Pisco Med Publishing

# lignocellulose/Nano-montmorillonite composite for waste water

**Cu(II)adsorption and desorption**

Zhangxiaotao[1], Wangximing[2]

[1] Schoolof Science ofInner Mongolia Agricultural University,hohhot0100182.

[2] College of Materials science and art design, Inner Mongolia Agricultural University,hohhot010018

***Abstract:*** usinglignocellulose(LNC)with nano-montmorillonite(nano-mmt)intercalation Composite preparedlnc/nano-mmtComposite asadsorbent, simulatecopper-containing wastewaterCu((I)sorption and desorption experiment.through static adsorption experiments,studywithCu((I)Initial strong of solutiondegree,pHvalue,adsorption temperature and adsorption time to solutionCu((I)effects of adsorption effects.results show:Best adsorption condition isCu((I)Solutioninitial concentration0 03mol•$L^{1}$,phvalue4.9,Adsorption temperature°C,adsorption time60min,adsorption capacity reached maximum322. MG•$g^{1}$no., (,)The quasi two-level kinetic model can well describe its adsorption process,adsorption isotherm compliantLangmuirmodel.useHNO3tolnc/NANCR MMTcomposites for desorption regeneration Experiment.Theresult shows that:with0 1mol.$L^{-1}$forHNO3as adesorption,desorption temperature40C,Ultrasounddesorption time30min maximumdesorption283. MG•$g^{-1}$.combinationXRD,SEMandFTIRanalysisLNC/NANO-MMTComposite Materialadsorption mechanism for material.adsorption/desorption Cycling Experimental study shows:lnc/nano-mmtComposite Reuse4Theadsorption is still higher at times,is aExcellent recyclable and efficient adsorbent.

***Keywords:*** Lignocellulose;Nano-montmorillonite;Composite;Cu((I);Adsorption;desorption;Waste water

Figure category number in:O636document Marker:Aarticle number:1000-3851 (2015)02-0385-10

with the accelerated pace of metallurgy and electronic industrialization,HumanWashing wastewater containing copper powder in living environment,electroplating Wastewater etc large number of workersindustry pollutant increases,theEconomic value of these copper-containing wastewater is more thanhigh,But the serious harm to human health and living environment is also affected by theworldwideconcern[1-2].to protect and improve human existenceEnvironment,Scientific research worker strengthens the decontamination section of the pollution controlresearch project,as ambient self-purifying lignin,its suctionAttach performance received extensive attention[3-6].and ligninm againwoodcellulose(LNC)The main components of the are,Wood quality,cellulose[8]andhalf cellulose3allkinds of polymers togetherLNCis aRenewableNatural Polymers,Widely present in seed plantsin,Because of its structure there are many active functional groups such as phenol hydroxyl,alcohol hydroxyl,carbonyl,methoxy etc[9],can be used as a metal ion for a liveAdsorption sites[ten],to certain heavy metal[1112]playedaveryGood adsorption.but becauseof the LNC multiple dispersion and amorphous junctionconstruction,but hard to apply as material.montmorillonite(MMT)is asilicate minerals with nanometer layer structure[13-14],But becausethe

MMTswelling and dispersion in water,Toattach it to the heavymetal ions difficult to separate from wastewater.ifMMTto layerThe form is dispersed to theLNC,for controllable chemical modification,Toprepare thetoLNC/Nano-montmorillonite(nano-mmt)Composite hasbothmachine and inorganic material unique structure and excellent performance,and reactiontoEasy Quick,withonePractical value[from].aboutLNC/nano-mmtadsorption of heavy

metal ions in wastewater is still rare.report.

giventheLNCandnano-mmtas a heavy metal waste waterThe adsorbent has some deficiencies,This article withLNCis the startingobjects,with permanent negative charge inside structurenano-mmtforwardrow intercalation Composite PreparationLNC/nano-mmtComposite,improvementLNCThe unordered structure of the.with thisLNC/nano-mmtcomposite materialmaterial for waste waterCu((I)adsorbents,Examining experimental conditions toeffect of adsorption kinetics and adsorption isotherm.withXRD,SEMand,FTIRstructure of composite before and after adsorptiontoken,deep analysislnc/nano-mmtComposite and

Cu(()The adsorption mechanism between the ((, I,).to thelnc/nano-MMTdesorption and regeneration properties of composite materials, toAchieve adsorptionloop use,toLnc/nano-MMTcomposites in suctionpractical applications in the fields ofwith,detach are exploratory work.

# 1. Experimental materials and methods

## 1.1 Experimental material

The experimental material used by IS:LNC (SAM-),BEIJING Chinamultiple Biotech Co., Ltd.;MMT,cation exchange capacity(CEC)100meq• $(g)^{-1}$,zhejiang Fenghong ClayWork Co., Ltd.;no water$CuS0_4$,Shanghai Jinshan Pavilion New chemical testAgent factory,parsing pure;two amine acetic acid(EDTA),Two-cresol Orange,NaOH,$HN0_3$,No water$CH_3C\$Na,,_3CH$,Hongyan reagent factory, Hedong District, Tianjin,Parse Pure,use directly.

## 1.2 lnc/naNo-MMTPreparation of composite materials

will be a quantitativeLNCisspread overNa0HSolution(1.0g LNCisspread overMLNa0HSolution) (BS210S,Beijing GamesDolis Balance Co., Ltd.),Magnetic stirringmm,form Allevenly 'LNCsuspension.willMMTsuspension(1.0gMMT scatterinmLdistilledwaterAdd to three flask,Stir(Rotate speed5r/min0.Hslow addLNCsuspensionin,heating up toCStir6H,Centrifugal separation(rotate Speed6-r/min)(H-2050R,Changsha Hi-tech Industrial development ZoneXiang Centrifuge Instrument co.,Ltd.products with acetic acid and water volumecompare to1:1The solution to clean to the upper supernatant is neutral,iCNextVacuum dry(dhg9254A,Shanghai Jixin Scientific Instrument Limited publicDivision) 5Hto grind after constant weight,overpmSieve,getstheLNC/Nano-MMTComposites.

## 1.3 adsorption Experiment

Toaccurately call0gadsorbent,Join$mLknown strongdegreeCu((I)solution,Placed in awater bath thermostat oscillator(rotate Speed//min,SHA-C,Jiangsu Jintan Jiangnan Instrument Factory),in the_toachieve adsorption balance,Centrifugal separation(rotate Speed6-r/min),Remove upper layer clarifying liquid5ML,add5drop twophenol orange,withEDTAcomplexing titration[a]Todetermine the solutionCu((I)The remaining concentration of.in differentCu((I)initial concentration,PHvalue,suckWithtime and adsorption temperature adsorption experiment,Press(1)calculationadsorbent pairCu((I)adsorption amount(Consider experimental error,is in the sameunder experimental conditions3test, results withaverage value: $(C0-C,_1))V_1Xno.5$

$...^{=}$----------m---------(1)

type:G, 1iszThe adsorption amount of the moment,mg•$G^1$;C.andC-1respectivelyCu((I)The initial concentration of andthe,remaining concentration ofthe, time,

mol•$L^{-1}$;%is adsorbedCu((I)Solution Volume,ML;iscalledfor adsorbent quality,g.

## 1.4 desorption Experiment

Toaccurately call0.tengSaturated adsorptionCu((I)TheLNC/nano-MMTcomposite,Join$mLdifferent strongdegreeHN03Solution,Ultrasonic Oscillation at a certain temperature(KS^+EI,Shanghai Bullans Instrument Co., Ltd.)When the desorption balance is reached,Centrifugal separator desorption,,measuringdesorptionCu((I)The concentration of the solution,calculationLNC/nano-MMTdesorption of composites[17-18](Testconsiderexperimental

error,parallel to the same experimental condition3Sub SolutionSuction experiment,results take their average):

$C_{z,z}$Vzx.all.5

type:G,,2is the desorption,mg•$G^{-1}$;C,,2iszalways desorptionsolutionCu((I)'s concentration,mol•$L^{1}$;V:is used for desorptionCu((I)Solution Total Product,mL;m:for saturated adsorptionCu((I)LNC/Nano-MMTcomposite dosage,G.

# 2. Results and discussions

## 2.1 Adsorption Performance

### 2.1.1 Cu(II)effect of initial concentration

diagram1isCu((I)Initial concentration ofLNC/nano-mmtInfluence of the adsorption capacity of composite materials.adsorption test conditions are:adsorbentdosage0g,pHvalue4.9,Adsorption temperature°C,Adsorptionbetweenmin.from Diagram1to see,withCu((I)initial strongincrease,LNC/Nano-MMTComposite toCu((I)The suctionThe trend to maintain relative stability after first increase.This is because withCu((I)increased concentration of,solutionCu((I)Increased number of,

andlnc/nano-mmtActive adsorption bits in composite structuresThe number of collisions between and points is increased,adsorption increases;to continue addingCu((I)concentration,Active adsorption sites have been saturatedwith saturation,dissolveTheliquid adsorption volume remains stable,so,Cu((I)Initial concentration with0.030mol•$L^{-1}$appropriate.

### 2.1.2 SolutionPHEffects of the value

diagram2is the solutionPHvalue tolnc/nano-mmtComposite Materialmaterial adsorptionamount,shadowring.suctionattachRealcheckBar,to:suctionattachagentwithQuantity0,g,Cu((I)Initial concentrationof the solution0.mol ·$L^{-1}$,Suckattached temperatureC,adsorption timemin.from Diagram2to see,with solutionphincrease of value,lnc/nano-mmtcomposite materialmaterial toCu(((The amount of adsorption for theI)appears first to increase and then to decrease,onphvalue4.9,Maximum adsorption value322 6mg•$g^{-1}$.This is because thepHvalueisLower,Solution$H^{+}$concentration is greater thanLarge,whenCu((I)andlnc/nano-mmtcomposite StructureThe active adsorption sites in are in contact with each other,H+Also on active pointGenerate adsorption competition,largelysuppressesCu((I)Suctionattach.pHvalue4.9,$H^{+}$concentration reduction,LNC/Nano MMTComposite Active adsorption sites toCu((I)'s complexForce maximum.and whenthepHvalue is higher than4.9,Cu((I)with alkalisexpHregulator is prone to complexation or precipitate phenomena,causeThe adsorption capability is reducedby[?].from whichYou can determine,Cu((I)Solution mostgoodpHThe value is4.9.

### 2.1.3 Adsorption temperature effect

diagram3for the adsorption temperature toLNC/Nano-MMTCompositeadsorptionamount,shadowring.suctionattachRealcheckBar,to:suctionattachagentwithQuantity0,g,Cu((I)Initial concentrationof the solution0.mol ·$L^{-1}$,pHvalue4.9,adsorption timemin.from Diagram3to see,withIncrease temperature of solution,LNC/nano-MMTComposite pairCuthe adsorption of the((I)increases first and then decreases.This is because of

to increase with the adsorption temperature,LNCThe intermolecular division of the molecular chainThe hydrogen bonds weaken,number of activated adsorption sites and adsorption energyForce enhancements,benefitCu((I)vs.lnc/nano-mmtadsorption between composites.continues to warmup,Because the adsorption process isradiated,inevitably leads to sorption weakening,Tomake the adsorption amountLower.so,Adsorption temperature selection50°Cappropriate

### 2.1.4 Effect of adsorption time

diagram4is the adsorption time pairlnc/nano-mmtCompositeEffect of the adsorption amount.adsorption test conditions are:absorbent dosage0.g,Cu((I)Initial concentration of solution0.Mol•$L^{1}$,pHvalue4.9,Adsorption temperatureC.can see,with reaction timeextension,lnc/nano-mmtComposite toCu((I)suctionAttach first fast increase decrease until finally steady trendtrend.This is becauseCu(((I)first spread from solution to adsorbentsurface,Then spread

into the inner pores of the adsorbent.,with adsorbent structurethe active adsorption sites in the are complex,quickly reaches the adsorption balance.

diagram4adsorption time tolnc/mrno-mmtInfluence of the adsorption capacity of composite materials

Fig.4Effects of adsorption time on adsorption capacity of

Lnc/nan0.MMT Composites

increases with adsorption time,LNC/nano-mmtCompositeactive sites tc saturation,decrease absorption until finally stabilizeset[2°].so,adsorption time with60minappropriate.

## 2.2 adsorption Dynamics

diagram5is differentCu(II)adsorption time at initial concentration tolnc/nano-mmtEffect of adsorption of composites.adsorption experimentconditions are:adsorbent usage0.10g,pHvalue4.9,Adsorption temperature°C,Cu(II)The initial concentration of the solution is0.027,0.030,0.033mol•$L^{1}$.from Diagram5to see,at start,adsorptionamount of timezincrease significantlyincreased,followedbyzincrease,adsorption changes are declining,@minAfter the adsorption reaches the balance,adsorption maximum.This is becauseCu(II)on multi-holeLNC/

Fig.5Effects of adsorption time onadsorption capacity of Lnc/an0.MMT Composites under different Cu ((I) initial concentrations

nano-mmtThe adsorption on the composite includes:FirstCu((I)adsorbed onlnc/NANO-MMTcomposite surface,vs. surfaceActive group reaction,adsorption rate accelerated,and thenCu((I)AlongtheLNC/nano-mmtThe surface layer of composite material expands to the insidescatter,The adsorption rate drops gradually,finally reach the adsorption balance.

toLNC/nano-mmtAdsorption kinetics of compositesLine First levelTMand level two[AII]adsorption kinetic equation forfit:

Kit

2.303

=+k2$q_e^2$q

type:9The adsorption amount of the for the adsorption balance,mg•$g^{1-}$;kis a quasi--level equation rate constant,$min^{1}$;K2is a class two equation rateconstant,g•(mg•min-\

to the experimental data by using a quasi-first and quasi two-level kinetic equation into theLine Linear regression fitting,and calculating related parameters,lnc/nano-mmtComposite toCu(II)Adsorption kinetics parameters for are as table1shows.tableMiddle:QCadsorption balance for experimentally measured adsorptionkFor Speedrate constant.Experimental data quasi-level and quasi-two dynamics model equationfitting curve asshown6shows.LNC/nano-mmtCompositeadsorption kinetics not conforming to quasi-first-level Dynamics model,but conforms to the quasi level twoDynamics Model,correlation coefficient only$^2$=0.9819.so,LNC/nano-mmtComposite pairCuThe adsorption of the(II)is compliant with level two suctionwithrate equation,mainly chemical adsorption|.

## 2.3 adsorption isotherm

diagram7isCu((I)Initial concentration oflnc/nano-MMTInfluence of the adsorption capacity of composite materials.adsorption test conditions are:adsorbentdosage0g,pHvalue4.9,adsorption timemin,Adsorption temperaturedegrees40, 50,then°C.from Diagram7to see,withCu((I)concentration increase,Lnc/nano-MMTComposite toCu((I)Balanced adsorption increase,Increase at lower concentrationslarge,As the concentration increases, it gradually flattens.This is becauselnc/nancr MMTThenumber of active adsorption sites on the composite is_set,when initial concentration is less than hours,The adsorbent has enough active adsorption sitesforCu((I)adsorption,withCu((I)Increase concentration,adsorbentsurface Active adsorbed sites are basicallyCu((I)overwrite,furtheradsorption restricted,Show more stable adsorption capacity.Experiment Results TableMing,The maximum amount of adsorption for whenCis reached.

mg[1];W,MimikoFisFreundlichconstant;$C_e$for adsorption balancesolution remainingCu((I)concentration,mol•$L^{-1}$;GM«is a single pointchild layer saturation adsorption,mg•$G^1$.

Table2isLNC/nano-mmtComposite toCu((I),isothermal adsorption model and correlation coefficient,Chart8for experimental dataLangmuirandFreundlichformula fitting curve.The fitting result for thecomparison chart8shows the,LNC/nano-mmtCompositetoCu(the adsorption for(I)is more consistent withLangmuirisothermal adsorption model.linear correlation factor=0.9925,Description Adsorption process is singleThe molecular layer is adsorbedon the[?].

## 2.4 adsorption mechanism

### 2.4.1 XRDanalysis

diagram9tonano-mmtandLNC/nano-mmtcomplexmaterialXRDspectrogram.can see,diffraction angle20Thevalue is5.83°with a distinct feature diffraction peak,consists of theBraggequation(2<isin")0 =MimikoA(for layer spacing,Afor Wavelength,is=1,2,...))Know,nano-mmtlayer SpacingD=1.52nm,Withhas typical nanomaterials structure features.nano-mmtwithLNCAfter a composite,thepeak strength of the characteristic peaks corresponding to the diffraction angle is obviously weakened and a fewdisappears,Its diffraction peaks are not in the<5.83°The area of appears,DescriptionLNCcorruptedNano-MMTThe crystal structure of the is inserted intotheNano-MMTbetween slice-layer structure,forms the Intercalation-Split type complexcombination material.

### 2.4.2 Profiling

diagramTenisLNC/nano-mmtComposite AdsorptionCu(II)before and afterSEMphotos.can see,lnc/nancr MMTComposite material(See figureTen(a))A flat surface appears withlayer stack with curly or group-like irregular scatter aggregations,Descriptionnano-mmtandLNCreaction occurred,nancr MMTThe nanometer layer structure of the is opened and dispersed totheLNCbasebody,and Structure contains manypores,These pores are adsorbed for heavymetalCu((I)increased contact area;in heavy metal adsorptionCu((I)after(See figureTen(b),LNC/nano-mmtcompound materialThe surface of the material is even wrapped upCu((I),layer stacking structure no longerObvious,description adsorptionCuactive sites for((I)exist mainly inLNC/nano-mmtprotruding tip on composite surfacebit,Cu((I)played a role in bridge,To connect the adjacent active bits of the surfacepoint to each other,to smooth the surface of the composite material,TableClearCu((I)Thereis a strong force between the adsorbents,itsadsorption process mainly chemically adsorbed[/].

### 2.4.3 FTIRtoken

diagramOneisLnc/nano-MMTComposite Adsorption and desorptionsuction^ ((1)?a1Ruler Chart.can see,3 464CafeThe Changquan of the$^{-1}$is the 0 of the Molecule Association.-HFlex Vibration absorptionpeaks and alcohols,characteristics of bonding hydrogen bonds between phenol molecules absorption peaks,suctionattachCu((I)then move to the low wave direction to3410Michael-$^1$,absorption peak narrowing,Description section here0-Hand corresponding hydrogen bonds

birth break andCu((I)response,desorption drift to3 438cm-$^1$near.2936cm-$^1$is connected to the aromatic ringCOneHTelescopic Vibration absorption Peak,in adsorption and desorptionCu((I)Then changetonot clear.1 732cm$^{-1}$the strong absorption peak at is carboxylic acid inC=0Asymmetric Telescopic vibration feature peaks of,in the adsorptionCu((I)Fadefail,desorptionCu((I)After the peak returns to1731cm-$^1$,only tolow wave count1cm-$^1$,carboxyl0-Hbending Vibration absorption ofPeak at1401cm-$^1$near,AdsorptionCu((I)Back peak almostmissing,desorptionCu((I)after drift to1401cm-$^1$.1313cm$^{-1}$atThe absorption peak is the phenol structureCone0Key telescopic Vibration absorption Peak,adsorptionCu((I)only moves to the Takanami number1~2cm$^1$,after desorptionpeak down to1313cm $^{-}$ $^1$at.1139cm$^{-1}$Strong peak is alcoholin[-0key Flex Peak,AdsorptionCu((I)Drift totakanami number1148cm$^{-1}$near,and peak decrease,after the desorption in1136cm-$^1$anabsorption peak is found at.above analysis shows,adsorptionCu(((I)after,LNC/NANO-MMTcomposite structure partand hydroxyl,,carboxy-bindingH+isCu(((I)replace,causes the corresponding

Theabsorption intensity of the absorption vibration peaks of the active functional groups is slightly different

from.,Peak absorption drift;desorptionCu((I)adsorbent afterFTIRspectrogram display andLNC/Nano-MMTCompositeFTIRSpectrumThepeaks almost overlap,from,LNC/nano-mmtComposite in adsorption/desorptionCu((I)After the basic structure and nature of the securityhold relative stability,is an excellent that can be applied to recycled regenerationadsorbent.

## 2.5 desorption

### 2.5.1 HN03effects of concentration

diagramisHN0$_3$concentration onlnc/nano-mmtCompositeThe effect of material desorption.desorption test conditions are:composite material withamount0g,desorption temperatureC,desorption timemin.from-chart [can see,withHNaincreased concentration,Lnc/nano-

MMTComposite toCu((I)The desorption is increased first and then minus thesmall trend.This is because when the acidity increases,in SolutionH+strongdegree increase,toLNC/nano-mmtActive adsorption of compositessites generate competitive adsorption,and with adsorbedCu((I)generateion Exchange,facilitates desorption.butHN03concentration pastHigh causes solutionH+has a sharp increase in concentration,andCu((I)Electrostatic repulsion enhanced,TosuppressCu((I)The desorption[28-29].from hereHN0$_3$solution concentration is0.1mol•L$^1$,lnc/nano-mmtcomposites maximum desorption,can be reached283.,mg•G$^1$.

### 2.5.2 desorption temperature effects

diagramto desorption temperature tolnc/nano-mmtComposite Materialmaterial desorption effect.desorption test condition:composite dosage0g,HN0$_3$0. 1mol/L,desorption time yearmin.Thecan be seenby the diagram,.as the desorption temperature increases,LNC/nano-mmtcomposite desorptionCu((I)The ability to first increaseAfter the decrease trend.This is because of rising temperature,active adsorption bitenhanced adsorption for points,There's a lot of in solutionH+andCu((I)Mutual Competitive adsorption,Desorption increased,but persistent ltemperature,Active point adsorption capability reduced,is not conducive to desorption for.becausethis,Choose desorption temperatureC appropriate.

### 2.5.3 desorption time effect

diagramfor the desorption time tolnc/nano-mmtComposite Materialmaterial desorption effect.desorption test conditions are:Saturated adsorptionCu(((I)composite dosage0,HN0$_3$concentration0.1mol/l,desorption temperature40°C.from the diagramtoSee,withdesorptiontime extension,LNC/nano-mmtThe solution of the composite materiala trend to increase the amount of suction first and then decrease.This phenomenon is the sameas thatof ultrasound. Holes in the same law,ultrasound reaction after a certain time,Solution Hollow

Pointconcentration reaches saturation,high temperature resulting from ultrasonic cavitation,

high pressure and strong shock waves increase the energy of the adsorbed motion,plusfast mass transfer speed,benefitCu(II)fromLNC/nano-mmtdesorption on composites[3○].from Diagramunknown,Ultrasonic desorptionbetween the-minwhen,composite material reaches maximum desorption,withoneFixed renewable and reused potential.

## 2.6 Loop Adsorption and desorption

lnc/nano-mmtComposite toCu((I)loop suctionwith/desorption as table3shows.table:tCfor experimental measurementsThe amount of adsorption on the resolution balance of the.can draw,lnc/nancr MMTComposites can be repeated under optimal adsorption and desorption conditionscycle with4times,Theamount of each adsorption and desorption can reach309.m G•$_G$.$^{-1}$and252.[]m$_g$•$_g^{-1}$Above,This can beknow,lnc/nano-mmtComposite material has certainrecyclableRegenerate performance and economic value.

# 3. Conclusion

(1)Lignocellulose(LNC)/Nano-montmorillonite(nancr MMT)Composite can effectively adsorb the solution of theCu(((I)fromchild,whenCu(((I)Solution Initial concentration is0.mol•$L^{-1}$,PHThe value is4.9,adsorption time?min,adsorption temperature is50°Cwhen,AdsorptionCu((I)Maximum saturation adsorption reached322.mg•$G^{1}$,adsorption kinetics and adsorption isotherm respectivelytwo level kinetic rate equation(coefficient only$^{2}$=0.9819andLangmuirisotherm 0?$^{2}$=0.992 5),description in the experimentin scope,adsorption equilibrium belongs to single molecule layer chemical adsorption.

(2)saturation adsorptionCu((I)onlnc/nano-MMTcomplexcombination material,takeHN03as adesorption,the best desorption condition isHN03concentration0.1mol•$L^{-1}$,desorption temperatureC,Ultrasonicdesorption timemin,maximum desorption is283mg•$g^{1}$.

(3)Adsorption/Thedesorption cyclic regeneration experiment shows that,Continuous4Secondary Adsorption/after desorption loop regeneration,Lnc/nano-MMTCompositeThe adsorption capacity of the material remains relatively high.theResults of the study show that,lnc/Nano-MMTcomposites with better regeneration repeat makewith potential,provides some lessons for the efficient use of natural resources andreference.

# References


1. Demirbas A. Heavy metal adsorption onto agro-basedwaste
Materials:a review [J].Journal of hazardous materials,2008,157 (2-3):220-229.
2. lils,YangY Z,Jia H S,etal.Isolation and Cu$^{hydrate}$biosorption of metal-tolerant bacterium [J].Ciesc Journal,2013,64 (9):3381-3389 (Inchinese).
LiLansong,YangYongjin,Jahusen,, and so on.screening of copper resistant strains and their application to$Cu^{2+}$adsorption performance[].inJournal of Chemical Industry,2013,(9): 3381-3389.
3. Sud D,Mahajan G,Kaur M P. Agricultural waste material as potential adsorbent for sequestering heavy metal ions from aqueous solUtion-a Review[J].bioresource Technology,2008,(+):6017-6027.
4. acemioglub,samila,almaim H,*et al* Copper (II) removal from aqueous solution by Organosolv lignin and its recovery [J].Journal of Applied PolymerScience,2003,(6):1537-1541
5. Gupta V K, Carrott PJM,Riberiro C m L.Low-cost adsorbents:growing approach to wastewater treatment-a Review [J]. Critical Reviews in environmentalScienceand Technology,2009,(Ten):783-842.
6. Sciban M,Klasnja M. Study of the Adsorption of copper (II) ions from water wood onto, sawdust and pulp [J].Ad-sorptionscience&Technology,3,(): 195-206.
7. Mohan D,Pittman C U,Steele P H.Single,binaryand
Multi-component adsorption of copper and cadmium from
Aqueous solutions on Kratt lignin-a biosorbent[j].Journal of Colloid and Interfacescience,2006,297 (2):489-504.-
8. Liu Z x»qu w»miao Y G»*et al*. Adsorption performance of CMC polymer for heavy Metal IONS[J].Journal of the Graduate Schoolof the chineseacademy of Sciences,2009,(5):627-632 (inChinese).
Liu,Bend,MiaoYonggang,, and so on.CMCPolymer absorption of heavy metal ions Withperformance[J].Postgraduate Journal of the Chinese Academy of Sciences,2009,5:627-632.
9. Ilu D,YangQ D,LiuII,*et al*. progressesof the
pretreatment Technology of Lignocelluloses[j].Hunan Agri Cultural Sciences,(a):The-108 (in Chinese).
Butterfly,YangQingdan,Liu Hong,, and so on.Research progress of Lignocellulose pretreatment technology[J].Hunan Agricultural Science,: 105-108.
10. GuoXY,Zhang S Z, Shan X Q. Adsorption of metal ions on lignin [J].Journal of hazardous materials,2008,151 (1): 134-142.
11. argun M E,Dursun S,Gur K. Adsorption of copper on modified wood (pine) materials sorption of chromium ((II) and copper ((I) ions On biodamaged Wood and lignin [J].Cellulose chemistry and Technology,,,,5 6-:581-591
12. Babel S,Kurniawan T A. Low-cost adsorbents for heavy metals uptake from contaminated water:A Review[j].Journal of hazardous materials,2003,1-3:219-243.
13. Chen Y M,Liu B,Zhou A N,*et al* preparation,structure and properties of Cetirizine Hydrochloride/montmorillonite Nanocomposites[j].Acta materiae Compositae sinica,,,(1):43-50 (in Chinese).
ChenYoumei,Liubo,Week of Peace,, and so on.levocetirizine Hydrochloride/montmorillonite Nano-compositethe preparation of the object and its structure and performance[].Journal of Composite Materials,,(1):43-50.
14. Li T,Zhangy,Song Z Y,*et al*. Preparation andCharac terization of Agamontmorillonite/chitosan[j].Acta mate-riae Compositae sinica,2013,(4): 88-92 (in Chinese).Begum,ZhangYuanyuan,SongZhiyong,, and so on.Bankimon/Preparation and sex of Chitosanto[].Journal of Composite Materials,2013,(4): 88-92.
15. GARCIA-VALLSR,Hatton T A. Metal ion complexation with lignin derivatives [J].Chemical Engineering Journal,, 2003,2:99-105.

16. Kommuri m,Krishna P,Syed R. Evaluation of the quali ty of colour changes ofcomplexometric indicators in the Titra/b31>tion of Copper ((I) with EDTA by Tristimulus colorimetry [J].Mikrochim Acta,1993,112(1-4): 63-69.
17. Zhang J P,Jin Y L,Wang A Q. Adsorption of Pb ((I)from
Aqueous solution by Chitosan-g-poly (acrylic acid)/attapulg-ite/sodium humate composite hydrogels[J]. Journal ofchem-ical Engineering Data,,,7:2379-2384.
18. Zhou Y F,Haynes R J.A Comparison of inorganic solid wastes as adsorbents to heavy metal cations in aqueous solu tion and their capaCity for desorption and regeneration [J].Water Air and Soil pollution,,,218 (1-4): 457-470.
19. Song J J.The agricultural organic waste to Adsorb Cr (IV),Cu2+</b30> from Wastewater[d].Changsha:hu-
nan University,(in Chinese).
Song JuanJuan.Agricultural organic waste adsorption wastewaterCr(V),$Cu^{2+}$Research[D].Changsha:Hunan University,.
20. Tan SZ,Zhang K H,Liu Y L. Preparation and Montmorillonite composite materials exchanged with $Cu^{2+}$andQuaternary phosphonium cation[j].Acta materiae Com-positae sinica,2006,3:82-86 (in Chinese).
Tan ShaoEarly,Sunflower,LiuChongliang.Quaternary scales Salt-Copper/System of Montmorillonite compositesStandby and performance[].Journal of Composite Materials,2006,3:82-86.