

废纸造纸废水处理方法与工程应用

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摘要: 介绍了采用微滤+混凝沉淀处理废纸造纸废水的研究和工程实例。试验结果和工程实践证明, 该工艺 SS 去除率达 90% 以上, COD 去除率达 85% 以上, 处理出水水质能达到国家排放标准 GB3544-2001, 且具有设备简单、运行稳定、操作方便、成本低等特点。

关键词: 废纸造纸废水; 微滤; 混凝沉淀

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目前, 利用废纸原料抄纸已是国内众多造纸厂普遍采用的生产方式, 尽管废纸造纸的水污染物产生量比化学制浆造纸削减了 85% 以上^[1], 但废水的 COD、SS 浓度仍然较高, 利用废纸再生抄纸的过程会对环境再度破坏。目前, 我国以中小型企业居多, 排水量一般在 100~200m³/t, 废水中除含塑料粒、泥砂外, 还有细微的纤维素和半纤维素、木质素、胶粒、矿粒、填料等污染物, 这些废水排入河流造成严重污染。

目前处理废纸造纸废水常用方法为气浮或沉淀法和物化与生化相结合的方法^[2-3], 本文采用微滤法预处理回收纸浆, 混凝沉降法处理废水的工艺, 处理后废水回用, 该方法在四川某纸厂已获得了较理性的效果。

1 试验部分

1.1 废水来源及性质

该纸厂主要以废纸为原料生产瓦楞纸和箱板纸, 废纸板经过碎浆、磨浆、筛选后送造纸机, 再经烘干即成成品。废水排放主要来源于筛选、磨浆及纸机白水等工序。生产工艺流程如图 1, 废水水质情况见表 1。

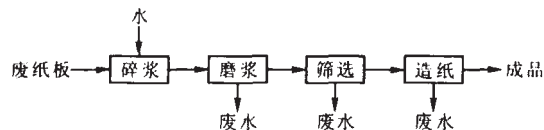


图1 生产工艺流程图

表 1 原水水质及排放标准限值 (pH 外, mg/L)

项目	pH	SS	COD	BOD ₅
原水水质	8.3~9.6	350~600	400~700	200~300
GB3544-2001 标准限值	6~9	100	100	60

1.2 微滤试验

微滤主要是利用机械过滤, 把废水中微小纤维与液体分离开来, 微滤采用的过滤介质是孔径较小的不锈钢丝网或化纤丝网, 在使用过程中, 滤网上集聚的悬浮物会形成更细的滤膜, 使截留下来的悬浮物的大

小比滤网微孔小。试验根据滤网规格与回收率关系, 确定滤网的规格。在相同条件下, 滤网规格与回收率见图 2。

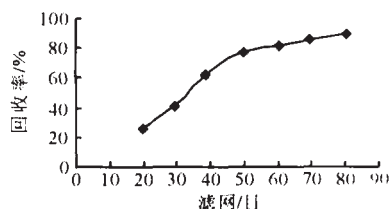


图2 滤网规格与回收率关系

试验表明: 随着滤网目数增加, 纸浆回收率增加, 当超过 50 目时, 回收率增加较小, 考虑滤网的使用寿命, 确定采用 50 目的滤网进行微滤试验, 各种污染物去除效果见表 2。

表 2 微滤处理效果

项目	pH	SS mg/L	COD mg/L	BOD ₅ mg/L
进水	8.5	568	567	260
出水	8.4	340	326	180
去除率 %		40.1	42.5	30.8

试验表明, 微滤单元可回收纸浆, 对 COD 也有一定的去除率。

1.3 混凝试验

通过混凝试验确定混凝剂种类、投加量、投加次序、搅拌速度、搅拌时间及沉淀时间。

1.3.1 试验方法^[4]

在 200mL 经过微滤处理后水样中, 固定其它试验条件和试验参数, 采取分别单独加入混凝剂、依次投加混凝剂的试验方式, 搅拌一定时间, 静止沉降, 测定上清液污染物浓度。

1.3.2 结果与讨论

经正交试验, 确定了以下试验参数:

混凝剂种类和最佳的投药量: 混凝剂选用聚合氯化铝(PAC), 投加量为 120mg/L; 聚丙烯酰胺(PAM) 投加量为 2mg/L; 投加次序为先投加 PAC, 后投加 PAM; 搅拌速度 70r/min; 搅拌时间 35s; 沉淀时间为 30min。

根据以上的优化条件进行混凝试验, 结果见表 3。

表3 混凝沉淀处理结果

项目	pH	SS mg/L	COD _{Mn} mg/L	BOD ₅ mg/L
进水	8.5	340	326	180
出水	8.4	85	89.4	54.8
去除率(%)		75	72.6	69.6

混凝剂加入量过少, 混凝不充分, 加入量过大, 废水中微粒被过多的混凝剂包围, 失去同其他微粒结合的机会, 形成再稳现象, 不易凝聚; PAM 的加入能促进絮体的形成, 提高沉降速度, 改变沉降性能, 但投加量过大, 由于 PAM 为有机物, 会增加 COD; 搅拌速度过小, 不利于颗粒碰撞发生凝聚, 搅拌速度过大, 易打碎形成的絮体, 不利沉降; 搅拌时间过短, 絮凝不充分, 搅拌时间过长, 易打碎形成的絮体, 不利沉降。

试验结果表明: 通过微滤回收纸浆, 再进行混凝沉淀处理, 处理后的出水能实现达标排放。

2 工程应用

2.1 工艺流程

根据有关资料和试验结论, 对四川某纸厂采用微滤-混凝沉淀法处理废纸造纸废水。由于该纸厂原有处理设施 1 套, 其中有 1 座过滤池, 同时本厂处理后的水部分回用于生产, 部分排放, 据此, 本设计工艺沉淀池出水达标排放, 部分废水经过滤池处理后回用于生产。工艺流程见图 3。

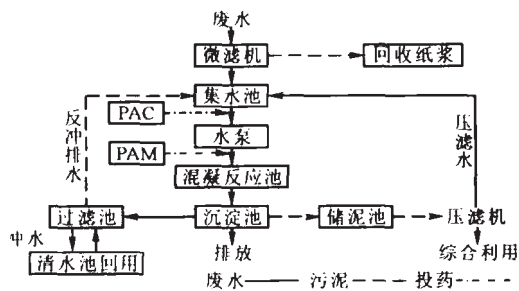


图3 废水处理流程图

2.2 设计参数

本厂废水产生量为 2000m³/d, 处理水量按 100m³/h 计。由于本工程属于改造工程, 原有集水池 1 座, 尺寸为 4.0m × 3.0m × 3.0m; 沉淀池 1 座, 尺寸为 φ8.0m; 过滤池 2 座, 尺寸为 φ4.5m。在设计中增设集水池和反应池, 原有沉淀池改为斜管式沉淀池, 过滤池保持原有功能, 对进水、出水和反冲进行改造。PAC 投加采取泵前投药, 利用水泵叶轮转动产生的水流紊动达到混合的目的, 为减小腐蚀, 在水泵吸入口和出水管内壁涂加耐腐蚀材料。PAM 投加采取静态混合器, 依靠废水自身具有的动能, 通过混合元件对废水的切割分流、交叉混合和漩涡反向旋转作用, 达到快速充分混合的目的。构筑物规

格及设计参数见表 4。

表4 构筑物规格及设计参数

构筑物名称	规格	数量	备注
集水池	6.0m × 8.0m × 3.0m	1 座	含原有部分
混凝反应池	8.5m × 4.0m × 2.5m	1 座	反应时间 25min
斜管沉淀池	φ8.0 × 4.5	1 座	表面负荷 3.0m ³ /m ² ·h; 停留时间 35min。
过滤池	φ4.5m	1 座	过滤速度 4.0m/h
储泥池	5.5m × 5.5m × 3.5m	1 座	有效容积 75m ³
清水池	8.5m × 5.5m × 3.5m	1 座	有效容积 120m ³

2.3 工程运行情况及处理效果

整套废水处理设施于 2003 年安装和运行, 运行过程中发现混凝剂 PAC 投加量为 140mg/L; PAM 投加量为 2mg/L 时效果较好, 能达到设计要求。经过 1 个月的调试, 系统进入稳定运行时间后, 经环境监测站连续 3 天取样监测, 出水完全达到设计要求, 验收监测结果见表 5。

表5 废水监测结果 (pH 外, mg/L)

名称	COD	BOD ₅	SS	pH 值
进水水质	612	284	543	6-9
排放均值	89.7	56.7	86.0	7-8

由表 5 可知, 经处理后, COD 等主要污染物指标都得到明显的去除, 经过运行实践可知, 经本工艺处理的废纸造纸废水能实现达标排放。

3 结论

(1) 利用微滤+混凝沉淀工艺处理废纸造纸废水是可行的, 其优点是工艺简单, 操作管理方便, 投资少, 占地面积小, 其处理后的废水水质达到国家废纸制浆造纸企业水污染物排放限值要求, 其 COD < 100mg/L, BOD₅ < 60mg/L, SS < 100mg/L, pH 值 6~9。

(2) 经四川某造纸厂 1 年多的实际工程应用, 证明该法处理效果很好, 处理成本为 0.26 元/m³, 系统工作稳定可靠。

(3) 废水处理重新回用于生产, 实现水循环使用的目的, 同时节约水资源, 节约成本, 带来了利润, 适用于中小型废纸造纸企业。

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and Their Pollution Assessment

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Abstract ID: 1003- 6504(2006)10- 0064- 03- EA

Abstract: Lead concentration of surface soil taken from 12 typical parks in urban area of Beijing was studied, and the pollution index was calculated based on national soil quality criteria to assess the situation of soil pollution. Results indicated that most of parks were polluted by pb, with average concentration of pb in soil 30.95mg/kg, ranging from 16.20 to 121.00mg/kg, and pollution index ranging from 0.65 to 2.35. Analysis indicated that in some parks with longer history and /or near the urban centre, the concentration and pollution index of pb in the soil were obviously higher than the average level.

Key words: Beijing; park; soil; pb; pollution index

Environment Management of Yaer Lake with Potential Ecological Risk Index

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Abstract ID: 1003- 6504(2006)10- 0067- 02- EA

Abstract: Potential ecological risk index was applied to assessing the sediments of Yaer Lake, Hubei Province before and after dredging, which can provide scientific basis for the decision making and management of environment agencies.

Key words: potential ecological risk index; Yaer Lake; environment management

Reducing Turbidity and Chlorophyll of Bittern in Solar Pond

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Abstract ID:1003- 6504(2006)10- 0069- 03- EA

Abstract: Starch modified and polymerised aluminium sulfate (POA), a newly synthesized flocculant, can reduce turbidity of bitten wastewater in the solar pond and optimisation of the operation conditions was investigated. Compared with traditional flocculants such as polymerised aluminium chloride or polymerised aluminium sulfate, POA can efficiently remove bitten turbidity and improve the efficiency by 62.2% and 48.3% respectively. The bittern treated by POA can stably run in the solar pond within 60 days and the increase of turbidity and chlorophyll after 60 days operation indicated the growth of some micro- algae.

Key words: bittern; turbidity; flocculant; salinity; chlorophyll

Treatment of Coking Wastewater with Fenton-coagulation and Sedimentation Process

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Abstract ID:1003- 6504(2006)10- 0072- 03- EA

Abstract: An integrated process including Fenton -oxidation, coagulation and sedimentation at bench scale was utilized to treat coking wastewater in order to investigate the best suitable treatment conditions of coagulation- sedimentation process and Fenton- oxidation process with ferric chloride and PAM as coagulants. Results showed that the maximum removal efficiency of COD, color and NH₃-N for the integrated process was 92.9%, 84.3% and 96.2% respectively, which can meet national discharge standards. The performance of the integrated process is much better than that of the coagulation - sedimentation process.

Key words: lpre -oxidation; Fenton process; coagulation; coking wastewater

Preparation of Highly Efficient PTA Degradation Bacteria and Biological Treatment of PTA Wastewater

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Abstract: 4 strains of highly efficient degradation bacteria for terephthalic acid (TA) were isolated and selected. By using inducing technique, mutation of bacterium DNAs achieved to improve the degrading capability. By embedding fixation, the optimized bacteria were applied to purifying terephthalic acid wastewater with highly effective treatment, whose load was up to 5kg COD/m³.d.

Key words: highly efficient PTA degradation bacteria; biological mutation; embedding fixation; PTA wastewater treatment

Treatment of Regenerated Papermaking Wastewater

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Abstract ID: 1003- 6504(2006)10- 0077- 02- EA

Abstract: Researches and engineering application were introduced for treatment of regenerated papermaking wastewater with microstraining and coagulant settling process. Running results showed that removal efficiency of SS and COD_{cr} were above 90% and 85% after the treatment, which can meet the national discharge criteria. The process is characterized by simple facilities, stable operation, easy control and cost effectiveness.

Key words: regenerated papermaking wastewater; microstraining; coagulant settling

Recycle of Deposited Diatomite from Chemical Fiber Factory

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(Department of Environment and Safety Engineering, Jiangsu Polytechnic University, Changzhou 213016)

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Abstract: Diatomite in the treatment of acrylic fibre wastewater was selected to study the recycling of deposited diatomite. Dynamic leaching experiment was conducted to evaluate the desorption rule and effect of Na⁺, Al³⁺, Fe²⁺, Zn²⁺, Ca²⁺ and Mg²⁺ absorbed deposited diatomite while SO₄²⁻ was evaluated by static soaking experiment. Results showed that efficient recovery of diatomite absorption was obtained by dynamic I