenvironmentTandTtodayTtheTmostTprofessionalTwayTtoTdoTthatTisTbyTutilizingTthoseTwasteTandTputtingTthemTtoTuse.TTodayTmanagementTofTwasteThasTbecomeTveryTessentialTaspectTofTourTsustainableTdevelopmentTandTbuilding.TInTthisTCircumstance,TwasteTmanagementTmeansTeliminatingTwasteTwhereTpossibleTandTensuringTthatTitTisTminimizeTwhereTfeasible.

1.4 TProblemT

SeveralTissuesTexistTregardingTreducingTwaste.TATkeyTenvironmentalTissueTisTwasteTincinerators,TfurnacesTforTburningTtrash,TgarbageTandTashes.TTheseTincineratorsTproduceT210TdifferentTdioxinTcompoundsTplusTmercury,Tcadmium,TnitrousToxide,ThydrogenTchloride,TsulfuricTacidTandTfluorides.TProducedTalsoTinTincineratorsTisTparticulateTmatterTthatTisTsmallTenough

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TtoTremainTpermanentlyTinTtheTlungs.TAdditionally,TwasteTincineratorsTgenerateTmoreTCO2TemissionsTthanTcoal,Toil,TorTnaturalTgas-fueledTpowerTplants.TForTyears,TscientistsTandTresearchersThaveTbeenTsearchingTforTpossibleTsolutionsTtoTenvironmentalTconcernsTofTwasteTproductionTandTpollution.ManyThaveTfoundTthatTreplacingTrawTmaterialsTwithTrecycledTmaterialsTreducesTourTdependencyTonTrawTmaterialsTinTtheTconstructionTindustry.

1.5 TScopeTofTtheTprojectTwork

ResearchT&TDevelopmentTactivitiesThaveTbeenTtakenTupTevenTinTIndiaTforTprovingTitsTfeasibility,TeconomicTviabilityTandTcostTeffectivenessTforTtheTuseTofTwasteTmaterialsTinTallTtheTconstructionTactivities.TAnnually,TAsiaTaloneTgeneratesT4.4TbillionTtonsTofTsolidTwastes.TAboutT6%TofTthisTamountTisTgeneratedTinTIndia.TheTrecyclingTofTsolidTwastesTinTcivilTengineeringTapplicationsThasTundergoneTconsiderableTdevelopmentToverTaTveryTlongTtime.TTheTutilizationTofTflyTash,TblastnfurnaceTslag,Tphosphogypsum,TrecycledTaggregates,TredTmud,TKraftTpulpTproductionTresidue,TwasteTtea,Tetc.,TinTconstructionTmaterialsTshowsTsomeTexamplesTofTtheTsuccessTofTresearchTinTthisTarea.TSimilarly,TtheTrecyclingTofThazardousTwastesTforTuseTinTconstructionTmaterialsTandTtheTenvironmentalTimpactTofTsuchTpracticesThaveTbeenTstudiedTforTmanyTyears.

1.6TObjectives

1. ToTmakeTpeopleTawareTaboutTtheTwastageTofTmaterialTthatTmayTbeTusedTagain.PeopleTshouldTbeTawareTagainstTwastagesTthatTmayTleadsTtoTenvironmentTpollutionTandThazardeousTforThumanTbeing.
2. ToTpromoteTrecycling,TreusingTsalvagedTbuildingTmaterialsTand**T**minimizingTmaterialsTandTpackagingTreducesTwaste**T**disposalTcostsTandTmaterialTexpenses.
3. ToTprovideTmarketingTopportunityTforTCompanyTbyTgrowingTnumberTofTpotentialTclientsTinterestedTinTparticipatingTinTtheTLEED™TandTBUILTTGREEN™TgreenTbuildingTprograms.
4. ToTprovideTemployment,Ecocycle.orgTestimatesTthatTforTeachTjobTinTaTlandfill,T10TotherTpeopleTareTemployedTelsewhereTinTprocessingTrecycledTproductsTandTanotherT25TareTemployedTinTproductsTfromTmanufacturingTrecycledTmaterials.
5. ToTminimizeTConstructionTandTDemolitionTwasteTwhichTgenerateTfromTconstructionTactivities.T

CHAPTER 2

LiteratureTSurvey

1.TMinaxiTRaniTetTal.**T(**2016)TstudiedTthatTinTnearTfutureTwastageTofTindustriesTareTveryThugeTsoTthereTisTaTneedTtoTtakeTcareTforTthatTfromTtheTpresent.TThereTshouldTbeTneedTofThiringTtheTprofessionalTandTtrainedTpeopleTregardingTforTC&DTSeparation.T

2.TM.TRameshTetTal.(2014)TstudiedTthatTindustrialTwastesTareThavingTaTdifferentTindustrialTapplicationTandTusagesTinTtheTconstructionTfield.TFlyTash,TredTmud,TsilicaTfumesTandTcopperTslagTareTreplacedTwithTtheTconstructionTmaterials.T

3.TR.K.KolisettyTetTal.(2013)TstudiedTthatTminimumTwasteTpromotesTnotTonlyTreuseTandTrecycling,TbutTalsoTandTmoreTimportantly,TpromotesTpreventionT-TdesignsTthatTconsiderTtheTentireTproductTlifeTcycle.

4.TSnehalTAnilkumarTKumbharTetTal.**T(**2013)TstudiedTthatTrecyclingTofTconstructionTandTdemolitionTwasteThasTmanyTbenefitsTsuchTasTreductionTinTtransportationTcost,TitTkeepsTenvironmentTcleanTandTreducesTnaturalTresourceTexploitation.T

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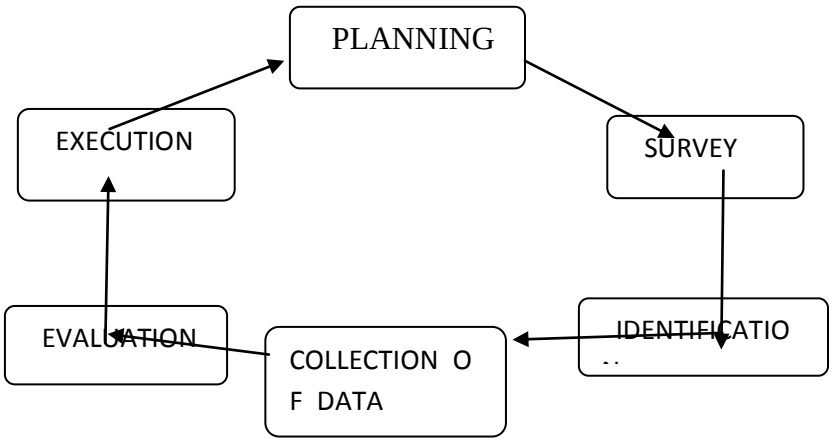
CHAPTER 3

Methodology

3.1TLifeTcycleT(FlowTdiagram)



FigureTNoT5.TFlowTDiagramTofTLifeTCycleTofTProject.

PlanningT:-
GetTyourTideasTtogether,TseparatingToutTwhatTyouTmustTachieveTandTwouldTyouTlikeTtoTachieve,TsoTthatTyouTcanTthinkTaboutTpriorities,TbudgetTandTtiming.PlanningTincludesTanToutlineTofTvariousTcollectionTandTrecyclingToptions.

SurveyT:-
TheTsurveyTresultsTinTkeyTdevelopmentTtargetsTforTwasteTmanagementTwhichTsignificantlyTbenefitsTtheThumanTbeingsTasTwellTasTenvironment.T

IdentificationT:-
IdentificationTofTsourceTofTwasteTandTtypeTofTwaste.TIdentifyingTfutureTdifficultiesTandTproblem.IfTanyTpermissionTisTrequiredTfromTanyTauthorityTthenTitTmustTbeTidentifiedTandTapplyTforTsuch.

CollectionTofTDataT:-
CollectionTofTdataTbyTsurveyingTdifferentTorganisation,workers,industrialTrepresentatives,NGO,etc.ItTmayTincludeTtypeTofTwasteTgeneration,methodTofTsolidTwasteTdisposal,difficultiesTtheyTareTfacing,etcT

EvaluationT:-
ConsideringTallTtheTpossibleTwayTforTwasteTmanagementTandTfinalisingTbestTapplicableTforTtypeTofTwaste.EvaluatingTtheTcostTofTprocessingTbeforeTitTisTreadyTforTuseTasTconstructionTmaterial.T

ExecutionT:-
OnceTtheTdecision-makingTstageThasTbeenTcompleted,TdecisionsTshouldTbeTtranslatedTintoTtheTrecommendationsTandTprioritiesTthatTformTtheTcoreTofTtheTplan.TTakingTwrongTdecisionTwillTaffectTonTproject Tobjective.

SourcesTofTSolidTWasteTGenerationT:-T

1)TResidentialTSourceT:-T
THouseholdTactivitiesTcontributesTtoTvariousTsolidTwastesTsuchTasTpaper,plastics,foodTwastes,Tcardboard,Tetc.

2)TIndustrialTSourceT:-
TIndustriesTareTknownTtoTbeToneTofTbiggestTcontributorsTtoTsolidTwastes.TTheyTincludeTlightTandTheavyTmanufacturingTindustries,TpowerTandTthermalTplantsT.

3)TCommercialTSourceT:-
TInTthisTcase,TreferTtoThotels,Tmarkets,Trestaurants,TgodownsTandTofficeTbuildings.

4)TInstitutionalTSourceT:-
TInstitutionalTcentersTlikeTschools,Tcolleges,prisons,militaryTbarracksTandTotherTgovernmentTcenters.SomeTofTtheTcommonTsolidTwastesTobtainedTfromTthisTplaces.

5)ConstructionTandTDemolitionTAreasT:-
TSomeTofTtheTsolidTwastesTproducedTinTthisTplacesTincludeTsteelTmaterials,Tconcrete,TwoodTandTtimber,Tplywoods,Tplastics,Trubbers,Tetc.

TheTfollowingTcategoriesTofTwasteTareTtheTmostTsuitableTtypesTofTwasteTtoTbeTusedTinTtheTconstructionTindustries;

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T**AgriculturalTWaste:T**TheTorganicTagriculturalTwasteTproductsThaveThighTutilization potential.TOrganicTAgriculturalTwasteTlikeTwheatTstraw,TcottonTstack,TvegetableTwaste, groundnutTshells,TorangeTpeels,TwheatThuskTareTsomeTgoodTexamples.

T**MineralTWaste:T**TheTproductsTofTminingTalsoTproduceTwasteTthatTaTsuitableTandThavingTtheTpotentialTofTutilizationTinTconstruction,TwasteTlikeTwasheriesTofTcoal,TironTminingTwasteTetc.

T**Ceramic-likeTWaste:T**TheseTareTnon-hazardousTwasteTandTtheyTmakeTgoodTconstructionTmaterial.TCeramic-likeTwasteTcanTbeTfoundTinTformTofTlimeTsludge,TbrokenTglass,TbrokenTceramicTmaterials,TkilnTdustTetc.

T**IndustrialTWaste:T**TheseTareTtheTinorganicTwasteTfromTindustriesTonlyTandTtheyTincludeTsteelTslag,Tbauxite,TresiduesTofTcoalTcombustionTetc.

T**OtherTHazardousTWaste:T**OtherTIndustrialTorTWorkshopTbaseTwasteTthatTareThazardousTinTnatureTlikeTmetalTworkingTresidues,Tblasting Twaste,TtanneryTwaste,TwasteTwaterTsludgeTetc.TalsoThasTaThighTpotentialTofTutilizationTinTconstruction.T

CHAPTERT 4

ResultTandTDiscussion

4.1TResultTandTDiscussion

ATquestionnaireTsurveyTwasTconductedTthrough TphoneTcalls,TvisitsTandTemail,Taddressing:T
(1)TIfTtheTcompanyTusesTorTsellsTanyTwasteTorTrecycledTmaterialsTforTapplication,
(2)TIsTtheTsurveyorTawareTofTotherTrecycledTmaterialsTthatTareTbeingTusedTinTconstructionTapplications,T
(3)TAreTthereTanyTrecycledTmaterialsTthatTareTnotTrecommendedTforTuseTinTtheTconstructionTindustryTandT
(4)TifTnotTusingTsuchTmaterials,TwhatTareTtheTbarriersTbehindTnotTusingTrecycledTmaterialsTinTtheirTwork.T

AllTtheTquestionsTendedTwithTaTyesTforTwhatTapplicationTandTifTno,TreasonsTforTnotTusingTtheTmaterial.TheTsurveyTconsistedTofTaTlistTofTrecycledTandTwasteTmaterialsTincluding;TCementTKilnTDustT(CKD),TflyTash,TfoundryTsand,Tslag,Tglass,Tplastic,Tcarpet,TtireTrubber,TrecycledTasphalt,TrecycledTconcrete,Tgypsum,TsilicaTfume,TswineTmanure,TanimalTfat,TsoyTbean,TroofingTshingles,TcitrusTpeels,TsewageTsludge,TdateTandToilTpalmTtreeTandTaTplaceTtoTaddTadditionalTrecycledTmaterialsTbeingTusedTinTtheTconstructionTindustryTnotTlisted.TTheTlastTquestionTwasTincludedTtoTrecordTanyTadditionalTcontactTor referencesTtoTquestionTforTmoreTinformationTonTtheTtopic.

TableTNoT3.TSelectedTrecycledTmaterialsTandTtheirTconstructionTapplications.

	Innovative recycled material in construction applications											
Recycled material	Hot mix asphalt	Concrete mixes	Embank ments	Aggregate	Base course	Mineral filler	soil stabilizer	Adsorbent	Waste water treatment	Polymer	Adhesive	Alternative fuel
Swine manure	×											×
Animal fat		×								×		
Silica fume	×	×									×	
Roof shingles	×			×	×	×	×					
Palm bunch fiber	×											
Citurs peels								×				
Cement kiln dust	×	×					×					
Fly ash		×	×	×		×		×	×			
Floundry sand	×	×	×	×	×							
Slag		×	×		×		×					
Glass			×	×			×					
Plastic	×		×	×								
Carpet	×	×	×									
Tire scraps	×	×	×		×	×	×	×				×
Asphalt pavement	×			×	×							
Concrete Aggregate		×		×	×							
Gypsum	×											
Sewage sludge	×	×										

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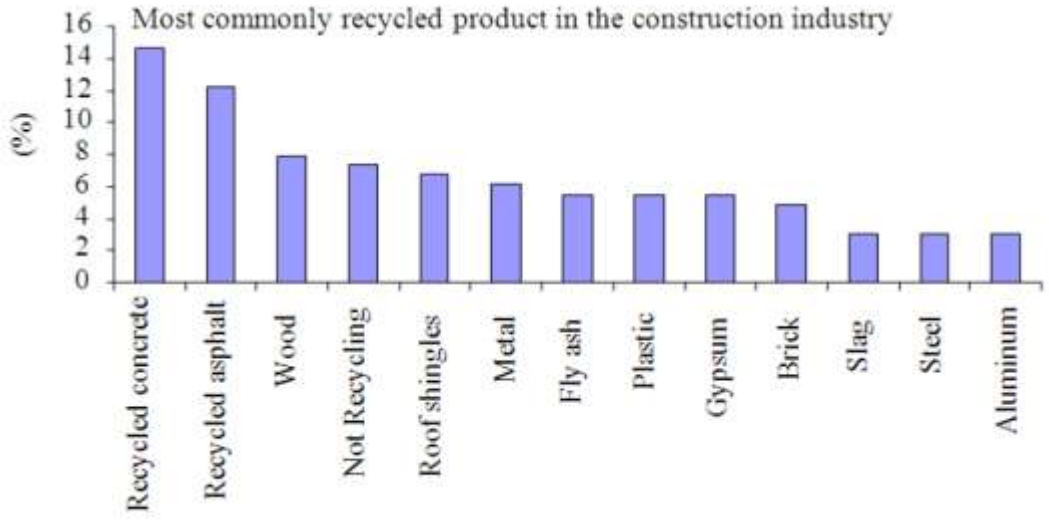
TheTsurveyTwasTcompiledTofT65TparticipantsTfromT50Tcompanies.TTheTcompaniesTsurveyedTconsistedTofTcontractors,Tengineers,TarchitectsTandTsuppliersTofTconcrete,Tasphalt,Tlandfills,TscrapTyards,TsteelTmanufactures,Tdrilling,TdemolitionTandTrecyclingTcompanies.TTableT4**T**showsTtheTpercentageTforTeachTtypeTofTcompanyTsurveyed.

TableTNoT4.TTypesTofTapplications.

Application	No.	Percentage
Recycling	20	31
Construction	11	17
Concrete	9	14
Contractors	6	9
Asphalt	5	8
Engineer	4	6
Manufacture	4	6
Architect	2	3
Salvage	1	2
Association	1	2
Trucking	1	2
Steel	1	2
Total	65	100

FigureTNoT10**T**showsTresponsesTofTtheTsurveyedTcompaniesTonTtheTmostTcommonTrecycledTmaterials.
T



FigureTNoT10.TMostTcommonlyTusedTrecycledTmaterials TforTconstructionTapllications.

FigureTNoT11TshowsTtheTpercentagesTofTtheTmostTcommonlyTrecycledTmaterialsTusedTinTconcrete.

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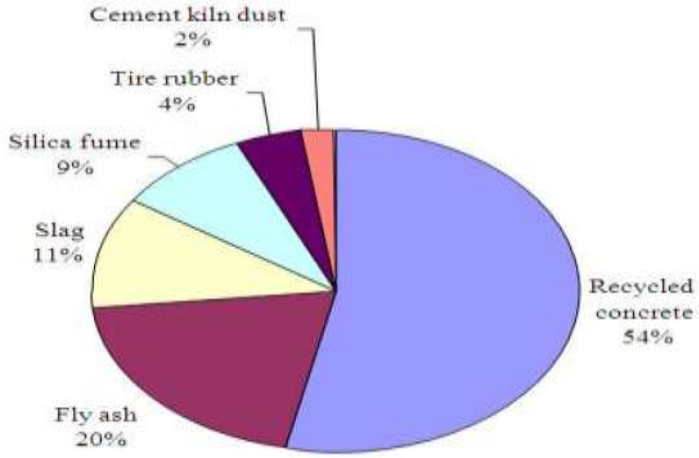
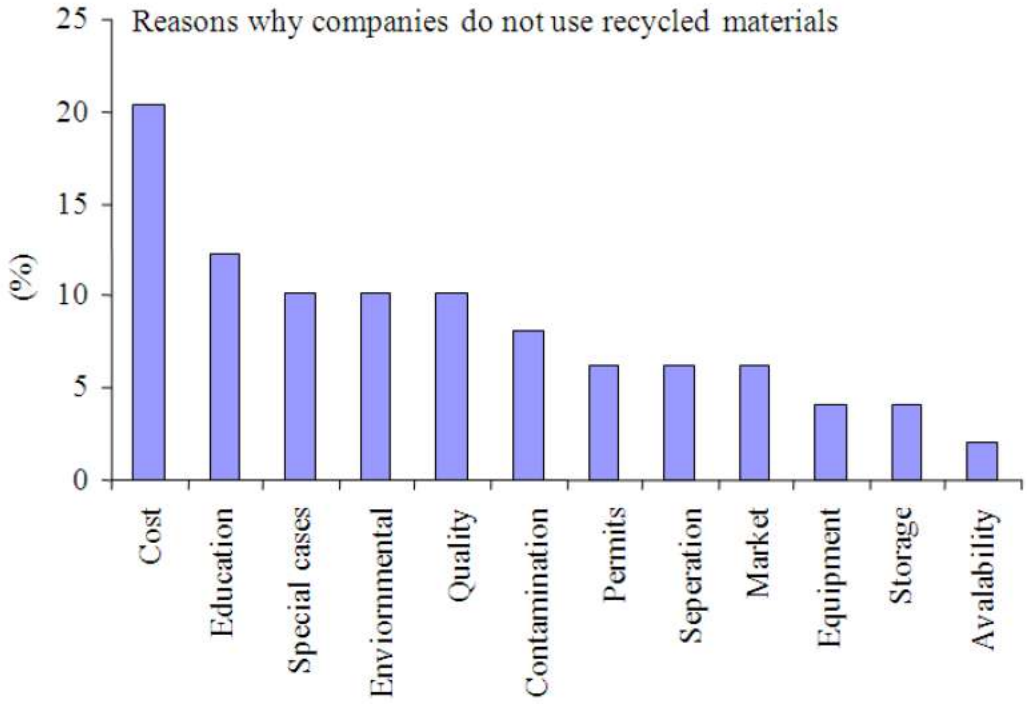


TFigureTNoT11.TMostTcommonlyTusedTrecycledTmaterialTinTconcrete.

FigureTNoT12TshowsTtheTpercentTofTreasonsTwhyTcompaniesTareTnotTusingTrecycledTmaterials.T



FigureTNoT12.TReasonsTofTnotTusingTrecycledTmaterials.

FigureTNoT13**T**showsTtheTpercentageToTmaterialsTtheTcompaniesTareTawareTofTinTtheTconstructionTindustry.TThereTareTmanyTotherTmaterialsTwereTnotTmentionedTinTthisTsurvey,butTcanTbeTusedTinTdifferentTconstructionTprojectsTconsistTofT14%.

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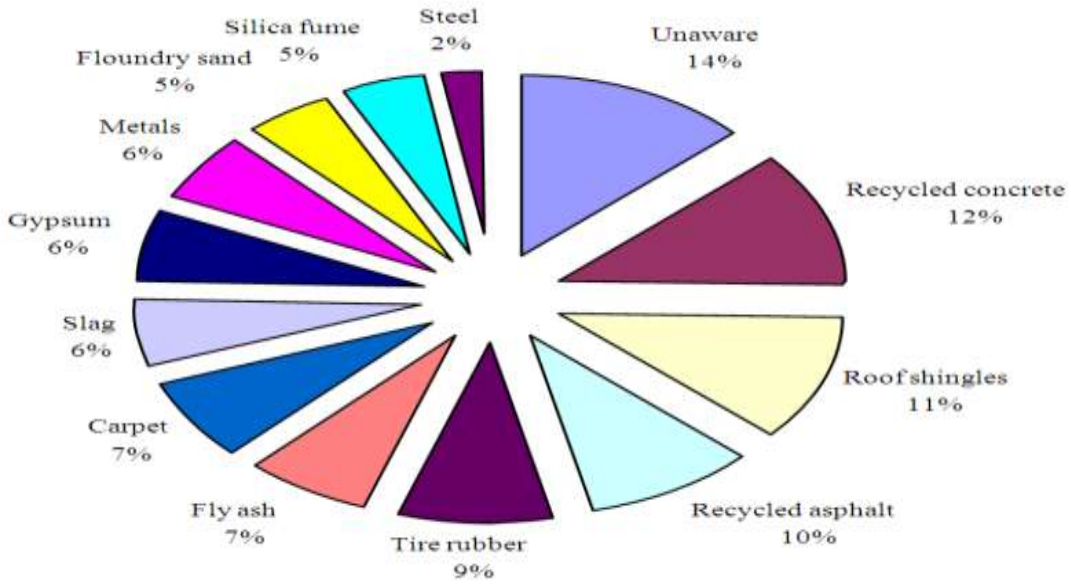
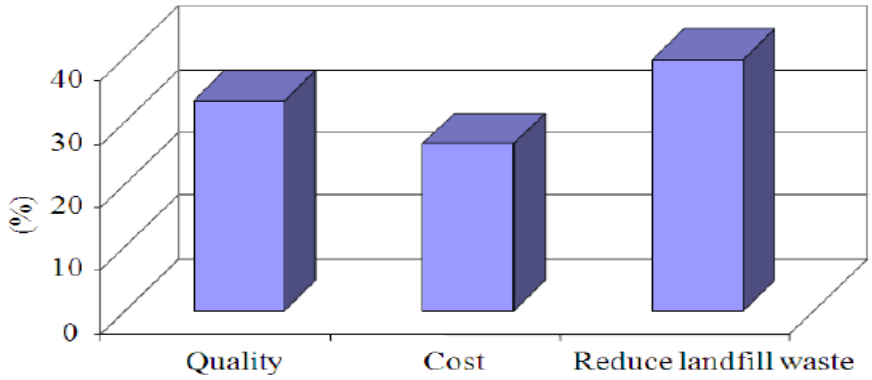


FigureTNoT13.TAwarenessTofTrecycledTmaterialsTforTconstructionTapplications.

WhenTcompaniesTwereTaskedTaboutTtheTbenefitsTofTusingTrecycledTmaterials,TreducingTlandfillTwasteTwasTnumberToneTatT38%TfollowedTbyTqualityTatT33%TthenTreducedTcostTatT27%.T



TWhyTcompaniesTareTusingTrecycledTmaterials.

CHAPTER 5

Conclusion

7.1TConclusion

1. DuringTdifferentTindustrial,Tmining,TagriculturalTandTdomesticTactivities,ThugeTquantityTofTsolidTwastesTareTbeingTgenerated,TwhichTcreateTmajorTenvironmentalTproblemsTasTwellTasToccupyTaTlargeTareaTofTlandsTforTtheirTstorage/disposal.
2. ThereTisTaTtremendousTscopeTforTsettingTupTsecondaryTindustriesTforTrecyclingTandTusingTsuchThugeTquantityTofTsolidTwastesTasTresourcesTinTtheTproductionTofTconstructionTmaterials.
3. UseTofTwasteTmaterialsThasTpositiveTimpactTonTdifferentTasceptsTthisTincludeTtheTbenefitsTinTenchancingTsustainabilityTofTconstructionTindustryTwhileTreducingTcostTprovidingTsolutionTforTenvironmentalTpollutionTandTreducingTneedTforTnaturalTresources
4. TheTideaTofTreusingTtheTwasteTmaterialTisTveryTexcitingTandTencouragingTspeciallyTwhenTitTwillTbeThelpfulTinTminimizingTdestructionTtoTearth'sTcrustTandTgreenTforestTcoverTbyTvirtueTofTreducedTmining.
5. ByTsuitableTrecyclingTandTreuse,TtheseTwasteTmaterialsTwillTnotTcontributeTtoTwasteTloadTdumpingTandTdisposalTsites.T

6. ConstructionTindustryTcanTcontributeTtowardsTitsTcommitmentTtoTprotectionTofTenvironmentTbyTencouragingTuseTofTrecycledTconcreteTstonesTandTbricks.T

CHAPTER 6

References

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