稻壳炭净化养殖场排泄污水的实践

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摘要:为减少养殖场排泄污水对环境的污染,控制污染源,利用装有稻壳炭的简易装置对污水进行过滤,观察其理化性质变化。结果表明:处理后明显降低了排泄污水中的氮磷及重金属含量。此方法能够为今后养殖场排污及种殖养的循环利用提供可行技术,促进生物质资源再利用及生态可持续发展。

关键词:养殖场;污水;稻壳炭;养分;重金属
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中国是世界上第一产稻大国,年生产稻谷20 822.52万t[1]。占世界稻谷总产量的1/3以上,稻壳作为稻米加工的副产物,是一种天然的植物类生物质资源,出壳率为20%左右,年产量达4 000万t以上[2-3]。如此丰富的稻壳资源对其进行科学的利用具有重要的社会与经济价值。稻壳炭是在完全或部分缺氧条件下,经300～600 ℃热解炭化产生的一种黑色固体,低温热解保留速效养分,高温热解增强其吸附特性[4]。稻壳炭具有较大的比表面积和高度的芳香化结构,具备能有

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Abstract:In order to select the new and effective drugs to effectively control the scale insect harm,the main Coccoidea species and harm were investigated in fruit tree and garden plant in urban and downtown of Yan'an from 2012 to 2017 year. Four kinds of chemical pesticides such as 40% methidathion-pirimiphos-ethyl·buprofezin EC 1 000×,25% buprofezin SC 500×,4% avermectin-acetamiprid EC 1 000×,40% acetamiprid-chlorpyrifos EC 800× were choosed and tested to control for the most severe of *Pseudaulacaspis pentagona*(Targioni Tozzetti),*Didesmococcus koreanus* Borchs and *Eriococcus legerstroemiae* Kuwana in the field. At the same time in order to find a better prevention and control technology,the chemical control measures were tested for three kinds of Coccoidea for more than a year. The results showed that there are 7 species of the main Coccoidea damage in fruit tree and garden plant,the main Coccoidea species and harm have been preliminary mastered. Investigation showed that four kinds of pesticide control efficiency for 93.76%,83.96%,79.92% and 91.19% respectively after 7 days,the result of experiment conducted in the field indicated that four pesticides of preventing Coccoidea all have good effect,and that 40% methidathion-pirimiphos-ethyl·buprofezin EC 1 000× and 40% acetamiprid-chlorpyrifos EC 800× were the best and worthy commended two pesticide to control the main Coccoidea. The test result of the annual chemical control measures,also has achieved significant effect. According to the results of the survey on July 1,2016,the population density of three kinds of Coccoidea species was significantly reduced,the largest reduction was *Eriococcus lagerostroemiae* Kuwana,the second was *Didesmococcus koreanus* Borchs,the third was *Pseudaulacaspis pentagona*(Targioni Tozzetti). According to the results of the survey on November 30,2016,the use of the brush in winter and early spring to brush and kill the insect body of the branches with dipped lime sulphur could greatly reduce the population density base and play a good role in the prevention and control of the latter. The survey showed that there was not any *Eriococcus lagerostroemiae* Kuwana in the crape myrtle tree,the survival rate of *Didesmococcus koreanus* Borchs in the *Prunus persica* tree was 0.66%,and survival rate of *Pseudaulacaspis pentagona*(Targioni Tozzetti)was 1.79% in the wild peach tree on May 15,2017.

Keywords:urban and downtown of Yan'an;the fruit trees and garden plant;Coccoidea

效吸附固定污染物等优点,在农业、工业上具有广泛的应用前景[5-6]。Uchimiya 等人的研究表明生物炭可以用作低成本的吸附剂,存储化合物,包括常见的环境污染物[7]。养殖场的排泄污水是一种高污染物质,重金属超标,对生态环境和人类健康都有潜在的危害[8-10]。目前对生物质炭的应用研究主要集中在农业土壤方面,如污染物转移、提高农作物产量和土壤肥力等[11-15]。在废水处理方面,研究发现生物质炭可有效吸附污水中萘、硝基苯及间二硝基苯污染物[15];徐仁扣、何娇等发现生物质炭对污水中甲基蓝和多环芳烃都具有较好的吸附效果[16-17]。养殖场排泄污水还没得到足够的重视,现有相关研究比较少。本文利用稻壳炭强吸附特性,吸附污水中富养成分及重金属,为今后从源头控制污染提供技术支持。

1　材料与方法

1.1　材料

供试材料为养殖场排泄物污水处理池中的上层澄清液。稻壳炭外购,粒径 1～5 mm,成分含量见表 1。

表 1　稻壳碳的成分

Table 1　Composition of rice husk carbon

SiO_2/%	K_2O/%	CaO/%	P_2O_5/%	MgO/%
86.15	4.82	0.77	2.91	1.05

1.2　方法

1.2.1　*稻壳炭净化污水处理方法*　过滤采用直径 15 cm,高 100 cm 的透明塑料管,其底为多孔(孔径为2 mm),过滤装置见图 1。填充,自下而上依次为沙粒(2 cm)-稻壳炭(15 cm)-沙粒(2 cm)。倒入沼液 5 L,过滤 24 h,分析滤出液。

图 1　稻壳炭净化沼液装置

Fig. 1　Rice husk carbon purification device of biogas slurry

1.2.2　*测定项目与方法*　委托黑龙江省农业科学农业部谷物及制品质量监督检验测试中心测试分析所采集的样品。浑浊度采用德国梅特勒·托利多公司浊度仪 npro8000 测定;电导率采用德国菲希尔 FISCHER-Sigmascope SMP10 电导率测试仪测定;养分按照常规分析方法测定[18];As、Hg 采用海光 AFS-9800 原子荧光测定仪[19]测定;Pb、Cd 采用耶拿 ContrAA700 原子吸收测定。

1.2.3　*数据分析*　采用 Excel 2007 制图及数据分析的方法。

2　结果与分析

2.1　稻壳炭过滤排泄污水对浑浊度的影响

排泄污水经稻壳炭过滤后,水质的颜色由深色变淡黄色(见图 2),浑浊度明显变小(见图 3),混浊度由滤前 1 808.3 mg·L^{-1}变为 141.3 mg·L^{-1},过滤后浑浊度下降了 92.2%。此方法利用稻壳炭的强吸附性,效果十分显著。

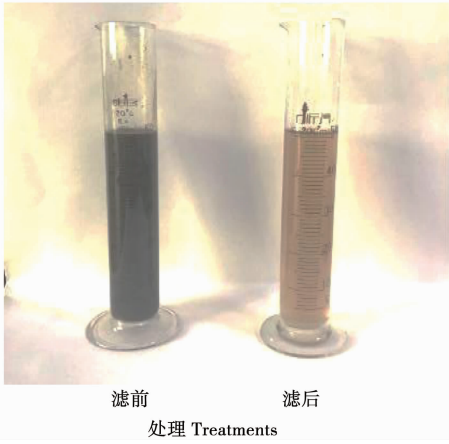

图 2　稻壳炭过滤前后颜色对比

Fig. 2　Color comparison of rice husk turbidity before and after filtration

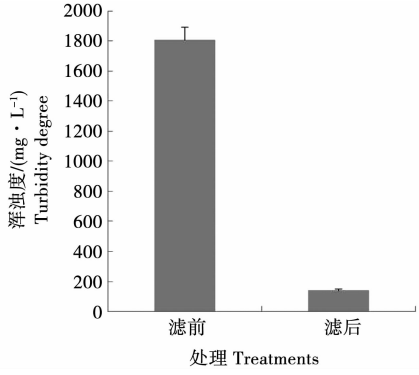

图 3　过滤前后的污水浑浊度

Fig. 3　The turbidity degree of sewage before and after filtration

2.2 稻壳炭过滤排泄污水对电导率的影响

由图4可看出，经稻壳炭过滤后明显降低了污水的电导率，污水原液的电导率值为8 900 μS·cm^{-1}，过滤后为1 450 μS·cm^{-1}，减少了83.7%。

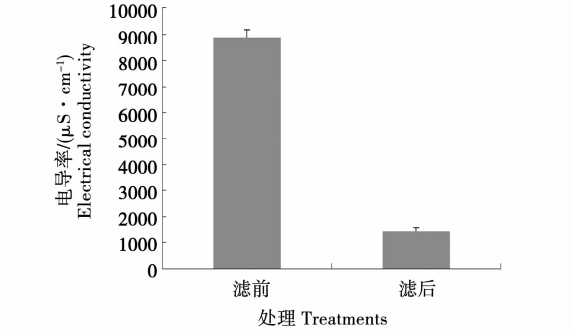

图4　过滤前后污水的电导率

Fig. 4　The sewage electrical conductivity before and after filtration

2.3 稻壳炭过滤排泄污水对耗氧量的影响

从图5看出，过滤前污水耗氧量为89.8 g·L^{-1}，滤后耗氧量为8.3 g·L^{-1}，降低辐度为90.8%。

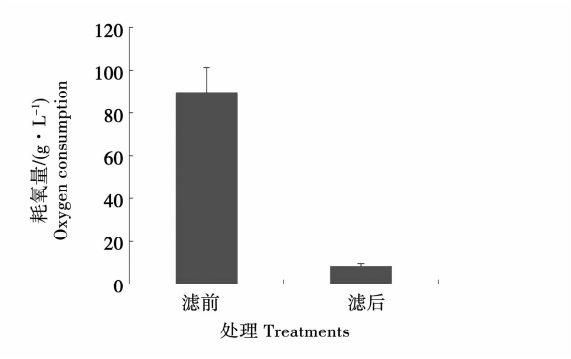

图5　过滤前后污水的耗氧量

Fig. 5　The oxygen consumption of sewage before and after filtration

2.4 稻壳炭过滤排泄污水对其养分及重金属的影响

从表2看出，稻壳炭无论对无机养分还是重金属都具有超强的吸附性，其中对污水中全磷的吸附率达到99.3%，全氮的吸附率为89.3%；对重金属的吸附率为79.3%～98.6%，对铅的吸附量远大于对砷、汞、镉的吸附，具体表现为铅＞砷＞汞＞镉。

表2　稻壳炭过滤前后对污水中养分及重金属的影响

Table 2　Effects of rice husk carbon on nutrients and heavy metals in sewage before and after filtration

项目 Items	全氮/(g·kg^{-1}) Total nitrogen	全磷/(g·kg^{-1}) Total phosphorus	砷/(μg·L^{-1}) Arsenic	汞/(μg·L^{-1}) Hydrargyrum	镉/(μg·L^{-1}) Cadmium	铅/(mg·kg^{-1}) Plumbum	pH
滤前	2.8±0.79	0.56±0.08	82.3±1.91	0.33±0.02	0.029±0.013	0.029±0.013	7.79±0.07
滤后	0.3±0.10	0.004±0.001	7.6±0.26	0.059±0.033	0.006±0.0007	0.00042±0.00021	7.95±0.06

3　结论与讨论

畜牧养殖场的排泄污水经过稻壳炭过滤后，水质发生明显变化，污水中杂质被吸附，水体颜色由深变浅，浑浊度下降92.2%，电导率减少83.7%，耗氧量减少90.8%，稻壳炭的强吸附性，对无机养分氮、磷及重金属均具有较强的吸附性，其中对磷的吸附最强，达到99.3%，对铅的吸附量大于对砷、汞、铅的吸附量，其顺序为铅＞砷＞汞＞镉，污水处理前后对酸碱度影响不大。

畜牧养殖场的排泄污水经稻壳炭过滤，滤掉了多种富养成分及重金属，减轻了排泄污水对水源及生态环境的影响。此试验方法简单易行、成本低，能够促进生物质资源的再利用。稻壳炭吸附污水中氮磷养分与土混合，将来可以用其做水稻育秧基质，减少能源浪费。今后养殖户可利用此试验原理，建造简易排污过滤池，并搭建在蓄粪池排水口处。过滤后的稻壳炭及养殖场的粪便等干物质进行混合，利用其堆肥，制造生物有机肥，并与化肥混施提高肥料利用率，达到种养的循环利用，促进生态可持续发展。

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Practice of Purifying Sewage from Farm with Rice Husk Carbon

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Abstract: In order to reduce the environmental pollution caused by the waste water from the farms, control pollution source. The sewage was filtered by a simple device containing rice husk carbon, change of its physical and chemical properties was observed. The results showed that after treatment, the contents of nitrogen, phosphorus and heavy metals in the waste water were significantly reduced. This method can provide feasible technology for the recycling of sewage and breeding in the future, and promote the reuse of biomass resources and the sustainable development of ecology.

Keywords: farms; sewage; rice husk carbon; nutrient; heavy metal

致　读　者

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