# Processed Text

materialstoday proceedingsxxx xxxx xxx contentslistsavailableatsciencedirect material today proceeding journal homepage www elsevier com locate matpr material characterization polymer nanocomposites aerospace application nandita roya b gurusideswara adepartmentofaerospaceengineering srminstituteofscienceandtechnology kattankulathur603203 india bdepartmentofmechanicalandaerospaceengineering arizonastateuniversity tempe85281 unitedstatesofamerica r c l e n f b r c articlehistory nanocompositeshavebeenusedassuitablesubstitutesformetalmatricesandalloysforquitesometime availableonlinexxxx inindustrialapplications carbonfiberreinforcedpolymers cfrp andotherfiberreinforcedpolymers frp prevalent compared polymer reinforced one dimensional nanofillers keywords becomesimportanttoanalyzetheeffectsonthemechanicalpropertiesofpolymermatrixwhenrein epoxy forced nanofillers nanocomposites prepared using epoxy resin polymer matrix carbonnanotubes twonanofillers namelycarbonnanotubes cnt andhalloysitenanotubes hnt areusedtocompare halloysitenanotubes theimpactofeachonthepolymermatrix threedifferentweightpercentagesforeachnanofillercompos scanningelectronmicroscopy itearefabricated 0 5wt 1wt 1 5wt forcntand1wt 5wt 10wt forhntisconsidered hardness microstructural characterization scanning electron microscopy sem x ray diffraction mechanicalproperties xrd providedanin depthunderstandingofthedispersionofnanofillersinthepolymermatrixand thequalityofitsfabrication theimagesobtainedfromthesemshowthepresenceofmicrovoidsand someagglomerationsinthespecimens thexrdplotswithpeakbroadeningconfirmthesmallersize crystallite nanocrystalline material specimen mechanical characterization includes hardness tensile flexural showed effect nanofillers epoxy however beconcludedthattheapplicationof1wt nanofillersleadstoanoptimumdispersionandimproved thepolymermechanicalcapabilities afractographyanalysiscanbeconsideredasafuturescopeofthis study copyright cid 1 2023elsevierltd allrightsreserved selectionandpeer reviewunderresponsibilityoftheinternationalconferenceonfuturetrendsinmate rialsandmechanicalengineering 1 introduction tiesduetothedispersionofnano fillersintothepolymermatrix andalso theyaddressedthecost processingdifficultiesandfuture compositesaremadeoftwoconstituentmaterials thematrix perspectivesofnanocomposites njugunaetal 2 providedawide binder reinforcement matrix surround pre rangeofmaterials whicharebeingusedinthestructuralandther servesitsreinforcementrelativelocationandproperties therefore mal application review work extract valuable information itprovidessupporttothereinforcement since thereinforcement onfundamentalelementsinvolvingfieldemission thermalstabil incorporatetheirextraordinarymechanical chemical andphysical ity electrical opticalaswellasmechanicalpropertiesofpolymer quality matrix matrix property need nanocomposites aerospace applicability concluded improved rathod et al 1 reviewed polymer ceramic aerospace industry could potential user polymer matrix composite aerospace application author pro nanocomposites prabhakar et al 3 reviewed tribological videdadetaileddiscussionontheinfluenceofmechanicalproper property polymer composite addressed challenge ofthecharacterizationofnanocomposites naturalnanocompositesaremultiphasesolidswithone two abbreviation cnt carbon nanotube hnt halloysite nanotube sem moredimensionswithin100nmandrepeatdistancesbetweenthe scanning electron microscopy xrd x ray diffraction ftir fourier transform infrared tem transmissionelectronmicroscopy distinguishablestatesinthenanoscalethatmakeupthematerial correspondingauthor fundamental perspective nanocomposite based e mailaddress gurusj alumnus iitm ac gurusideswar http doi org 10 1016 j matpr 2023 05 606 2214 7853 copyright cid 1 2023elsevierltd allrightsreserved selectionandpeer reviewunderresponsibilityoftheinternationalconferenceonfuturetrendsinmaterialsandmechanicalenginee ring pleasecitethisarticleas n royands gurusideswar materialcharacterizationofpolymernanocompositesforaerospaceapplications materialstoday proceeding http doi org 10 1016 j matpr 2023 05 606n royands gurusideswar materialstoday proceedingsxxx xxxx xxx concept instilling enhanced characteristic matrix otubes hnt onthemechanicalpropertiesofepoxysystemandto use reinforcement nano level concept identifytheoptimumloadingofcarbonandhalloysitenanotubes nanocomposites two part matrix reinforcement 2 experimentaldetails et al 4 studied tribological behavior polymer nanocomposites find application automotive high 2 1 material barrier food packing film extremely hard wear resistant coating work author discussed key known primarily two type polymer mechanism governing effect reinforcement curingmethods whichclassifytheresinasthermoplasticorther mechanicalandtribologicalbehaviorofpolymernanocomposites moset resin uncured thermoplastic resin room temperature husaen 5 investigatedtheeffectofcarbonnanotubeshavingvar areinsolidstateanditmakestheimpregnationofnanofillersinto iousweightpercentageof0 01 0 05 and0 1 inepoxymatrixand theresinsystembecomedifficult themanufacturingprocedureof itseffectonthemechanicalpropertiessuchastensile bending thermoplasticcompositesisverytediousincomparisonwithtradi hardness fromtheresults itisobservedthattheflexuralandten tional thermoset composite due problem current silemodulusoftheepoxynanocompositeswasfoundtobehigher study focus thermoset polymer resin cured neat epoxy could due highmechanical atroomtemperature onesuchthermosetpolymerresinisepoxy strength carbon nanotube njuguna et al 6 provided whichisbeingusedasamatrixinthecurrentstudy detailed review nanocomposites primarily focused uncuredthermosetresinsatroomtemperatureareinaliquid characterization technique hrsem ftir xrd tem stateanditmakestheimpregnationofreinforcingthenanofillers method dinca et al 7 reported structural com intotheresin systembecomeconvenient duringthecuringpro posites important application nanocomposites ce resin molecule cross linked catalytic aerospaceindustryandalsoitcanbeusedasanti lightning anti chemical reaction exothermic reaction facilitates resin radarprotectorsandpaints theauthorsstudiedtheeffectsofsonic tocreateextremelystrongbondswithoneanother therebychang dispersion carbon nanotube montmorillonite clay ingfromaliquidtoasolid apartfromtheeaseofmanufacturing mechanical electrical rheological tribological property process thermoset resin also exhibit excellent property epoxy polymer laminated composite carbon glass low material cost resin used research araldite cy fiber reinforcement nonadditive epoxy matrix kamal et al 205 aliphatic glycidyl epoxy resin araldite hardener hy 8 reviewed various fabrication technique polymeric 951 n 2 2 aminoethylamino ethyl ethane 1 2 diamine nanocomposites fuetal 9 discussedthebasicaspectsofpoly important understand effect curing mechanical mernanocompositesanditsvariousprocessingmethodsandchar capabilitiesofthepolymernanocomposite acterizationtechniques askaretal 10 explainedthebenefitsof basedontheliteraturesurvey carbonnanotubesandhalloysite multifunctional nanocomposites wear resistance optical nanotube considered reinforcing one dimensional transparency stimuliresponsiveness surficialwettability recycla nanofillersforthecurrentstudy microstructuralcharacterizations bility andbiodegradability inthiswork theauthorsincorporated werecarriedoutusingsemandxrdandmechanicalcharacteriza halloysitenanotubes hnt andcelluloseacetatebutyrate cab tionwascarriedouttounderstandtheinfluenceofnanofillers nanotube filler anddispersivemolecules respectively kamble themechanicalpropertiesoftheepoxysystem etal 11 explainedthebenefitsofhalloysitenanotubes itisnoted thatthemechanicallyadvantageousnanomaterialssuchascarbon nanotube nanofluids nanoparticles nanoemulsions nanocap 2 2 compositionandfabrication sules etc arehazardoustoenvironment inordertoovercomethis issue halloysitenanotubesarepreferred whichisnaturallyavail theexperimentalsetupiscomposedofamoldhavingtwoglass ablenanomaterialandeco friendlyinnature plateswithtwomylarsheetsandrubberbeading glassplatesof inrecentyears alotofresearchworkhavebeencarriedoutin 300 cid 1 300 mm used supporting member wax natural fiber reinforced composite due easy availability coatedmylarsheetswereusedtogetbettersurfacefinishandto low cost sustainability eco friendliness biodegradability releasethespecimeneasilyfromthemold recyclability kumar et al 12 presented review study inordertofabricatetheepoxynanocomposites threedifferent mechanicalpropertiesofbamboofiber bamboofiber basedcom weightpercentagesforeachnanofillercompositewereconsidered posites hybrid bamboo fiber based composite goyat et al asfollows 0 5wt 1wt and1 5wt forcntand1wt 5wt 13 carried detailed review mechanical property and10wt forhntisconsidered therequiredweightpercentage untreated coir

chemically treated coir composite da nanofiller incorporated calculated 200 g epoxy etal 14 presentedadetailedreviewofbiocompositesmadefrom therefore1g 2g 3gofcntwasusedand2g 10g and20g various waste related mechanical fire property hnt used prepare specimen mechanical stirrer based recent study concluded nanofillers wasusedforadurationof7htofacilitategooddispersionofthe also added secondary reinforcement natural fiber nanofillersintheresin theadditionofcntincreasedtheviscosity reinforcedpolymerstoimproveitsmechanicalproperties
oftheepoxyandhenceaspeedof200rpmwassettodispersethe
polymercompositeshavebeenresearchedforthepastfewdec nanofillersinepoxysystem inthecaseofhnt theepoxyviscosity adesanditisextensivelyusedintheconstruction automobile wasunchanged thus aspeedof300rpmwassettodispersethe aerospace industry significant change composition nanofillers epoxy system dispersion nanofillers aerospacepartswouldmakethemlighterwithoutcompromising epoxysystem arequiredamountofhardenerwasaddedandthe structural strength incorporating proper manufacturing tech mixturewaspouredintothemold theweightofnanofiller epoxy niques thissmall scaleevaluationcanbeincorporatedinsolving hardener measured carefully using high resolution real world mechanical aerospace problem current weightbalance
itusuallytakestheepoxyandhardener8htocure study attempt made enhance mechanical property due addition nanofiller 24 h set curing epoxy matrix incorporating one dimensional nanofillers time reinforcement themainobjectiveofthecurrentworkistounder aftercuringprocess
thespecimensweremachinedusingwater standtheinfluenceofcarbonnanotubes cnt andhalloysitenan jetcuttingmachinetogetdesiredgeometry thedimensionofthe 2n royands gurusideswar materialstoday proceedingsxxx xxxx xxx specimen considered according astm standard process specimen held two crosshead cuttingmethodincorporatedwaswater jetcutting clamped
theloadisappliedgraduallyandthespecimenelongates
whilethetestingprocesscontinuesuntilthespecimenbreaks graph elongation respect force applied 2 3 microstructuralcharacterization recorded suggested test speed given strain rate 0 01 min cid 3 1 constant crosshead speed 2 mm min 0 05 x ray diffraction xrd non destructive analyzing tech min thegeneralpracticeistoconductthetestataconstantcross
niqueusedtounderstandthecrystallographicstructureofamate headspeed rial testing specimen placed x ray flexural test bending test used determine flexural diffractometer illuminated beam x ray x ray strengthandstiffnessofthecompositematerial sincecomposites
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thesettingoftestneedstobecarriedoutcarefully tiveinterferencewiththeincidentx rayiscalleddiffraction andtheflexuraltestsmustbeproperlyconductedtoensureproper istheprinciplebehindtheinstrument theanglebetweentheinci dentrayandthescatteredbeamiscalled2h thex raydiffraction specimenalignment loadapplication tothe test specimen three point four point loading configuration employed performedinthiscurrentstudyhelpstounderstandthequalityof carry flexural test astm d790 used determine thedispersionofthenanofillersinthespecimen flexural property composite material flexural strength scanning electron microscopy sem technique used well flexural modulus ability quantitative value examine surface image specimen using focused beam amaterial
scapabilitytoresistcrackingorbreakingunderbending electron electron penetrate specimen till stress material high flexural strength ability certain extentand thenget reflectedby thespecimenmolecules resistdeformationwhenaloadisimplementedintensionorcom reflected electron captured processed get pression inherently withstands bending stretching twisting micrographs general sem image provide insight andothertypesofstress byusingtheoryofbending theflexural
thelevelofdispersionandqualityofthefabricatednanocompos strengthofthespecimenscanbeevaluated ites dikinetal 15 discussedthefactorsinfluencesthescanning electronmicroscopy suchasaccelerationvoltage conductivityof thematerialsofthecomposites thicknessofthespecimenetc 3 resultsanddiscussion 2 4 mechanicalcharacterization 3 1 microstructuralcharacterization mechanical characterization conducted performing hardness tensile flexural test composite specimen thex
raydiffractionwasperformedtocharacterizethequality hardness test used test wear resistance toughness etc dispersion fabricated nanocomposites result show material hardness determined performing indentation exfoliated structure nanocomposites xrd result specified period time indenting instrument used noted specimen posse uniform dispersion fig 2 calleda durometer

itincludesacalibratedspringwhichismeant show micrographs obtained scanning electron micro toapplyadefinedandconstantload theindentationhardnessis scopy fromthemicrographs itisnotedthatlowerweightfraction inversely proportional penetration dependent ofnanofillersshowauniformdistributionofthe nanofillers theelasticmodulusandviscoelasticityofthematerial thehard slight presence agglomeration higher weight fraction nesstestusedinthecurrentstudyis shoredhardnessscale nanofillers show lot micro void micro void measuresthehardnessofhardrubbers semi rigidpolymers inevitableduetotheabsenceofvacuumsetup hardpolymers theshoredtestinvolvesaspring loadedindenting machineformeasuringthematerial shardness thetypeofinden tervarieswithrespecttoeachmaterialtobetested shoredhard nesstestemploysasharpconicalpointasindentertipandahigh 3 2 mechanicalcharacterization stiffnessspringtomakeitidealfortestingharderpolymerssuchas curedepoxiesorhighlycross linkedmaterials thespecificationof hardnessisdescribedasaresultofempiricaltestingowingto theindenterisasshownintable1 indentation specimen using durometer hardness tensile testing used determine elongation ultimate value specimen measured machine tensile strength young modulus composite material resultsareshowninfig 3 itisnotedthattheadditionofnanofil tensiletestingisoneofthedestructivetestscarriedouttounder ler impacted hardness criterion epoxy shore stand mechanical characteristic fabricated nanocom hardness1wt cntwithepoxyand1wt hntwithepoxyshows posites astm d638 used test plastic reinforced improvementin comparison neat epoxy since hard particle one primary test used characterise nessisasurfaceproperty itcanbespeculatedthatduetoimper thetensilepropertiesofcompositematerials fig 1showstheten fectionsinthespecimen theregionsofindentationinthecntand silespecimensofepoxyanditsnanocomposites duringthetesting hntspecimensmighthavemicrovoids thetensiletestingwasperformedandtheadditionofnanofil ler considerably increase tensile strength epoxy table1 specificationsofshoredhardness fig 4 noted neat epoxy system show lowest valueofultimatetensilestrengthand1wt cntand1wt hnt property value showthehighestultimatetensilestrength theadditionofnanofil hardnessscale shored lersatmorethanaspecifiedlevelledtopoordispersionofnanofil indentertype conicaltype lersintotheepoxysystem tipangle 30 cid 3 theflexuraltestingwasperformedandtheresultsofbothcnt tipsize 0 1mmradius range 20 90 andhntisshowninfig 5 thereasonforthedecrementinflexu resolution 0 1 ralstrengthcouldbeduetotheexistenceofinevitablemicrovoids testingload 44 64n oragglomerationofnanofillers 3n royands gurusideswar materialstoday proceedingsxxx xxxx xxx fig 1 specimensfortensiletestingofepoxyanditscarbonnanotubes andhalloysites e h nanocomposites neatepoxy b 0 5wt cnt c 1wt cnt 1 5wt cnt e neatepoxy f 1wt hnt g 5wt hnt h 10wt hnt fig 2 semmicrographsofepoxyanditsnanocomposites neatepoxy b 0 5wt cnt c 1 5wt cnt 1wt hnt e 5wt hnt f 10wt hnt fig 3 variationofshoredhardness cnt b hnt 4 conclusion thatitisnotedthatlowerweightfractionofnanofillersshowauni formdistributionofthenanofillerswithslightpresenceofagglom epoxy cnt epoxy hnt specimen containing various erations higher weight fraction nanofillers show lot weightfractionswerefabricatedusinghandmoldtechnique microvoids variousmechanicalcharacterization whichincludes quality dispersion nanofillers epoxy matrix hardness tensileandflexuraltestswerecarriedouttounderstand characterizedthroughsemandxrdtechniques theresultsreveal theinfluenceofnanofillersintheepoxysystem fromtensiletest ing itisobservedthattheadditionof1wt cntand1wt hnt 4n royands gurusideswar materialstoday proceedingsxxx xxxx xxx fig 4 variationoftensilestrength cnt b hnt fig 5 variationofflexuralstrength cnt b hnt showedanenhancedstrengthincomparisonwithneatepoxysys 2 j njuguna k pielichowski polymer nanocomposites aerospace tem hardness flexural test noted neat application property adv eng mater 5 11 2003 769 778 3 k prabhakar debnath r ganesan k palanikumar areviewofmechanical epoxyspecimensshowthehighestvalueofhardnessandflexural andtribologicalbehaviourofpolymercompositematerials iopconference strength could due presence agglomeration series material science engineering vol 344 1 p 012015 iop andmicrovoids publishing 4 q u r sehgal f wani k singh overview polymer polymernanocompositeshavealotofscopeintheimpending nanocomposites understanding mechanical tribological behaviour future current study may beextended following iopconferenceseries materialsscienceandengineering vol 1189 1 area may focused fractographyand thermalcharacterization 2021 p 012010 ioppublishing 5 husaen mechanicalpropertiesofcarbonnanotubereinforcedepoxyresin improvement also implemented fabrication composite baghdadsci j 9 2 2012 330 334 methodstoget good specimen thenanofillerscanalso beused 6 j njuguna k pielichowski polymer nanocomposites aerospace secondary reinforcement traditional fiber reinforced application characterization adv eng mater 6 4 2004 204 210 7 dinca c ban stefan g pelin nanocompositesasadvancedmaterialsfor polymer thelimitationsofpolymernanocompositesneedtobe aerospaceindustry incasbull 4 4 2012 73 incorporatedinlargescaleaerospaceindustrieswithfurtherexplo 8 kamal ashmawy algazzar h elsheikh fabricationtechniquesof rationintopolymerfiberbasedcomposites polymericnanocomposites acomprehensivereview proc inst mech eng partc j mech eng sci 236 2021 4843 4861 9 fu z sun p huang li n hu basic aspect polymer creditauthorshipcontributionstatement nanocomposites acriticalreview nanomater sci 1 1 2019 2 30 10 k askark songepoxy basedmultifunctionalnanocomposites polymer basedmultifunctionalnanocompositesandtheirapplications2019111135 nandita roy conceptualization investigation validation 11 r kamble ghag gaikawad b k panda halloysite nanotube writing original draft gurusideswar methodology project application areview j adv sci re 3 2 2012 25 29 administration resource supervision visualization writing 12 v goyat g ghangas sirohi kumar j nain areview onmechanical propertiesofcoirbasedcomposites mater today proc 62 4 2022 1738 review editing 1745 13 j kumar chaudhary v goyat goyal areviewonmechanicalproperties dataavailability bamboo fiber based composite c pandey v goyat goel ed advance material mechanical engineering lecture note mechanical engineering springer singapore 2021 http doi org 10 1007 datawillbemadeavailableonrequest 978 981 16 0673 1_7 14 oisikdas karthikbabu vigneshwaranshanmugam kesavaraosykam mike tebyetekerwa rasoulesmaeelyneisiany michaelförsth gabrielsas jaime declarationofcompetinginterest gonzalez libreros antonio j capezza mikael hedenqvist filippo berto seeram ramakrishna natural industrial waste sustainable theauthorsdeclarethattheyhavenoknowncompetingfinan renewable polymer composite renew sustain energy rev 158 2022 http doi org 10 1016 j rser 2021 112054 cial interest personal relationship could appeared 15 dikin k kohlhaas g dommett stankovich r ruoff scanningelectron toinfluencetheworkreportedinthispaper microscopy method analysis polymer nanocomposites microsc microanal 12 s02 2006 674 675 reference 1 v rathod j kumar jain polymer ceramic nanocomposites aerospaceapplications appl nanosci 7 8 2017 519 548 5

# Top Keywords

nanocomposites: 0.2442732516826255
polymer: 0.2442732516826255
epoxy: 0.231416764751961
hnt: 0.2185602778212965
specimen: 0.179990817029303
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