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Fabrication and properties of Polypylene matrix composites reinforced by

Ultrafine Bamboo-char

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Abstract: Toimprove the mechanical and thermal properties of polypropylene (PP) matrix composites,ultrafine Bamboo-char (UFBC) was introduced intoppby twin-screw extrusion and injection.Effects of different mass fractions of UFBC on the properties of the resulting ufbc/pp composites were mvestigated.A combination of SEM,dsc,mechanical test and moisture absorption test wasPerformed to provide a comprehensive analysis of the structure and properties of UFBC/PP composites.Uniform dispersion of UFBC in the PP matrix and do Mterac.tion via physical interfacial interlocks were obseRVed with SEM.The addition of UFBC has remarkable impacton

Themechanical properties of the composites.Tensile strength and bending strength increase with the mcrease of UFBC contents, and reach maximum values of MPa and 54 mpa,respectivelywhen30%mass fraction of ufbcaddition s Used,whichIncrease by 9%and18%Comparing with those of PP.The moisture resistance of ufbc/pp compos ites is still excellent,and the moisture absorption s less than 0.1%.DSC analysis illustrates that melting tempera

ture increases by 3 c when mass fraction of UFBCis40%,And thecrystallization temperature increases by 8^0C when the mass fraction of UFBC s 50%.The crystallization and fabricability of composites are improvedwith the addition of UFBC.

Keywords: ultrafine Bamboo-char;Polypropylene;Mechanical Properties;Moisture Resistance;Thermal Properties

Polypropylene(pp)is a kind of semi-knot made by propylene polymerizationfor a wide variety of general plastic one.however,ppmaterial causecrystal thermoplastic resin.is usually semi-transparent colorless solid,odorlessnoPoor mobility,low mechanical strength,Polar Polymer compatibility differencepoison,has excellent thermal performance and processing performance,is currently applied mostLimitations such as apply to a certain limit[].Find a valid party

Themethod increasestheppmaterial performance has become a research hotspot.

ultrafine powder refers to the particlesize<30pmPowder,Istypically divided intomicron level(size>1ym),submicronlevel(size is0.1~1.0pm)and Nanoscale(sizing in1~nm)[5|].Bamboo charcoalis the remaining solid matter after pyrolysis of bamboo in anoxic environment,is a source wide,cheap,unique material[6].Bamboo Charcoal Material surface roughness,with more pores,specific surface area,havefacilitates surface bonding between bamboo charcoal and polymer materials.China bambooplanting area wide,Large quantities of bamboo processing residues are burned directly ordiscard,is not effectively exploited and pollutes the environment[7].if bamboo carbonizedPrepare bamboo Charcoal Granules//polymer composites,expand bamboo shouldwith domain,Increase Bamboo's utilization value.

improve by adding organic and inorganic fillersPPThe force of the base materialLearning Performance and thermal performance is an important modifier._[812].whySpring Chardonnay etc[]Use a mixture of rice husk powder and wheat flour to fill out thechargePPpreparing composites,discovers30%Mixed FiberPink/tensile/strength of polypropylene

composites appears at greater value,closeto/MPa.sudhakaraetc[]with palm fruit fiber,Yellowlinen,sisal and coconut fiber

reinforcedPPBase composite performance,anduse maleic anhydride as additive to prepare composites,Find the PalmFruit Fiber Add quality score to'WT%Composite Force whenlearning intensity is better.1^out etc[]to |J ?methyl polyhedron low poly halfsiloxane to interface compatibility,and the vapor phase nanometerS02,PPandinterface compatibility melting blending composites,Find the interface phaseagent in NanoSi02When content is low it can effectively improve the composite.The tensile properties of the material.however,for ultra Micro Bamboo charcoal(UFBCenhanced)PPResearch on base composites no public reports,ufbc/ppComplexComposite Mechanical Properties,Humidity-tolerant,Thermal performance and micro-shapeThe appearance structure has yetto be studied.

This study adds a different mass fraction to theUFBCaspadding withPPpreparedufbc/ppcomposite,on its structure,mechanical Properties,Comprehensive characterization of wet and thermal properties byAnalysis,designed to achieve better performanceufbc/ppcomposite withsquare,to go_Step IncreasePPBase Composite properties provide data supporthold,also available for bamboo resources_Way.

1. Experimental materials and methods

1.1 raw materials

ultra-micro bamboo charcoal(UFBC),National Forestry Administration Bamboo Research and developmentCenter offers;polypropylene(PP),model:045,melt flow raterate:230C,3 8kgunder conditions1g/10min,Wenzhou YintaiChemical Co., Ltd.;release Agent,shenzhen Sub-Aerosol Aerosol Limitedcompany.12Experimental method

1.2.1 Raw Material drying process

willUFBCin the blower dryer,TheCunder the condition ofcontinued dryingh,The is removed and placed in the dryer for alternate.willPPPlaceinvacuum drying box,CContinuous drying under conditionsH,Removeput in the dryer for alternate.

1.2.2 UFBCparticle size test

The appropriate amount ofUFBCinto the laser granularity Analyzer(Master RsizerMalvernCo.,),Use dry testtest analysis,getufbcto size distribution.

1.2.3 UFBC/PPPreparation of composite materials

TocallUFBCThe mass score is0WT%,WT%WT%WT%,WT%WT%forufbc/ppmixedcombination,Total quality10g, mixed withcheckinWLGtenminitype screw extruder(Shanghai New Shuo Precision Machinery Co., Ltd.)Medium meltingmixing5min,temperature condition190C,rotaterate100r/min.A sample of the melted mixture is extruded to the plastic cartridge.takewzsTenDMini injection machine(Shanghai New Shuo Precision Machinery Limitedcompany)at temperature of195C5 MPapressure guaranteetens,makesample injection into mold,Remove sample into dryeralternate.

1.2.4 Mechanical Performance Characterization

inCNT-7014Microcomputer controlled electronic universal Material testing machine(United StatesMTSLimited)onPPandufbc/ppcomplextensiletest and bending test for materials, thetensile test reference standardGB/T1040-2006[],speed tomm/min,test toLess test3parallel-like,take average;Bend Test Reference StandardGB/t9341-@[],speed to5mm/min,experiment toless test3parallel like,averages.

1.2.5 characterization of moisture tolerance

Reference StandardGB/t1034-2008[]plastic Water absorptionDetermination Method4,Place sample intoCOven DryH,Yesafter cooling in dryer to room temperature,weighing specimen qualityrn1;will trySample put relative humidity to50%,temperature control in%Cconstant temperatureThe In the Humidity box,ToPlaceHweighing the sample qualitym2,sample fromTheconstant temperature and humidity box is removed,should be in1minComplete Measurement;and thenPutsamplesin Cdry in ovenH,to cool the in the dryerto room temp,weighing sample qualityM3.based on the following calculationWater quality scoreC:

$e=^{m2}One^{m}X100\%(1)$

M_1

1.2.6 Thermal Profiling

takes approximatelyTenmgforufbc/ppComposite Samples,Benefits

withF3type differential scanning calorimeter(GermannetzschLimited publicDivisionmeasuringThermal Performance,first from room temperature to200C,heating ratetoTenc/min,thermostat5minafter,and thenTenc/minSpeedratedown to +c,and then from theCwithTenc/minThe rate of isupthrough200CScan,Purgenitrogen asML/min.crystallinity$X_c$calculation formula is::

AHm

AWQX^pp

type:AHmisufbc/ppThe melting enthalpy of composites;AH.toPP100%melting enthalpy at crystallization138j/g;Xppisufbc/ppcompositesPPThe quality score of.

1.2.7 Microscopic profiling

usestheSU8010Type field emission scanning electron microscope(JapanHitachiCo.,)makeUFBCsurface microscopic appearance andufbc/ppcomposite tensile fracture surface topography observation,Sample tableface gold-plated,electron microscope emission voltage is3.0kV.

2. Results and discussions

Z1Ultra Micro Bamboo charcoal(UFBC)particle size distribution and surface microscopic appearanceuseThe size distribution of the UFBC is as shown in the figure1.unknown,UFBChas a normal distribution,particle volume fraction cumulative calculationgets:10%Volume fractionufbcparticlesize3.pmtoNext,Thesize ofthe50%is in.1pmThefollowing,90%the size of the IS in,7$_p$mbelow.diagram2toUFBCsurface microscopic appearance of particlesfeaturesSEMimage.Figure Ultra-micro bamboo charcoal particle shapeirregular,Particle sizeis smaller,length size is less than$_P$m.usesufbcinthe volume fraction of the particles is larger,This kind of particle surface roughness,pores developed,has a large surface area,These pores can produce stronger capillary effects,toIncreasePPinfiltration effect,Which enhances the interface between the two.Force[on].can observe a partial length dimension of the bamboo charcoal particlelessthan3$_p$mSmall particles,Suchparticles can be wellPPBase

Body Wrap.

2.1 ufbc/ppComposite mechanical Properties

diagram3isUFBCAdd amount toufbc/ppComposite Pullextension Performance effect.to see,withUFBCadd to +high,ufbc/ppThe tensile strength of the composite decreases first and then risesDrop again,This result with natural fiber reinforced polymerCompositesMaterial research results similar to[20].onufbcquality score30wt%when,The tensile strength of the composite is greater than the maximum value of26MPa,more purePPThe material is enhanced9%.ufbc/ppcomplexThe tensile modulus of the composite material rises first and then falls.,onUFBCQuality dividedbynumber toonWT%,The tensile modulus of the composites reaches a greater valueto45XTen^{2}MPa,morePPimprove103%.ufbcandThe main combinationofPPis physical lock,Followed by Van der Waals theForce of the molecular inducer.whenufbcLow quality score,PPThe force between chains is broken,and a small number ofUFBCisless thantohave more physical binding pointswith PP,at this time,UFBCbinding betweenandPP,but weaker,causes the composite materialmaterial tensile strength drop.and withufbcIncrease quality score Large,ppThe molecular chain willUFBCThe protruding structure of the surface is wrappedaround,spreads into the at the same timeUFBCin the pores of,to form a stable physical lockbutton,so the tensile strength increases withit[]].whenufbcadd too much,result in a reunion ofufbcwithtoo many particles,Stress sets when stretched,eventually causes a drop in tensile performance.ufbc/ppcomposite fracture elongation withUFBCQuality dividedbynumber increases and decreases,This is due to lower quality score,PPandUFBCPhysical lock is weaker,stretch whenPPnumeratorchain easier tounlock lock,PPeasy to pull extensions;withufbcincrease of particles,A large number of molecular chains are wrapped in a physical clasp in the form oftheufbcaround,When the material is

stretched,PPThemolecular chain does notand unlocking the latch,There wasa break,UFBCpreventsPPchainMovement of the segment,makeufbc/ppThe fracture elongation of composite material is constantdecrease.

ufbc/ppThe bending properties of composites are changing as shown in the figure4shows.can see,ufbc/ppComposite bending strongdegrees withufbcIncrease the mass fraction first and then decreasethe,on

[3]PComposite Tensile Properties

PP and UFBC/PP Composites

UFBCThe mass score isWT%,Greater bending strengthvalueMPa,more purePPincreased18%,This is becauseUF--BCvsPPMatrix physical locking functionis good,Two-phase interface is more than,Strong,increases the bending strength of composite materials,but excessiveufbcReunion results in stress set,after bending strengthdown.The bending modulus of the material is the same as theufbcquality scoreincreasingandincreasing,on quality scoreWT%isstill notappears down,fracture bending strain and bending modulus change of materialpotential opposite,withtheufbcincreases the quality score by decreasing.

Z3UFBC/PPThemicroscopic appearance of tensile fracture surface of composite materials

UFBC/PPThe tensile strength of the composite is purePPMaterialIncreased,is becauseUFBChas greater strength,andUFBC,particle size smaller,thecan distribute a wider and better populated matrix.ufbcpadding withPPInterface binding characteristics of the matrix as shown in the diagram5shows.unknown,ufbcsurface exists morePPdrawing,showbefore stretching,PPmolecule spreads well toufbcsurfacevoidwith, toform a stronger physical locking effect,knot

Strong.during stretching,duetoUFBCandPPSubPhysical locking of children,The unlock of the molecule has absorbed most of the RafahExtend Energy,so on the fracture surface,UFBCWire Drawing on the surface of the particle tosignificantly more thanPPbase surface.diagram5 (b)can be observedufbcwithPPTwo-phase boundaries are almost fused_up,composite material breakssplit,thetwo phases have not yet been separated.This indicates thatufbcvsPPboundsclosetogether.

Z4ufbc/PPcomposite Moisture resistance

PPandufbc/ppThe hygroscopic rate of the composite is shown in Figure6"show."can seethat,ufbcintroducedufbc/ppcomposite materialThe moisture absorption rate of the material increases slightly.,--composite Moisture-resistant properties slightly downDrop,This is because theUFBCis more hygroscopic.butufbc/ppThe increase in moisture absorption of composites is not obvious,low Moisture absorption,isless than0 1%,excellent moisture resistance of materials,becauseof theUFBCcan be compared towell spread toPPbase,Thesurface isPPmatrix is betterpackages,Both form a tighter structure,UFBCharder to reachto air moisture,reasonufbc/ppComposite to keeptheBetter humidity-resistant performance.

Z5UFBC/PPComposite Thermal Properties

PPandufbc/ppCompositeDSCcurve asshown in figure7shows.table1listPPandufbc/ppcomposite Heattheperformance parameter,including crystallization temperature(T.)),crystallization enthalpy(HJ,Crystal degree(Xpp),Melting temperature(Tm)and melting enthalpy(AHm).from

Thediagram showsthat,UFBCAdd toufbc/ppfusion of compositethaw temperature slightly increased,toUFBC/PPcomposite crystallization temperaturedegreeGreater increase.isfrom tableto,ufbcQuality score is$wt%when,ufbc/ppComposite Melt temperature is greatervalue163.8C,morePPThe improves the3.1c,UFBCQuality Scoretowt%,ufbc/ppComposite crystallization temperature is morePPThe improves the8C.ufbcadd to makeufbc/ppComposite materialmaterial crystallinity is more purePPslight drop,UFBCAdd to DepartmentBreakPPinternal crystal structure,affects the crystallization ability of a material,soufbc/ppThe crystallinity of the composite has decreased,but alsoUFBCvsPPThe matrix forms a stable heterogeneous nucleation structure[all],thisstructure crystallization performance morePPmatrixStronger,ufbc/ppComposite MaterialThe crystallization temperature of the material increases significantly,UFBCThe addition of promotesUF-bc/ppcomposite

crystallization,Improvedufbc/ppcomposite materialProcessing of material.

3. Conclusion

(1)ultra-micro bamboo charcoal(UFBC)vs. polypropylene(PP)thetwo-phase has a""Better Interface binding,ufbcintroduced toufbc/ppthe mechanical strength of composites has a better effect.ufbcqualitymeasure score is,wt%when,ufbc/ppcomposite tensile strengthdegree and bend strength reached a greater value,respectivelyMPaiMPa,ismorePPThe increases the9%and18%,but excessiveUFBCreduce thestrength of composites.

(2)ufbc/ppcomposites have better moisture resistance,hygroscopicrate is less than0.1%.

(3)UFBCTheintroduction of Toufbc/ppcomposite KnotCrystal plays a catalytic role,ufbcmass score isWT%,Composite crystallization temperature is morePPThe improves the8C.ufbcqualitymeasure score is+wt%when,,Melting temperature of composite isgreater than large value163.8C,thanPPslightly improved.

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