目　　录

1.外源群体感应-好氧反硝化菌强化生物膜脱氮机理研究

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摘要：重点研究了外源添加高 AHLs 调控能力的群体感应-异养硝化好氧反硝化菌(QS-HNAD)过程中生物膜反应器的运行、生物膜生理生化特征、信号分子浓度、脱氮功能基因含量、群落组成和空间结构的变化。结果表明，高 C/N 比(8~14)条件更有利于其促进反应器脱氮效能:添加群体感应 *Pseudomonas mendocina* 促进了反应器的反硝化，而添加 *Pseudomonas putida* 提高了氨氮的去除。与水相比，生物膜相信号分子对于环境变化具有更灵敏的响应，C6-HSL 是潜在调控生物膜修复和强化脱氮的信号分子。荧光定量 qPCR 表明，外源添加 QS-HNAD 有效促进了氨氧化、硝酸盐还原和一氧化氮还原过程。微生物群落结构分析表明，添加不同外源 QS-HNAD 菌的生物膜微生物群落结构差异较大，*P. mendocina* 菌促进了放线菌、TM7、变形菌在生物膜中富集。

关键词：生物膜;脱氮;N-酰化高丝氨酸内酯;脱氮功能基因;群落结构

2.环境浓度双氯芬酸对活性污泥处理效率和微生物性能的影响

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摘要：双氯芬酸（diclofenac，DCF）是水环境中高频检出的新兴污染物，随着 DCF 的广泛使用，城市污水中 DCF 逐年增加，对污水生物处理系统可能产生不利影响。本研究在序批式活性污泥反应器（SBR）中进行了连续 120 d 的 DCF 暴露实验，考察环境浓度 DCF（5 和 50 $\mu g \cdot L^{-1}$）对 SBR 出水水质、微生物活性以及微生物群落结构的影响。结果表明，DCF 降低了 COD 的去除效果，对氨氮和总氮的去除几乎没有影响。在微生物生理生化性能方面，5 $\mu g \cdot L^{-1}$ DCF 促进超氧化物歧化酶（SOD）和琥珀酸脱氢酶（SDH）活性升高，但 50 $\mu g \cdot L^{-1}$DCF 导致 SOD 和 SDH 活性下降，DCF 胁迫使胞外聚合物（EPS）含量增加。DCF 对微生物群落结构造成影响，其中革兰氏阴性菌丰度增加，革兰氏阳性菌在 5 $\mu g \cdot L^{-1}$ DCF 压力下无明显变化但在 50 $\mu g \cdot L^{-1}$ DCF 压力下显著降低(p <0.05)，微生物群落多样性在 5 $\mu g \cdot L^{-1}$ DCF 下增加但在 50 $\mu g \cdot L^{-1}$ DCF 下降低。16S rRNA 基因焦磷酸焦磷酸测序结果表明，Proteobacteria 是活性污泥群落中的优势门。随着 DCF 浓度的升高，Proteobacteria 丰度不断增加， Chloroflexi、OD1 和 Firmicutes 丰度受到一定程度的抑制。高浓度 DCF（50 $\mu g \cdot L^{-1}$）刺激导致特定菌属如 *Nakamurella*，*Micropruina* 等丰度的增加。研究结果揭示了环境浓度的 DCF 对活性污泥微生物处理能力和群落结构的影响，为 DCF 的风险评估和污水处理工艺的优化提供借鉴意义。

关键词：SBR；双氯芬酸；活性污泥；微生物群落；污水处理效率

3.基于 DPSR 模型的区域河流健康综合评价指标体系研究

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摘要：深入的河流健康状态评价技术研究，有助于管理者了解河流现状,尤其是健康状况,进而合理地开发利用河流,实现河流生态、经济、文化的可持续发展。研究基于 DPSR(驱动力 D-压力 P-状态 S-响应 R)模型，构建了河流健康评价理论框架，遵循科学性、系统性、稳定性、可比性原则，从驱动力、压力、状态、响应四个维度构建区域河流健康综合评价指标体系。研究可为水生态环境健康管理提供决策依据，对于区域河流恢复、生态环境建设、转变经济增长方式及社会的可持续发展有着重要的理论和现实意义。

关键词：河流健康；DPSR 模型；评价指标；响应机制

4.电镀废水中低浓度镍和锌离子的高效富集研究

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摘要：电镀废水中低浓度重金属离子的处理，普遍采用混凝沉淀法，由此产生大量重金属污泥，其安全处置过程复杂且成本高。本文展示了一种资源化回收电镀废水中低浓度镍和锌离子的方法。电镀废水经过铁盐混凝后，产生的沉淀溶解于硝酸中，得到硝酸溶解液中镍和锌离子浓度高达 2.3g/L 和 1.5g/L，而杂质铁浓度为 12.2g/L。将硝酸溶解液直接进行水热处理，溶液中镍和锌离子浓度不变，残留铁浓度为 1755mg/L。向硝酸溶解液中添加乙酰丙酸后进行水热处理，镍和锌离子浓度依然不变，但溶液中残留铁浓度仅为 0.78mg/L。硝酸溶解液中铁的去除主要源于水热条件下铁的水解和缩聚转化为高结晶度的赤铁矿。添加乙酰丙酸，能够同时降低溶液中硝酸根离子浓度和提升 pH 值，促进溶液中铁的水解和缩聚。这是首次报道通过高效沉淀铁，实现重金属离子高纯富集的电镀废水处理方法。

关键词：重金属离子；赤铁矿；沉淀；富集；资源化

5.若尔盖花湖沉积物氨氧化与反硝化功能基因丰度垂向分布特征及其环境响应

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摘要：若尔盖湿地作为中国最大的泥炭沼泽区，是生物地球化学循环的重要场所。本文以若尔盖湿地的花湖为研究对象，采集 0-47 cm 的沉积物样品，通过实时荧光定量 PCR（qPCR）技术，探究沉积物中氨氧化（*amoA*）和反硝化（*nirS*、*nirK*、*nosZ clade I*）功能基因丰度的垂向分布特征，及其对环境因子的响应。结果表明：花湖沉积物中古菌 *amoA* 基因丰度在垂向分布上呈下降趋势，而 *nirS* 基因丰度呈上升趋势；古菌和细菌的 *amoA* 基因丰度相近，*nirS* 基因丰度则远高于 *nirK* 基因，且氨氧化功能基因丰度整体上远低于反硝化功能基因。总氮（TN）、总磷（TP）、氨态氮（NH_4^+-N）、硝态氮（NO_3^--N）和亚硝态氮（NO_2^--N）与古菌 *amoA* 基因丰度均呈显著正相关关系（$P<0.05$），而与 *nirS* 基因丰度呈显著负相关关系（$P<0.05$）。这两种功能基因明显受到花湖沉积物中不同形式氮素浓度的影响与限制。通过研究花湖沉积物氨氧化与反硝化功能基因的垂向分布特征及其对环境的响应，可为深入了解高原湖泊沉积物中的氮循环机理提供参考。

关键词：花湖；沉积物；氨氧化；反硝化；垂向分布；环境响应；qPCR

6.脱卤球菌纲（Dehalococcodia Class）在有机氯生物地球化学循环中的作用

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摘要：脱卤球菌(Dehalococcoidia, Dia)纲是绿弯菌门下属八大纲之一。迄今为止，脱卤球菌纲中包含三个能进行严格厌氧有机卤化物呼吸的菌属：脱卤拟球菌(*Dehalococcoides*，*Dhc)*，脱卤单胞菌(*Dehalogenimonas*，*Dhgm*)，以及尚未正式命名的 *Candidatus* “Dehalobium”。当前关于脱卤拟球菌和脱卤单胞菌的生理学、生物化学和生态学方面的研究，主要集中在从有机氯污染场地中富集或者分离出来的菌株。而越来越多研究证据表明，能进行有机卤化物呼吸的脱卤球菌纲微生物不仅仅只存在于污染物产地，在各种原始环境（例如海洋、淡水、陆地）中也能经常被检测和鉴定到。在自然界中，脱卤球菌纲微生物是有机卤化物循环的重要驱动者，但这一重要的生物地球化学过程尚未得到完全揭示。本文旨在介绍和讨论被低估且未被充分研究的脱卤球菌纲微生物的生理生态特征，从而引起研究人员更广泛的关注，鼓励跨学科研究来揭示这一类特殊微生物在卤素生物地球化学循环中的重要作用。

关键词：脱卤球菌;厌氧微生物生态;生物地球化学循环

7.制药废水二级出水中溶解性有机物混凝去除特性研究

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摘要：制药废水二级出水中溶解性有机物（DOM）由于其组成复杂、难去除、具有多异质性和分散性，是污水深度处理与回用的主要去除对象和关键限制因子。本论文以发酵制药废水二级出水的 DOM 为研究对象，采用聚合氯化铝（PAC）絮凝去除 DOM，考察混凝剂投加量和混凝 pH 值对去除效果的影响，并结合分子量分级、亲疏水性分级以及三维荧光光谱—平行因子分析方法等对 DOM 进行了系统表征和分析，进一步阐述混凝过程 DOM 的去除特征。结果表明，250 mg/L PAC 投加量、pH 为 7~8 时，混凝沉淀 30 min 对 DOC、UV_{254}、色度和浊度均有较好的去除效果，其中 UV_{254} 的去除率为 23.65±0.75%优于 DOC 的去除率 13.05±0.29%；混凝对分子量>10 kDa 的组分和疏水中性（HON）组分有较好的去除效果，而对分子量<1 kDa 小分子有机物几乎不去除；三维荧光光谱—平行因子分析将制药废水二级出水分为 3 个组分，混凝对类腐殖质物质组分有一定去除效果，而亲水性的小分子和蛋白类物质很难通过混凝去除，需要进一步结合其他工艺提高去除效果。

关键词：制药废水；二级出水；溶解性有机物（DOM）；混凝；去除特征

8.高级氧化联合生物活性炭工艺深度净化污水中 PPCPs 研究进展

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摘要：污水处理厂传统的二级生化处理对药品及个人护理用品（Pharmaceutical and Personal Care Products，PPCPs）等新兴污染物的去除率较低，PPCPs 随出水排放会给环境带来较大的生态风险，并会经过生物富集最终危害到人体健康，因此需要通过进一步的深度净化以削减其风险。本文综述了常见 PPCPs 在污水处理系统的分布特征及生态风险，阐述了高级氧化工艺（Advanced Oxidation Processes，AOPs）、生物活性炭工艺（Biological Activated Carbon，BAC）以及高级氧化联合生物活性炭工艺（AOPs-BAC）深度净化 PPCPs 的净化原理，在此基础上，综述了 AOPs-BAC 工艺深度对污水中 PPCPs 的深度净化效果及主要影响因素，并探讨了 AOPs-BAC 工艺对污水中 PPCPs 的风险削减能力，为污水中 PPCPs 深度净化工艺的研发及 PPCPs 的生态风险控制提供了参考。

关键词：污水；PPCPs；高级氧化联合生物活性炭工艺；深度净化；风险控制

9.不同碳源下硫还原地杆菌对反硝化过程的影响机制探讨

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摘要：硝酸盐是废水中常见的污染物，其具有较高的氧化还原电位，在水中的去除主要依靠微生物的反硝化作用。目前的初步研究表明，电活性细菌能够和反硝化细菌通过互营生长加速反硝化过程。为探究在不同外加碳源下电活性细菌对反硝化过程的影响，选取不能够利用硝态氮作为电子受体的模式电活性细菌硫还原地杆菌（*G. sulfurreducens* PCA）与不同碳源（乙醇、丙酸或葡萄糖）驯化得到的反硝化细菌进行共培养。结果表明，改变碳源为乙酸盐后，不同体系中硝态氮的去除效率达到了 94%。碳源的改变造成了不同程度的反硝化滞后现象，在当以乙醇为外加碳源时，*G. sulfurreducens* PCA 的加入能够将迟滞时间缩短 3 h，其反硝化速率可达到 186 g $N \cdot m^{-3} \cdot d^{-1}$，同时产生的亚硝氮含量也相对最低。但以葡萄糖作为反硝化外加碳源时，迟滞时间最短，但加入 *G. sulfurreducens* PCA 后会延长反硝化所需的时间，这可能是与反硝化细菌同 *G. sulfurreducens* PCA 竞争体系中的乙酸盐碳源有关。分析微生物群落结构变化发现，与 *G. sulfurreducens* PCA 的加入提高了反硝化细菌的相对丰度，使其能够适应因碳源改变而产生的对反硝化细菌的生长抑制现象。

关键词：厌氧反硝化；反硝化细菌；共培养；*Geobacter sulfurreducens* PCA

10.混碱调控剩余污泥碱性发酵实现 LDHs 高效提取短链脂肪酸

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摘要：通过配置不同氢氧化钠和氢氧化钙混合比例的碱液，用于调控剩余污泥碱性发酵实验，发现混碱比例为 25:75 时，可避免钙离子对污泥水解产酸影响，发酵液中短链脂肪酸(SCFAs)浓度达到 6581.4 mg COD/L，是空白对照组(4179.4 mg COD/L)的 1.6 倍. 同时，碱液提供的钙离子可将污泥发酵过程释放的无机阴离子去除，CO_3^{2-}、PO_4^{3-}浓度分别低至 3.7 mmol/L 和 0.5 mg P/L. 利用氢氧化钠和氢氧化钙调控剩余污泥进行混碱厌氧发酵，可有效提高 SCFAs 的产量，消除主要无机阴离子对发酵液原位合成层状双金属氢氧化物(LDHs)提取 SCFAs 的干扰，合成的 LDHs 中 SCFAs 的含量为 52.3 mg COD/g LDHs，是空白组(18.9 mg COD/g LDHs)的 2.8 倍.

关键词：层状双金属氢氧化物；生物脱氮；短链脂肪酸；剩余污泥；碱性发酵

11.钛基改性 DSA 电极氧化法去除水中全氟化合物

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摘要：为了提高 DSA 电极的稳定性及催化活性，实现全氟化合物（PFCs）的高效降解，本文以溶胶涂覆法和电沉积法分别制备了改性 DSA（Ti/SnO_2-ZnO）电极，并用于全氟辛酸（PFOA）和全氟辛烷磺酸（PFOS）的电化学降解过程研究。实验分别考察了电流密度、溶液初始 pH、 PFOA 与 PFOS 初始浓度对 PFCs 降解效果的影响。结果表明：两种方法制备的改性 DSA 电极表面均匀负载了 SnO_2-ZnO 复合涂层。在二维电极体系中，极板面积约为 65 cm^2，电流密度为 20 $mA•cm^{-2}$，极板间距 15 mm，电解质为 1.3 $g•L^{-1}$ 次氯酸钠溶液以及电解时间为 150 min 时，溶胶涂覆法和电沉积法所制备的 Ti/SnO_2-ZnO 电极对初始浓度为 100 $mg•L^{-1}$ 的 PFOA 和 PFOS 分别在 pH 为 3.5 和 6.5 时去除效果最佳，达到了 90.6%、94.6%和 91%、93.7%；循环使用电极 3 次后，其降解过程符合一级反应动力学，且电沉积法制备的电极效果优于溶胶涂敷法，表现出对 PFCs 类污染物稳定、高效的去除能力。

关键词：溶胶涂覆；电沉积；PFOA；PFOS；电化学氧化

12.酸性含硒含镉废水低温生物强化处理技术研究

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摘要：本研究将枯草芽孢杆菌接种于活性污泥，系统考察了酸性含硒含镉废水的低温生物强化处理效果。研究发现，活性污泥联合枯草芽孢杆菌对硒、镉的去除效率（Se：94.8%，Cd：99.1%）高于单一枯草芽孢杆菌（B 菌）、混合枯草芽孢杆菌及活性污泥。影响因素试验结果表明，在 20℃、pH4.0、甲醇为碳源时生物强化硒、镉去除效率较高。利用 SBR 反应器处理酸性（pH4.0）含硒（3.7-10.0 mg/L）含镉（5.0-11.2 mg/L）废水，在低温（8.0-10.8℃）条件下运行 80 个周期，硒、镉和 COD 的平均去除率分别为 97.4%、90.7%和 95.0%。红外光谱分析表明，酰胺基、芳香族 C-H 伸缩健在硒、镉去除中起到主要作用。透射电镜与能谱分析证实了生物强化污泥对硒、镉去除之后形成纳米颗粒物。通过高通量测序分析微生物群落结构，发现生物强化污泥中富集了 *Pseudomonas*（假单胞菌属）、*Dechloromonas*（脱氯单胞菌）等典型硒还原菌。

关键词：硒；镉；枯草芽孢杆菌；低温；生物强化

13.AnMBR-Anammox 耦合污水甲烷回收及自养脱氮的工艺特性研究

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摘要： 本研究分别启动了厌氧膜生物反应器（anaerobic membrane bioreactor, AnMBR）和部分亚硝化-厌氧氨氧化反应器（Partial Nitrification/Anammox, PN/A），两者达到稳态后耦合为“AnMBR+PN/Anammox”新系统，实现前段有机质甲烷化、后段自养脱氮的污水处理目的。耦合系统运行结果表明：化学需氧量（chemical oxygen demand, COD）在 AnMBR 的去除率为 96%，其中 80.3%的 COD 在此段转化为 CH_4，Anammox 内一定的反硝化作用进一步强化了 COD 去除，系统 COD 总去除率达 97%以上；氮污染物经 AnMBR 处理后均以 NH_4^+-N 形态存在，再经 PN/A 处理后，总氮（total nitrogen, TN）平均去除率达 78%；系统出水 COD 和 TN 值分别低于 13 和 11 $mg \cdot L^{-1}$。因此，AnMBR-Anammox 耦合系统在同步实现污水甲烷回收、自养脱氮、低碳氮排放方面具有显著优势，本研究结果为开发 AnMBR-Anammox 耦合新工艺提供了理论依据。

关键词： 厌氧膜生物反应器；厌氧氨氧化；耦合；甲烷回收；自养脱氮

14.废水中对甲酚、硝酸盐和氨氮同步去除效能研究

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摘要：含酚含氮废水的处理一直以来都是石油化工等行业关注重点之一。本研究采用 UASB 反应器，通过反硝化微生物与厌氧氨氧化微生物的耦合作用，成功实现对甲酚、硝酸盐和氨氮的同步去除。在温度为 30 °C，进水 pH 为 7.0，HRT 为 12h 进水对甲酚、硝酸盐和氨氮浓度为在 75mgC/L，78mgN/L 和 91mgN/L 的条件下，三种污染物的去除率 95%、100% 和 73%以上，去除的硝酸盐和氨氮大部分转化为 N_2，去除的对甲酚尚未矿化。当对甲酚、硝酸盐和氨氮的负荷为 0.195kgC/m^3d、0.189kgN/m^3d 和 0.234kgN/m^3d，系统三种污染物的去除稳定在 94%，75%和 93%以上。微生物分析结果表明，门水平微生物主要有 *Chloroflexi*、*Planctomycetes*、*Acidobacteria*、和 *Proteobacteria*，属水平上 *Candidatus Kuenenia* 是主要的厌氧氨氧化微生物，*Bacillus* 是主要的反硝化微生物，二者协同作用完成对甲酚、硝酸盐和氨氮的同步去除。

关键词：对甲酚；厌氧氨氧化；反硝化；UASB

15.聚噻吩改性阴极强化电极生物膜反应器去除硝酸盐机制研究

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摘要：为进一步提高电极生物膜反应器的脱氮效能效能，采用导电聚合物聚噻吩（PTh）和电子穿梭体蒽醌-2,6-二磺酸二钠（AQDS）改性阴极材料石墨毡。系统地研究了碳氮比（C/N）条件下，改性电极的应用对 BER 体系的脱氮效能、电极表面生物相和体系微生物群落结构等方面的影响。结果表明，应用 PTh 与 AQDS 的协同处理石墨毡的 BER 体系的 NO_3^--N 去除速率和效能均明显优于未处理电极体系，在 HRT 为 4 h，C/N 为 2.0 时 NO_3^--N 的去除率达到 90.0%以上。PTh/AQDS 改性石墨毡电极的生物膜与电极的比重为 0.26±0.04，其值是对照组的 2.4 倍，证明了 PTh/AQDS 改性后电极具有更优的生物相容性。应用 PTh/AQDS 改性电极的 BER 具有更好的微生物丰富度和多样性，AQDS 促进特定微生物 Thauera_mechernichensis（24.6%）的富集和亚硝酸盐还原酶的活性，保障了 BER 体系的反硝化效能。

关键词：聚噻吩；电极改性；电极生物膜反应器；脱氮；反应机制

16.季节性温差变化对非控温 PN-Anammox 工艺稳定脱氮的影响

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摘要：采用具有自回流的分区式部分亚硝化（PN）和厌氧氨氧化（Anammox）耦合工艺，利用季节性温度的变化，研究了逐步降温对耦合工艺整体脱氮效能及各区域氮素转化能力的影响.结果表明，当温度由 35℃降低到 25℃时，因厌氧区 Anammox 的氮去除速率由 18 $kg·(m^3·d)^{-1}$ 下降到 9 $kg·(m^3·d)^{-1}$，导致耦合工艺的整体氮去除速率大幅度下降，由 1 $kg·(m^3·d)^{-1}$ 下降到 0.5 $kg·(m^3·d)^{-1}$.当温度降低到 20℃时，联合工艺的脱氮速率下降趋势趋于缓慢，但是好氧区的 NO_2^--N 生成速率开始明显下降，由 0.9 $kg·(m^3·d)^{-1}$ 下降到 0.2 $kg·(m^3·d)^{-1}$.同时，AOB 的优势生长被打破，NOB 开始大量增长，出水 NO_3^--N 的浓度迅速增大.运用 Arrhenius 公式对联合工艺总氮去除速率及各个区域氮转化速率与温度的关系进行非线性拟合，厌氧区 Anammox 的氮去除速率的温度特征系数比好氧区 NO_2^-生成速率的温度特征系数大，表明温度对 PN-Anammox 工艺的 Anammox 的效能影响更大.

关键词：季节性降温；部分亚硝化-厌氧氨氧化；脱氮速率

17.分流制系统雨水管网混接旱流排放污染特征研究

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摘 要：本文以上海市某混接分流制排水系统（3.74km2）为研究对象，通过开展雨水管网旱天放江水质监测（SS、COD、BOD5、NH3-N、TN 等），以及雨水管网旱天污染输移质量平衡分析，研究了混接雨水管网旱流放江污染特征。结论如下：1）旱流放江分为重力流放江和市政泵站放江两种情况，通常重力流放江水质和混接源水量水质相关，市政泵站放江水质和混接源水量水质以及底泥冲刷相关；当旱天前期不开泵时间小于 2d 时，河水倒灌还会对重力流放江和市政泵站放江水质造成明显影响；2）随着前期不开泵天数增加，管道淤积程度越严重，市政泵站放江 SS、COD、BOD5 浓度相应增加；3）总体上重力流放江期间的底泥淤积量大于泵站放江期间的底泥冲刷量，以 2011 为例，57%淤积底泥通过旱天市政泵站放江排出，其余 43%淤积底泥在雨天放江时排出，加重了雨天放江污染。

关键词：分流制系统；雨污混接；旱流放江；质量平衡；沉积物

18. 石墨强化微生物异化铁还原合成蓝铁石的磷回收研究

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摘要：蓝铁石结晶法磷回收是近年来磷回收领域国内外研究的热点，如何获得高产率的结晶产物，对于蓝铁石结晶法磷回收技术的广泛应用具有至关重要的作用。本研究采用不同投加量、不同粒径的石墨，加入混菌铁磷复合体系中培养 22 天，探讨石墨对微生物异化铁还原合成蓝铁石过程的影响，以期为碳材料强化蓝铁石结晶法磷回收提供科学依据。结果表明：当石墨投加量为 1 $g \cdot L^{-1}$、粒径为 10 μm 时，Fe(Ⅱ)含量在第 10 天和第 14 天时分别比对照组高 12%和 10%，对蓝铁石合成的强化作用最为明显。因此，1 $g \cdot L^{-1}$、10 μm 的石墨投加条件为本实验中石墨强化微生物异化铁还原合成蓝铁石的最佳磷回收条件。实验末期测定了对照组和最佳石墨组体系中微生物蛋白含量，发现二者之间并无明显差异，表明石墨对微生物量的影响不大。此外，分析微生物群落结构变化发现，与原始污水水样相比，对照组和石墨组的变形菌门比例明显增加，且石墨组的增幅更大，表明石墨更利于变形菌的富集。由此推测，石墨对微生物异化铁还原合成蓝铁石的促进可能源于体系中石墨对变形菌门细菌的强化富集作用。

关键词：石墨；异化铁还原；蓝铁石；磷回收

19.双表面活性剂修饰下纳米零价铁对水中 Cr(VI)污染去除研究

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摘要：为克服纳米级零价铁（nZVI）在环境中易团聚易氧化的特性，强化其去除水中Cr(VI)的能力，选择非离子型表面活性剂聚乙烯吡咯烷酮（PVP）和阴离子表面活性剂油酸钠（NaOA）两者同时对其进行修饰，对比考察了材料在干燥前（悬液状）和干燥后不同的去除效果。结合不同pH值、初始浓度及共存离子条件下的反应效果，材料的XRD和XPS表征、动力学实验和25°C等温线的拟合进行机理分析。结果表明：干燥过程大大降低了材料的去除效率；酸性条件有利于Cr(VI)的去除；悬液样去除水中Cr(VI)可在2 min内达到反应平衡，去除效率99.5%以上，最大去除量为231.75 mg g^{-1}，反应过程符合准二级动力学模型及Langmuir模型；过程中Cr(VI)大部分转化为Cr(III)。

关键词：纳米零价铁；表面活性剂；干燥处理; Cr(VI)；去除

20.长江原水臭氧-生物活性炭挂膜中试研究

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摘要：为了探究面向长江水源的臭氧—生物活性炭深度处理工艺的挂膜技术，进行了长江原水常州段的臭氧—生物活性炭挂膜中试研究。结果表明，在挂膜前期，由于炭柱的物理吸附作用逐渐饱和，炭柱对DOC、UV_{254}和COD_{Mn}的去除率逐渐降低，对氨氮几乎没有去除，在挂膜中后期，由于活性炭上生物膜逐渐成熟，生物降解起主导作用，有机物和氨氮去除率升高并趋于稳定。90d 后，炭柱对 DOC、UV_{254}和COD_{Mn}这三个有机物指标的去除率分别稳定在 30.64%、57.50%和30%以上，氨氮去除率稳定在 88.93%左右，认为挂膜成功。扫描电镜图显示活性炭表面出现丰富的菌胶团，同时高通量测序也验证了活性炭中丰富多样的微生物群落结构。

关键词：臭氧—生物活性炭，挂膜，长江水，中试

21.聚磷生物膜的快速启动及微生物特性研究

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摘要：在同步去除并富集磷的基础上，探究采用前期不排泥、后期排泥的挂膜方式对于聚磷生物膜反应器的运行效能、微生物特征及群落结构的影响，以期实现聚磷生物膜的快速启动及聚磷菌的富集。结果表明，经过 26d 的驯化运行，聚磷生物膜的蓄磷能力明显提升，好氧出水磷浓度达标。在挂膜阶段，生物膜厚度及 EPS 含量出现一定程度增长；在驯化阶段，生物膜厚度增加明显，增长至 32μm，EPS 含量增加明显，上升至 81.6 $mg \cdot g^{-1}$，PN/PS 上升至 3.12，PN/PS 比值增加有利于微生物粘附在填料上，在好氧出水达标的情况下，富集液中磷酸盐浓度提升至 89.5 $mg \cdot L^{-1}$，达到了鸟粪石回收标准。高通量测序结果表明经过富集培养，微生物群落多样性呈现下降的趋势，群落组成变化明显。挂膜成功后，活性污泥与生物膜上微生物群落组成存在差异。聚磷生物膜成熟后，优势菌门为变形菌门(Proteobacteria)，从 33.6%增长至 75.3%；反应器中的聚磷菌属丰度明显增加，从 11.8%上升至 23.2%，红环菌属(Rhodocyclaceae)、UKL 13-1 为反应器中优势聚磷菌。

关键词：生物膜；膜厚；聚磷菌；高通量测序

22.饮用水水质目标的阶段性特征及科技需求

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摘要：饮用水供应的发展从水量、水压到水质，饮用水安全的研究在饮用水获取路径各个环节或饮用水发展的不同阶段，都有与之相对应的主要研究内容，健康水研究无论从国际还是我国，目前都进入到了饮用水安全研究的新阶段，是未来一段时期内的首要内容及方向，尤其是饮用水中必需物缺失带来健康危害的研究。臭氧活性炭共生技术将是人们对健康水追求的解决方案。

关键词：伤残调整生命年；共生；健康水；溶解性总固体；危害物；必需物缺失

23.基于 DEM 数据的 HEC-HMS 和 Vflo 降雨特征模拟对比研究-以北京密云区为例

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摘要：选用密云区域 30m 和 90mDEM 数据并运用 ArcGis 软件提取 DEM 数据的水文地理信息，经过分析水文模型 HEC-HMS、EPASWMM 和 Vflo 后选择并应用 HEC-HMS 和 Vflo 模型对降雨进行分析。统计分析 30 年密云地区的降雨数据，结合密云地区水文情况确定水文模型的参数并率定参数证明其有效性。基于密云区域普通降雨、暴雨、大暴雨和特大暴雨的降雨数据选用 HEC-HMS 和 Vflo 软件做水文模拟。研究结果表明，HEC-HMS 和 Vflo 软件可有效地模拟中国密云的降雨情况。HEC-HMS 和 Vflo 软件输出仿真结果很好，仿真模型的确定系数均大于 0.82。分析 HEC-HMS 软件输出的普通降雨、暴雨、大暴雨、特大暴雨的降雨强度及其它参数，说明降雨强度越小模拟结果越接近实际数值，同样基于 Vflo 水文模拟软件也有相同结果。同时也说明在对暴雨、大暴雨和特大暴雨做水文模拟时需要开发或优化相应软件来满足实际需求，最终为生态系统建设提供一定研究基础。

关键词：水文模拟；降雨；Vflo；DEM 数据；HEC-HMS

24.低温条件下分流式测流-AAO 工艺污水处理及同步污泥减量效果研究

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摘要：当前剩余污泥产量巨大以及低温条件下运行不稳定是城市污水处理厂活性污泥技术主要的挑战和制约。研究通过向 AAO 系统污泥回流系统引入分流式测流厌氧系统，以期实现强化污水处理和同步污泥减量的目标。研究发现当侧流分流比例为 30%时，分流式侧流-AAO 系统能够实现最好的污泥见减量效果，污泥累计排放量减少 18.4%，污泥表观产率下降 19.7%。同时分流式侧流-AAO 系统的 COD，氨氮和总氮去除效率分别为 88.56%，83.12%和 71.6%。均略高于 AAO 系统。同时该条佳下，分流式侧流-AAO 系统能够更快地实现良好的总磷去除效率，并维持出水 TP 含量稳定在 0.5mg/L 以下(51d vs 93d)。分流式侧流厌氧池污泥的适度水解衰减，能够为实反硝化脱氮效果的提升碳源。

关键词：分流式侧流；脱氮除磷；污泥减量；低温水处理

25.基于导电碳纳米管中空纤维膜的膜生物反应器的构建及性能评价

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摘要:本研究中首次采用通量高且导电性能良好的碳纳米管中空纤维膜(carbon nanotubes hollow fiber membranes, CNTs-HFMs)作为基本的膜分离单元，分别构建了厌氧膜生物反应器(anaerobic electrochemical membrane bioreactor, AnEMBR)和好氧膜生物反应器(aerobic electrochemical membrane bioreactor，EMBR)，利用电化学排斥和直接电氧化的作用来考察电化学作用对膜污染的缓解和出水水质的增强效果。在AnEMBR中 CNTs-HFMs作为电源的阴极，最佳施加电压为-1.2V，膜污染程度大幅缓解，COD去除与产甲烷效率均优于对照反应器。而在EMBR中CNTs-HFMs作为阳极，最佳施加电压为1.0V，膜组件运行周期也显著延长，COD、氨氮等污染物去除效率优于对照反应器。该项研究为电化学和膜生物处理工艺的结合奠定了基础。

关键词：膜污染；膜生物反应器；电化学；碳纳米管中空纤维膜

26.Ca^{2+}、Mg^{2+}共存对 SBR 工艺生物脱氮和微生物群落结构的影响

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摘要：为了研究共存的硬度金属离子在废水生物处理中的作用，考察Ca^{2+}/Mg^{2+}摩尔比对 SBR 工艺污染物去除和微生物群落的影响，采用高通量测序技术分析了微生物优势种群的变化，以期从微生物角度明确 Ca^{2+}、Mg^{2+}共存对生物脱氮的影响机制。结果表明：当 Ca^{2+}/Mg^{2+}摩尔比分别为 2、1 和 0.5 时，COD 去除率由 88%分别升高至 90%、91%和 93%；NH_4^+-N 去除率由 74%分别升高至 91%、93%和 96%；TN 去除率由 44%分别升高至 58%、62%和 69%。随着进水 Ca^{2+}/Mg^{2+}摩尔比的降低，微生物群落的丰富度升高，Ca^{2+}/Mg^{2+}摩尔比为 2 的微生物群落结构与 Ca^{2+}/Mg^{2+}摩尔比 1 和 0.5 的微生物群落结构差异显著。变形菌门、拟杆菌门和放线菌门一直为 SBR 工艺的优势菌门，有利于有机污染物的去除。参与脱氮过程的 *Niabella* 和 *Dechloromonas* 在反应器内富集，保证了良好的脱氮效果。Ca^{2+}/Mg^{2+}摩尔比的降低促进了有机物和总氮的去除及微生物多样性的提高。

关键词：生物脱氮；废水；微生物群落结构；优势菌门；金属离子

27.应用紫外/氯组合工艺去除微污染原水中氨氮的特性研究

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摘要： 针对饮用水中氨氮超标对环境造成的污染问题，采用紫外/氯组合工艺对饮用水中氨氮进行降解研究。结果表明，紫外/氯高级氧化工艺可以有效去除水中氨氮。一方面，自由氯和氨氮之间发生取代反应将氨氮转化为氯胺， 254 nm 紫外光可有效裂解 N-Cl 键，一氯胺在 254 nm 处的摩尔吸光系数为 354 $M^{-1}\cdot cm^{-1}$，量子产率为 0.68 $mol\cdot E^{-1}$；另一方面，自由氯光解产生的自由基可直接氧化氨氮。随着紫外辐照剂量的增加，氨氮和总溶解性氮(TN)的浓度逐渐减少，当紫外辐照剂量达到 1000 $mJ\cdot cm^{-2}$ 时，氨氮（起始浓度 2 $mg\cdot L^{-1}$）和 TN 的去除率分别为 53%和 35%，相比单独氯化条件下分别提高了 20%和 15%。随着 Cl_2/N 的增加，氨氮和 TN 的浓度逐渐减少，当 Cl_2/N≥1.6 时，紫外/氯组合工艺对氨氮的去除率接近 100%，当 Cl_2/N＜1.6 时，紫外/氯工艺对 TN 的去除率相比单独氯化工艺提高了 30%左右。此外，氨氮的去除率随 pH 升高而增加，而 TN 的去除率随 pH 升高而降低。本研究结果可以为紫外/氯组合工艺在水厂中的实际应用提供有效的理论和技术支持。

关键词： 紫外/氯；氨氮；高级氧化；饮用水处理

28.旋轮虫在污水生物处理中的作用机制初探

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摘要：蛭形轮虫常被用作生物处理性能良好的指示生物。本文以一种常见的蛭形轮虫—旋轮虫（*Philodina* sp.）为研究对象，着重探讨了旋轮虫和旋轮虫分泌物对活性污泥处理性能和细菌的作用方式，以明确旋轮虫在污水生物处理中的非直接捕食性的间接作用机制。结果表明，旋轮虫和其分泌物均有提高活性污泥对 COD、氨氮、总磷的去除率的作用，且作用效果相近，提示了旋轮虫分泌物是旋轮虫对活性污泥的主要作用形式，即非直接捕食性的间接作用是其主要作用形式。旋轮虫分泌物对絮凝性细菌的絮凝性、异养硝化-好氧反硝化菌的同步硝化和脱氮效能均有促进作用，进一步提示了旋轮虫提高活性污泥活性的作用是通过其分泌物提高细菌活性的结果。此外，通过使用根癌农杆菌 KYC55 从旋轮虫分泌物中检测出 AHLs 信号分子的类似物，提示了旋轮虫对细菌的作用机制可能是其分泌物误导或触发细菌的群体感应所致。本文结果为研究微型动物在污水生物处理中的作用机制提供了新的研究思路。

关键词：旋轮虫；分泌物；污水生物处理；作用；群体感应

29.上海水源水库产 2-MIB 生物总量评估方法与应用初步

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摘要：本文开展了蓝藻产 2-MIB 功能基因 *mic* 的 qPCR 定量分析，对上海水源水库中的 *mic* 基因进行长期调研。结果表明，在长江水源水库和黄埔江水源水库中 *mic* 基因都有检出。在夏季其丰度达到峰期，基因拷贝数达到 10^7 - 10^8 copies·L^{-1}。分析表明 *mic* 基因拷贝数与蓝藻、伪鱼腥藻细胞密度、2-MIB 浓度之间均存在相关性。因此通过 *mic* 基因定量进而推断水中产嗅生物总量的方法，可代替繁琐、重现性低的显微镜镜检过程。应用中还需更多实践，结合其他指标改进准确度。

关键词：二甲基异莰醇；qPCR；饮用水源水库

30.化学预处理对微塑料 Pb 吸附潜力的影响及机理研究

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摘要：污水和污泥是土壤等生态环境中微塑料的重要来源，受到人们的广泛关注。由于污水和污泥中含有大量的有机质，化学预处理通常被用于提高其中微塑料的提取及分析效率，然而至今关于化学预处理对微塑料的吸附潜力及表面理化特性的影响研究较少。本研究探讨 5 种预处理条件，即 1 M HCl、1 M HNO_3、30% H_2O_2、1 M NaOH 和 5 M NaOH，对 6 种微塑料类型（(PA、PE、PP、PS、PET 和 PMMA）Pb 吸附潜力的影响，同时通过微塑料表面理化特性的分析，探讨了预处理影响微塑料 Pb 吸附的机理。结果表明 6 种微塑料对 Pb 吸附等温式符合 Langmuir 模型，Pb 吸附能力大小顺序分别为：PA＞PMMA＞PET＞PE＞PP＞PS，最大吸附量分别为 2922.9、699.3、584.8、549.5、510.2 和 277.8 $\mu g \cdot g^{-1}$。与此同时，不同预处理条件对微塑料 Pb 吸附特性的影响不同，总体而言，碱预处理会导致微塑料 Pb 吸附量的增加，且随着碱处理浓度的增加而增加，而酸预处理会引起 Pb 吸附量的减小，其中硝酸预处理作用更加显著。进一步分析预处理前后微塑料质量、尺寸、表面官能团及表面形态等的变化情况，发现碱预处理对微塑料的腐蚀作用最大，其次为硝酸预处理组，最后为盐酸和过氧化氢预处理组。此外，与玻璃型（如 PS）微塑料相比，预处理对橡胶型微塑料（如 PE）的影响更大。

关键词：微塑料；污泥；预处理；吸附特性；理化特征

31.羟胺强化亚铁活化过硫酸盐降解对乙酰氨基酚的研究

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摘要:利用羟胺（HA）强化 Fe^{2+}/过硫酸盐（PS）体系降解对乙酰氨基酚（ACT），考察了 Fe^{2+}、PS、HA 投加浓度以及反应初始 pH 值对 ACT 降解效果的影响。结果表明，在反应时间为 30 分钟，亚铁浓度为 0.05 mmol/L， PS 浓度为 0.8 mmol/L 和初始 pH 为 3.0 的条件下，0.5 mmol/L HA 可将 ACT 的去除率从 13%提高到 90%。适量增加 Fe^{2+} 或 HA 浓度可以提高 ACT 的降解率，但是过高的 Fe^{2+}和 HA 浓度会抑制 ACT 的降解。当 PS 浓度达到 1.2 mmol/L 时，30 min 内 ACT 几乎可以完全降解，ACT 的降解效果随着 pH 的升高而降低。EPR 实验表明 Fe^{2+}/PS/HA 体系中主要的自由基是 $SO_4^{\bullet-}$和 $HO^{\bullet}$。Na_2SO_3、$NaNO_2$ 和 $Na_2S_2O_3$ 等常见的还原剂均能够强化 Fe^{2+}/PS 体系对 ACT 的降解效果，但是其对 Fe^{2+}/PS 体系的强化效果均比 HA 低。

关键词:羟胺;过硫酸盐;对乙酰氨基酚;硫酸根自由基;羟基自由基

32.垃圾渗滤液浓缩液高铁酸钾联合 PAC 处理技术研究

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摘要：以碟管式反渗透（DTRO）处理垃圾渗滤液产生的浓缩液为研究对象，采用高铁酸钾联合聚合氯化铝（PAC）处理浓缩液。DTRO 浓缩液 COD、UV_{254}、色度去除率随着高铁酸钾投加量增加而升高。高铁酸钾投加量为 10 g/L，pH 为 5 时去除效果最佳，反应在 40 min 内基本完成，COD、UV_{254}、色度去除率分别为 38.50%、35.71%和 68.50%。通过响应曲面法分析高铁酸钾联合 PAC 处理浓缩液效果提出：高铁酸钾投加量在 10.0 g/L 至 13.0 g/L 之间，pH 调节至 3.0 至 4.0 之间，PAC 投加量为 13.0 g/L 至 15.0 g/L，DTRO 浓缩液去除效果最好。

关键词：高铁酸钾；垃圾渗滤液浓缩液；聚合氯化铝；响应曲面

33.不同曝气位点对微氧强化硫酸盐还原-反硝化脱硫效果及群落结构的影响

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摘要：微氧强化硫酸盐还原-反硝化脱硫（SR-DSR）工艺因其具有同步处理废水中 COD，NO_3^-，SO_4^{2-}生成 S^0 且运行成本低、流程短的优势受到关注。但因不同曝气方式而在反应器中形成的不同的微氧区的位置对反应器运行效能、S^0 的转化率和群落结构的影响尚不明确。因此，本文以 5 mL $_{空气}$·min^{-1}·L $_{反应器}^{-1}$ 的曝气速率，10.4 mmol·L^{-1} 硫酸钠，31 mmol·L^{-1} 乳酸钠和 8 mmol·L^{-1} 硝酸钾连续运行 EGSB 反应器，对比研究了回流槽中曝气（微氧区位于反应器下部）和反应区上部（微氧区位于反应器上部和下部但 DO 更低）运行稳定后，反应器的运行效能、S^0 的转化率和功能微生物的演替规律。结果表明，上部曝气时乳酸盐去除率 100%，出水中乙酸盐浓度为 9.1 mmol·L^{-1}，丙酸盐浓度为 3.7 mmol·L^{-1}，NO_3^-去除率 100%，出水中 NO_2^-浓度为 0.35 mmol·L^{-1}，SO_4^{2-}去除率为 84%，出水中 S^{2-}的浓度为 2.6 mmol·L^{-1}，S^0 转化率为 59%。与下部曝气相比，出水中乙酸盐和丙酸盐浓度分别升高 2.2 和 1.9 mmol·L^{-1}，NO_2^-浓度下降 0.15 mmol·L^{-1}，S^{2-}浓度降低 0.5 mmol·L^{-1}，SO_4^{2-}去除率和 S^0 转化率分别下降 6%和 1%。上部曝气时，反应器下部和上部均存在相对减弱的微氧环境，使得反应器中硫酸盐还原菌（SRB）*Desulfomicrobium* 和 *Desulfobulbus* 总丰度分别增加 9%和 5%，

硫氧化反硝化菌（soNRB）Halothiobacillaceae 和 *Sulfurovum* 的丰度均减小 3.1%。异养反硝化菌（hNRB）*Comamonas* 的丰度升高 0.2%。互营菌 Synergistaceae 的丰度减少 37%。其中反应器下部的 SRB 和 soNRB 总丰度分别升高 28%和 3%，为 SO_4^{2-}还原和 S^0 转化提供充分条件，而反应器上部的微氧环境又减弱了 SO_4^{2-}还原过程，从而降低反应器出水中的 S^{2-}。因此，在碳源充足的条件下，可以采取反应器上部曝气的方式创造微氧环境，既可以保证较高 S^0 转化率，又可以减少出水中的 S^{2-}和 NO_2^-浓度。

关键词：硫酸盐还原-反硝化脱硫；微氧；曝气位点；运行效能；群落演替

34.自养反硝化脱氮耦合沼气同步脱硫效能研究

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摘要：污水深度脱氮问题日益突出，在实现污水深度脱氮的过程中尽可能降低运行成本更是符合目前我国的发展目标，因此，开发经济绿色的污水脱氮技术对可持续发展具有重大意义。本试验提出自养反硝化脱氮耦合沼气同步脱硫工艺，具有成本低，资源利用率高等优势。以沼气中的硫化氢作为电子供体，实现了污水中同步脱氮及沼气脱硫净化的耦合，并探究了上升流速、硫氮比对该工艺运行效能的影响。实验结果显示，以硫化氢代替硫化物作为电子供体参与反硝化，对工艺脱氮效能无明显影响，在低硝酸盐负荷条件下运行时，污水脱氮效能不受气体上升流速及硫氮比的影响，均能达到 100%。而本工艺的脱硫效能受上升流速影响较小，受硫氮比影响较大。在不同上升流速下，硫化氢去除率均为 100%。在硫氮比为 5:8 的时，硫化氢 100%转化为硫酸盐；硫氮比为 5:5 时，硫化氢去除率为 99.1%，单质硫产率约为 30%；硫氮比为 5:2 时，回流比为 1:1 时，硫化氢去除率最高可达 91%，单质硫产率为 77%。本试验可为后续自养反硝脱氮同步沼气脱硫工艺参数优化及应用的拓展提供理论依据和参考。

关键词：自养反硝化；沼气脱硫；污水脱氮；耦合体系

35.海积平原区某非正规垃圾填埋场地下水氨氮污染模拟研究

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摘要:本研究结合天津市海积平原区水文地质条件，构建了某非正规垃圾填埋场地下水溶质运移模型，该模型用于预测分析垃圾填埋场地下水氨氮污染迁移规律。采用敏感性分析研究了渗透系数、孔隙度和弥散度等参数的变化对模拟结果的影响。模拟评价了地下水氨氮污染抽出处理效果。研究结果表明，氨氮污染羽在 10 年内最大迁移距离为 648m，污染面积达到 368667m^2，高浓度氨氮污染羽主要分布于南部浅层潜水含水层。抽出处理方案效果不佳，易导致氨氮污染羽的拖尾和反弹效应。本研究可为海积平原区地下水氨氮污染治理、修复提供理论参考和依据。

关键词：海积平原；非正规填埋场；地下水；氨氮污染；数值模拟

36.硝酸改性活性炭对赤铁矿生物可利用性强化效果与影响因素分析

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摘要：赤铁矿生物可利用性弱、污染物去除效率低，但因其价格低廉，存在广泛，常被用于环境治理与修复。本研究向赤铁矿生物还原体系中添加硝酸改性后的活性炭，以强化矿石中 Fe(Ⅲ)的生物可利用性。以 Fe(Ⅲ)还原率与有机物降解率为响应值，通过响应曲面法探究了赤铁矿浓度、有机物浓度与硝酸改性剂浓度对赤铁矿生物可利用性的影响机制。研究结果表明，硝酸改性活性炭可以提高赤铁矿的生物可利用性、促进有机物的降解，赤铁矿浓度对反应影响最为显著。生物反应过程的最佳条件为：赤铁矿初始浓度 8.35mmol/L、有机物初始浓度 13.41mmol/L、硝酸改性剂浓度 5.07%。硝酸改性活性炭强化赤铁矿生物体系，虽能降解高浓度有机物，但有机物去除效果仅为 20%~50%，证明该体系适用于低有机物浓度的水环境。本研究对促进水、土壤环境中有机物的降解具有重要科学意义。

关键词：硝酸改性活性炭；赤铁矿；生物可利用性；效果；影响因素

37.基于新型载体 AMC/UASB- SCMBBR 生物工艺处理印染废水的中试研究

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摘要：针对泉州某印染厂实际废水(COD 800~1800 mg·L^{-1}，NH_4-N 20~50 mg·L^{-1}，pH 8~14)，以两种新型载体分别作为厌氧与好氧单元中微生物固定化载体，考察了中试规模上流式厌氧污泥床反应器（UASB）与柔性悬浮载体移动床生物膜反应器(SCMBBR)组合工艺对该废水的处理效果。4 个月的连续试验结果表明：（1）经过 30 天前期调试运行该工艺系统成功启动。处理量为 1.5~2.2m^3·d^{-1} 时，AMC/UASB 和 SCMBBR 反应器对 COD 的去除率分别达到 22%和 50%，AMC/UASB 反应器出现明显的产气现象，SCMBBR 中载体挂膜状况良好；（2）启动完成后经过 90 天的连续运行，当 AMC/UASB 和 SCMBBR 水力停留时间分别为 10.7 h 和 8.8 h 时，废水处理量为 5 m^3·d^{-1} 时，稳定运行阶段废水整个工艺废水 COD 去除率达到 78%，出水氨氮平均浓度为 3.4 mg·L^{-1}；此外整体工艺色度去除率达到 65%，其中厌氧段色度去除率达到 50%左右；（3）通过分析计算，整个系统污泥减量达到 67.7~76.6%，该生物组合工艺具有明显的污泥减量效果。

关键词：AMC 载体；PGB 载体；柔性悬浮载体移动床生物膜反应器；

色度；污泥减量；印染废水

38.基于泥质的剩余污泥脱水策略与数学模型构建研究

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摘要：本研究以无锡市 A^2O-MBR（Anaeroxic Anoxic Oxic-Membrane Bio-Reactor，A^2O-MBR）工艺、CAST（Cyclic Activated Sludge System，CAST）工艺和氧化沟工艺三种不同工艺的污泥泥质为对象，通过试验测定 7 种污泥泥质参数，分析不同污泥泥质参数间相关性。并通过主成分分析发现含固率、胞外聚合物（Extracellular Polymeric Substances，EPS）蛋白质和多糖是影响污泥脱水性能的主要因素。通过均匀设计实验探究不同药剂投配比对污泥毛细吸水时间及有机物含量的影响，并采用统计分析软件（Statistical Product and Service Solutions，SPSS）软件构建污泥脱水药剂线性回归模型，得到线性方程：

$$含固率 = 2.5049 - 0.0261 \times X_1 - 2.28 \times 10^{-3} \times X_2$$

$$有机物 = 40.5728 - 0.1894 \times X_1 + 0.2264 \times X_2$$

通过验证试验发现，此线性方程残差低于 3.0，可用于指导实际工程中药剂投配比。

关键词：污泥泥质；药剂投配比；主成分分析；均匀设计试验；线性回归模型

39.成都平原典型区地下水污染时空异质性及污染源分析

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摘要：成都平原地下水是重要的生活、工农业生产用水，长期过量使用化肥、畜禽养殖、乡镇企业及生活污废水无组织排放，已对地下水环境构成威胁。本研究选取成都平原某典型城镇农村区进行不同时季地下水水质监测分析，联合 ArcGIS 空间分析技术、相关矩阵分析和主成分分析（PCA），揭示研究区地下水水质时空异质性、污染影响因素、潜在污染源及污染源时季变化规律。结果表明，研究区“三氮”、铁、锰、氯离子、硫酸根离子存在不同程度超标，其中氨氮超标最为突出；地下水中氨氮含量及“三氮”之间的转化主要受土地利用类型、地下水铁锰分布及含水层氧化还原条件影响；PCA 结果显示农业活动、生活污水和工业排放是造成研究区地下水污染的主要影响因素，从春季到夏季地下水污染源由生活污染为主转向农业污染为主，冬季地下水污染源以生活和工业源为主。ArcGIS 空间分析和 PCA 分析的结合，有助于探讨地下水水质及潜在污染源的时季变化规律，为地下水环境保护、污染控制和减缓方案提供理论依据。

关键词：地下水污染；三氮；主成分分析；时空分析；污染源

40.城市水源地地下水污染特征分析及水质评价

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摘要：根据2018年绥化市第一水源地13口监测井水质检测结果分析地下水污染特征,并对地下水质进行综合评价.结果表明:绥化市第一水源地取水井主要超标因子为铁、锰、氨氮,第一水源地补给区内其他取水井监测指标中铁、锰、氨氮、溶解性总固体和总硬度超标. 硫酸盐、氯化物、溶解性总固体、总硬度、氟化物和磷酸盐浓度高值区均出现在垃圾填埋场,高锰酸盐指数和氨氮的高值区出现在太平岗村屯地下水井,硝酸盐高值区出现兴发村屯地下水井.地下水污染评价结果显示污染指标主要为溶解性总固体和氨氮,分别为中污染和极重污染,主要集中有B5、B7、B8、B9、E和X1.溶解性总固体、硫酸盐、氯化物和总硬度空间分布呈相似趋势,高值区均出现在E、X1、B7、B8和B9.氨氮高值区出现在X1,这可能与该处为垃圾填埋场有关.高锰酸盐指数高值区出现在E,硝酸盐氮高值区出现在B8,砷浓度的空间分布没有变化.

关键词：水源地；地下水污染；空间分布；水质评价

41.水文调控在山地城市河道水生态修复中的运用探讨

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摘要：本文以城市河道水生态恶化问题为研究对象，以山地城市水文循环为主要研究内容，提出对应的山地城市河流生态基流量对应计算方法以及河道补水措施，为山地城市河道水生态修复指引新方向。

关键词：水文调控；山地城市；水生态修复

42.哈尔滨市融雪径流中多环芳烃污染生态风险评价

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摘要: 根据 2018 年哈尔滨市春季融雪径流中 16 种 PAHs 检测数据,利用 BaP 毒性当量法和风险熵值法评价融雪径流中不同下垫面及各采样点中 PAHs 风险等级、16 种 PAHs 单体风险等级和对水生生物的影响.结果表明: 不同下垫面 ΣPAHs 的生态风险差异明显, 城市道路、内部道路、人行道和绿地融雪径流中 PAHs 污染处于高生态风险等级,而屋面和冰面的生态风险处于较低水平.城市道路和内部道路均超出我国地表水环境质量标准 2.8 $ng.L^{-1}$,EBaP 最高值分别为 20.06 和 15.5,人行道和绿地中部分 EBaP 值超标,屋面和冰面均为超标.从各 PAHs 单体 RQ 均值来看,Ant 和 BbF 最高,其 RQ_{MPCs} 均值都为 1.53,其次是 BaA 为 1.46,Pyr 为 1.2,BghiP 为 1.04,均属高风险等级,其余单体均有中等生态风险.松花江干流水生生物对融雪径流中 Pyr 的毒性最强,Flu 的毒性最弱, Nap 的毒性居中.耐受性顺序依次为: Flu > Ace> Chr > Ant > Nap > Fla> BaP > Phe >Pyr.城市道路、内部带路和人行道融雪径流中 PAHs 对大型蚤和胖头鲤鱼的风险商均大于 1,说明 9 种 PAHs 对这两种水生生物存在风险.

关键词：融雪径流；多环芳烃污染；生态风险评价；风险熵值法

43.哈尔滨市融雪径流中多环芳烃污染源解析

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摘要：本文利用比值法和主成分分析法分析哈尔滨市春季融雪径流中PAHs污染来源.结果表明,比值法结果显示融雪径流中PAHs主要来源于燃烧过程,其中交通排放源显著,尤其是汽油车辆尾气排放.主成分分析结果表明各源的贡献率在不同下垫面中有差异.城市道路主要来源为混合源、内部道路为汽车尾气排放、人行道为石油来源,屋面、绿地和冰面主要受燃煤和化工厂废气排放以及大气沉降的影响.从各主要来源的相对贡献率的结果可以看出城市道路位于城市中心的繁华地带,是城市中污染较严重的区域.内部道路较城市道路车流量小,路边经常停放临时车辆,导致来源种类较多.人行道的污染来源主要受燃油、石油类泄露和汽车尾气.屋面、绿地、冰面主要受大气干湿沉降及汽车尾气排放等的影响.

关键词：融雪径流；多环芳烃;；比值法；主成分分析

44.改性秸秆材料对高盐废水中染料和重金属的吸附性能研究

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摘要：高盐印染废水是一种难处理的工业废水，其盐度高，色度高，且含有染料、重金属等多种污染物。本文针对高盐印染废水中污染物的特点，设计了一种制备过程简单、成本经济的柠檬酸/丙烯酰胺改性秸秆材料（WA-CA-AM）。通过 SEM、FI-IR 和 DTG 等表征手段分别观测材料形貌、测定表面官能团和热稳定性。并在不同盐度下，考察了单元/多元污染物体系中 WS-CA-AM 吸附污染物的效果。结果表明：在单元污染物体系中，WS-CA-AM 对污染物的吸附量随盐度的升高而降低；在多元污染物体系中同时存在竞争吸附和协同吸附；通过二元体系了得出四种污染物的吸附受盐度影响大小 MO＜Cu^{2+}＜Cr^{6+}＜MB。有趣的是，在高盐度下，四元混合体系中 MB 和 Cu^{2+}的吸附量均比染料/重金属二元混合体系的要大，Cr^{6+}的吸附量虽受到一些抑制但依然可观。表明改性秸秆材料在高盐印染废水的处理中具有巨大的应用潜能。

关键词：改性秸秆；高盐印染废水；吸附

45.印染废水处理过程中有机污染物及急性毒性变化规律研究

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摘要：我国印染废水排放量大，印染废水中的典型毒害物质控制日趋严格，且生物毒性控制越来越受到重视。以掌握典型印染废水处理中污染物去除特性和毒性转化机制为目标，发现典型印染废水处理对典型污染物去除效率较好，出水 COD、色度、苯胺浓度分别为 46 mg/L、0.86mg/L、6 倍，去除效率分别为 78%、95%、86%；但对急性毒性控制不足，尤其有机组分的急性毒性控制不足。典型印染废水处理中，生物曝气处理是控制典型污染物的主要阶段，对 COD、色度、苯胺的去除效率分别达 60%、23%、50%，对生物毒性的去除率为 48%。氯氧化和混凝沉淀是保障印染废水中苯胺类有毒药物质和色度达到排放标准的重要深度处理阶段，对色度、苯胺的去除效率分别为 86%、95%；然而，深度处理却会引发印染废水急性毒性急剧升高，升高比例达 150%。印染废水中的急性毒性组分包括有机组分和无机组分，生物曝气主要去除有机组分毒性；氯化深度处理会增加有机组分毒性和无机组分毒性，其中无机组分毒性可通过还原脱氯削减，但有机组分毒性控制需综合考虑前处理阶段提质增效或实施氯氧化替代工艺。

关键词：印染废水；有机污染物；苯胺；发光细菌；毒性

46.不同结构的人工湿地系统对溶解性有机物去除效率的研究

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摘要：为研究溶解性有机物在生态修复系统中的降解与残留，构建石英砂，焦炭及曝气焦炭系统的人工湿地，比较填料及强化曝气对 DOM 代谢的影响，研究结果表明：填充焦炭的反应器处理 COD、NH_4^+-N、DOC、蛋白质、多糖和 UV-254 的效果明显优于填充石英砂的反应器；表层连续曝气能有效的提高对 COD 和 NH_4^+-N 的去除效果，平均最优去除率分别为 89.58%和 51.15%，与未曝气组相比分别平均提高了 4.22%和 14.79%，COD 和 NH_4^+-N 的去除与 DOC 中 HPI 组分的降解成相关性；系统表层进行曝气大大提高了系统对 TPI-A 中溶解性蛋白质的降解，降解率为 65.9%，而对多糖中 TPI-A 组分的降解与未曝气相比无明显差异。

关键词：人工湿地；NH_4^+-N；COD；DOM；曝气

47.周村水库四季变化过程中水体溶解性有机物的分布与光谱特征

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摘要：运用三维荧光光谱(EEMs)技术结合平行因子分析法(PARAFAC)以及紫外-可见光谱技术(UV-vis)，对周村水库四季变化过程中溶解性有机物(DOM)的分布及光谱特征进行分析。结果表明：周村水库表层水体的氮素(总氮和溶解性总氮)和有机物(总有机碳和溶解性有机碳)的季节性差异显著，并且水库冬春两季 TN 较多、TOC 较少；表层水体 DOM 夏秋两季的吸收系数 a_{254} 和 a_{355} 均高于冬春季节，与有机物的分布相一致；四季的 E3/E4 均大于 3.5 说明 DOM 以富里酸为主，E2/E3 表明富里酸所占 DOM 的比例夏秋两季高于冬春，除夏季外水库表层水体 S_R 均大于 1，显示为 DOM 主要为生物源；三维荧光通过 PARAFAC 解析出 3 种组分,分别为类腐殖质(C1)、可见区富里酸（C2）和类蛋白（C3）；对 3 个组分进行相关性分析，结果显示 C1、 C2、C3 之间具有显著的相关性(P<0.01)；DOM 的总荧光强度以及各组分的荧光夏秋强度均呈现出夏秋季高、冬春季低的特征，总荧光强度最大为夏季的(1993.52±40.84)A.U，最小值为春季的(1074.10±113.63)A.U；周村水库各个季节间的 DOM 总荧光强度和荧光组分 C1 荧光强度除夏秋外呈现显著的差异(P<0.05)，组分 C2 和 C3 的荧光强度均呈现显著差异明显(P<0.05)；周村水库四季的 DOM 生物源指数(BIX)在 0.8~1.0 之间，表明水库 DOM 具有较强的自生源

特征，与腐殖程度指标(HIX)的结果相吻合；PCA 分析显示周村水库表层水体 DOM 的光谱特征差异明显，夏秋两季的 DOM 光谱特征相近、冬春两季的水体 DOM 特征相似；并且组分 C1、C2、C3 与 DOM 特征参数[FI、β/α]以及溶解性有机碳(DOC)显著相关性(P<0.01)。通过对周村水库水体四季的 DOM 光谱特征研究，可以进一步分析水库水体的有机物污染特征，并为水库水质管理提供技术支持。

关键词：溶解有机质（DOM）；周村水库；光谱特征；紫外-可见光谱；三维荧光光谱

48.路面径流生态阻控技术研究—以改性麦饭石透水沥青路面为例

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摘要：为强化透水沥青路面对路面径流中氮磷的控制效果，采用铁盐联合碱热技术制备了涂层负载改性麦饭石蓄水层集料，并运用场发射扫描电子显微镜（SEM）、能谱分析仪（EDS）和 XRD 等手段对改性后麦饭石集料的表面形态、特征和化学成分进行了表征，通过静态吸附试验对和 TP 的吸附效果及其作用机理进行了对比研究，最后将改性麦饭石作为蓄水层集料应用于透水沥青路面中，通过模拟降雨和周期蓄水试验探究其净化机制。结果表明：相比于天然麦饭石，铁盐联合碱改性麦饭石的表面性状发生明显变化，最大饱和吸附容量明显提高，对氨氮和磷酸盐的吸附容量从 1.32mg 和 1.48mg/g 提升到 12.82mg/g 和 6.38mg/g，降雨全过程中改性蓄水层路面可对 NH_4^+ 的整体去除效果提高 20%左右，对 TP 可提高至少 15%的净化效率，蓄水阶段较模拟降雨试验污染物的截留效果较降雨期均显著提高，改性后麦饭石蓄水层 24h 后出水水质均可达 III 类水标准，强化蓄水层和提高蓄水时间是提高路面径流净化效率的有效措施。因此，本实验中铁盐联合碱热技术制备的改性麦饭石可推荐用于海绵城市生态处理设施透水沥青路面中削减氨氮和总磷的污染负荷。

关键词：透水沥青路面；生态阻控；麦饭石；路面径流；蓄水层

49.混凝和强化混凝对印染废水中锑(V)的去除特性

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摘要：印染废水中锑的排放标准日趋严格，是印染废水处理面临的新挑战。以混凝和强化混凝去除印染废水中锑(V)为目标，发现聚硫酸铁 (PFS)混凝剂对印染废水中锑(V)的去除效率显著优于铁铝复配混凝剂和铝盐混凝剂，去除效率达 97.4%，出水锑(V)浓度可达 <4 μg/L。酸性条件（低水解度）有利于 PFS 生成 Fe(a)活性组分和静电吸引、锑(V)迁移，且絮体颗粒较小，促进 PFS 混凝除锑(V)效率；酸性条件下 PFS 除锑(V)效率是中性条件的 1.27 倍，处理出水中锑(V)浓度仅为中性条件的 33.3%。PFS 投加量与除锑(V)效率符合反比例模型。在较高锑(V)浓度下，提升 PFS 投加量可提高除锑(V)效率，但在较低锑(V)浓度下，提升 PFS 投加量对除锑(V)效率的促进较小。PFS 絮体回流与混凝沉淀串联或耦合可显著提升印染废水中锑(V)的去除效率，其除锑(V)效率分别是单一 PFS 混凝沉淀的 1.14 倍和 1.32 倍，可有效降低出水锑(V)浓度并节约 PFS 投加量和减少污泥生成量。其中混凝-絮体回流耦合工艺中，最佳絮体回流比例为 100%。

关键词：印染废水；锑；混凝；聚硫酸铁；絮体回流

50.2019UWEWE 可见光响应的石墨烯光催化膜制备及其光催化性能研究

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摘要：利用氧化石墨烯、二氧化钛和硅烷偶联剂制备石墨烯光催化剂复合体系，以无纺布为基材，采用浸渍烘干的方式制备石墨烯光催化膜。利用 SEM 扫描电子显微镜，X 射线衍射仪和拉曼光谱仪表征石墨烯光催化膜的微观形貌、负载分布及成分组成，并考察石墨烯光催化膜对亚甲基蓝的吸附降解效果。结果表明，石墨烯光催化膜对可见光吸收效果好，在模拟太阳光照射下对亚甲基蓝吸附降解率可达到约 80%，即使在微光或无光条件下，对有机污染物也表现出良好的光催化降解性能；对河道废水进行的中试试验结果表明，石墨烯光催化膜能够有效降低河道废水中 COD_{Cr}、NH_3-N 和 TP 等主要污染指标，同时大幅度提高废水溶解氧（DO）含量至近饱和状态。可见光响应的石墨烯光催化膜节能环保，能够通过吸附-光催化复合作用有效治理修复河道废水水质。

关键词：氧化石墨烯；二氧化钛；光催化；可见光；亚甲基蓝

51. The effect of dissolved oxygen on long-term stability of partial nitrification process

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Abstract： Keeping stable partial nitrification stage is the main challenge to make wastewater treatment energy-saving. Achieving partial nitrification process was widely reported with low dissolved oxygen (DO) concentration. However, recently it was found partial nitrification process turned into complete nitrification process with long-term low DO concentration. So it is significant to reveal the effect of DO concentration on the long-term stability of partial nitrification process. In this study, two same sequencing batch reactors (SBRs) cultivated with same seeding sludge were built up. Different DO concentrations were controlled to explore the effect of DO concentrations on the long-term stability of partial nitrification process at room temperature. It was discovered that for stable partial nitrification process, ammonium oxidation rate (AOR) was inhibited by low DO concentration when DO concentration decreased from 2.5 mg/L to 0.5 mg/L. The proportion of Nitrospira increased from 0.056% to 3.2% during the 190 operational cycles, finally partial nitrification turned into complete nitrification process. However, high AOR and stable microbial community structure was kept with DO concentration of 2.5 mg/L, and long-term stable partial nitrification process was maintained.

Furthermore, nitrous oxide emission was less with high DO concentration. This study can further optimize the operation condition to maintain stable partial nitrification process.

Keywords: Partial nitrification; Nitrite oxidizing bacteria; Dissolved oxygen; Ammonium oxidation rate; Nitrous oxide

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52. Application of Chemical Crystallization Circulating Pellet Fluidized Beds for Softening and Saving Circulating Water in Thermal Power Plants

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Abstract: Circulating pellet fluidized beds (CPFBs) are a highly efficient and environmentally friendly softening technology that can be used to reduce water hardness during the pretreatment process of the circulating water of thermal power plants. The performance of chemical crystallization CPFB reactors was tested for increasing the concentration ratio and softening the circulating water in a thermal power plant in Dingzhou, Hebei. The results show that using CFPB reactors can remove water hardness and Ca^{2+} ions with efficiencies exceeding 60% and 90%, respectively. The size of the particles discharged from the reactors was approximately 1–3 mm. The content of CaO in these particles was found to be greater than 50%. All of the discharged particles were reused in the desulfurization system in the power plant. After adopting the proposed CPFB technology in Dingzhou Power Plant, the concentration ratio of the circulation cooling water was increased from 4.5 to more than 9. In addition, the amount of

replenishing water and sewage discharges were both reduced by 150 m^3/h, and the amount of scale inhibitor used in the system was reduced by more than 30%. These improvements contribute to approximately US$200,000 in annual savings in the power plant. In summary, CFPB technology demonstrated a high hardness removal rate, strong economic benefits, and remarkable environmental and social benefits. Therefore, CFPB technology seems ideal for softening replenished circulating cooling water, increasing the concentration ratio of circulating cooling water, and achieving zero liquid discharge (ZLD) in thermal power plants.

Keywords: Circulating pellet fluidized bed， Thermal power plant, Circulating cooling water, Concentration ratio, Zero liquid discharge, Water softening

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53. Characteristic and correlation analysis of influent and energy consumption of wastewater treatment plants in Taihu Basin

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Abstract: The water quality and energy consumption of wastewater treatment plants (WWTPs) in Taihu Basin were evaluated on the basis of the operation data from 204 municipal WWTPs in the basin by using various statistical methods. The influent ammonia nitrogen (NH_3-N) and total nitrogen (TN) of WWTPs in Taihu Basin showed normal distribution, whereas chemical oxygen demand (COD), biochemical oxygen demand (BOD_5), suspended solid (SS), and total phosphorus (TP) showed positively skewed distribution. The influent BOD_5/COD was 0.4%–0.6%, only 39.2% SS/BOD_5 exceeded the standard by 36.3%, the average BOD5/TN was 3.82, and the probability of influent BOD_5/TP>20 was 82.8%. The average energy consumption of WWTPs in Taihu Basin in 2017 was 0.458 kWh/m^3. The specific energy consumption of WWTPs with a daily treatment capacity of more than 5×104 m^3 in Taihu Basin was stable at 0.33 kWh/m^3. A power function relationship was observed between the reduction in COD and NH_3-N and the specific energy

consumption of pollutant reduction, and the higher the pollutant reduction is, the lower the specific energy consumption of pollutant reduction presents. In addition, a linear relationship existed between the energy consumption of WWTPs and the specific energy consumption of influent volume and pollutant reduction. Therefore, upgrading and operation with less energy consumption of WWTPs is imperative and the suggestions for Taihu WWTPs based on stringent discharge standard are proposed in detail.

Keywords: Taihu Basin; Wastewater treatment plant; Influent characteristics; Energy consumption evaluation; Specific energy consumption; SPSS correlation analysis

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54．Advances in Fe(Ⅲ) bioreduction and its application prospect for groundwater remediation: a review

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Abstract: Microbial Fe(Ⅲ) reduction is a significant driving force for the 20 biogeochemical cycles of C, O, P, S, N, and dominates the natural bio-purification of contaminants in groundwater (e.g., petroleum hydrocarbons, chlorinated ethane, or arsenic). In this review, the mechanisms and environmental significance of Fe(Ⅲ) (hydro)oxides bioreduction are summarized. The application prospect of Fe(Ⅲ) 24 (hydro)oxides bioreduction was analyzed for groundwater remediation technologies. Compared with crystalline Fe(Ⅲ) (hydro)oxides, amorphous Fe(Ⅲ) (hydro)oxides are more bioavailable. Ligand and electron shuttle both play an important role in microbial Fe(Ⅲ) reduction. The limiting factors of Fe (Ⅲ) (hydro)oxides bioreduction should be further investigated to reveal the microcosmic mechanisms. It will improve the bioavailability of crystalline Fe(Ⅲ) (hydro)oxides and accelerate the anaerobic oxidation efficiency of the reduced pollutants. Furthermore, the approach to extract, culture, and incubate the favored

Fe(Ⅲ) reducing bacteria from the complicated environment, and apply it to the bioremediation of organic, ammonia, and heavy metals contaminated groundwater will become a research topic in the future. The study provides an important reference for the treatment of reduced pollutants in groundwater.

Keywords: microbial Fe(Ⅲ) reduction, mechanism, groundwater contamination, remediation

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55. The impact of ultrasonic treatment on activity of ammonia-oxidizing bacteria and nitrite-oxidizing bacteria in activated sludge

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Abstract: The ultrasonic treatment of sludge has recently been considered as an effective way to facilitate the partial nitritation of municipal sewage. This study aimed to reveal the difference in the effects of ultrasound on ammonia-oxidizing bacteria (AOB) and nitrite-oxidizing bacteria (NOB). In this work, the impact factors including ultrasonic irradiation time and intensity, sludge concentration, thermal and free radical released were studied. The optimized conditions were found to be 10 g MLSS/L, ultrasonic treatment energy density and interval time were 0.9kJ/mL and 12 hours respectively, to maximize the difference between the changes in AOB and NOB activities. With the improvement of high intensity, the floc structure of activated sludge was significantly destroyed, as well as the microbial death increased, and the cellular ATP level decreased. Further, the mechanism exploration indicated that the mechanical shearing was considered a key factor to achieve the nitritation as it could have an inhibitory effect on the nitrite oxidation. Free radicals generated by ultrasound were trace, while the thermal released promoted both AOB and NOB activity.

Keywords: Ultrasonic treatment, Optimal control, Nitrifying bacteria, Mechanism analysis

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56. Improved water quality evaluation method based on a novel fuzzy support vector: A case study of the Heihe River, China

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Abstract: Water quality evaluation is a centrally important basis for the protection and utilisation of water resources. Although a large number of studies have attempted to improve the performance of water quality evaluation model, the evaluation accuracy still need to be enhanced. This paper aims to develop a novel fuzzy support vector machine (FSVM) model for water quality evaluation, which could subdivide membership of all sample point, construct more precise classification hyperplane and improve classification performance. As a case study, the water quality of the Heihe and Haihe Rivers in China from 2011 to 2017 was evaluated. To derive the best-performing model, a host of evaluation models were also adopted and compared. According to mean absolute percentage error (MAPE) and root mean square error (RMSE), the FSVM model proposed was proved apparent advantages in estimation accuracy in full tolerance range. The new model is a reliable alternative for evaluating water quality and helps decision makers formulate effective policies and measures.

Keywords: support vector machine; fuzzy support vector machine; membership degree; distance membership degree; centripetal degree; water quality evaluation

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57. AgNPs@ZIF-8 hybrid material modified polyethersulfone microfiltration membranes for anti-biofouling property and permeability improvement

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Abstract: Membrane fouling is a major hindrance to the effective application of the polyethersulfone membranes. In this work, synthetic AgNPs@ZIF-8 hybrid crystals were modified to PES microfiltration membranes for mitigating membrane fouling and improving water permeability. Transmission electron microscope characterization results showed the successful synthesis of the AgNPs@ZIF-8 hybrid crystals. The successful modification of AgNPs@ZIF-8 hybrid crystals on membrane surface was confirmed by scanning electron microscopy and energy dispersive spectrometer. The results indicated that the surface modification of AgNPs@ZIF-8 hybrid crystals improved antifouling property of the membranes; the number of live bacteria in the bacteria suspension was over 90% less than that of control membranes. Furthermore, after surface modification, membrane permeability was improved, which was due to improvement of surface hydrophilization of the membranes which could explain the improvement of antifouling property partly. Results demonstrate that the use of AgNPs@ZIF-8 hybrid crystals is a feasible and

attractive approach for the development of anti-fouling membranes.

Keywords: AgNPs@ZIF-8 hybrid crystals, surface modification, microfiltration membrane, anti-biofouling, permeability

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58. Thermodynamic analysis of direct interspecies electron transfer in syntrophic methanogenesis based on the optimized energy distribution

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Abstract: Energy transfer is one of the communication modes between syntrophic partners in syntrophic methanogenesis. The transition of energy distribution in the methanogenesis process indicated the energy competition among the syntrophic microorganisms. Effects of redox materials and redox potential on direct interspecies electron transfer (DIET) were analyzed through thermodynamic analysis based on the energy distribution principle. Types of redox materials could affect the efficiency of DIET via changing the total energy supply of the syntrophic methanogenesis. Decreasing system redox potential could facilitate DIET through increasing the total available energy. The competition between hydrogenotrophic methanogens and DIET methanogens might be the reason for the low proportion of the DIET pathway in the syntrophic methanogenesis. A mechanism of facilitation of DIET was proposed based on the energy distribution. Providing sufficient electrons, inhibiting hydrogenotrophic methanogens and adding more competitive redox couples to avoid hydrogen generation might be beneficial for the

facilitation of DIET.

Keywords: Direct interspecies electron transfer; thermodynamic analysis; Redox materials; Energy distribution

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59. Demonstration on Comprehensive Treatment Technology of Water Environment in Tidal River of Tropical Islands

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Abstract: The effect of comprehensive treatment of water environment in tidal channel of Wenqing River was studied, and the related factors were analyzed. The results showed that Exogenous pollution was the main reason of pollution: COD, TN, and TP accounted for 19.1%, 31.7% and 37.3% of the total pollution sources, respectively. The COD emission reduction can reach 128.2, 62.3, 56.8 and 74.2 t/a, TN emission reduction is 8.4, 13.1, 3.7 and 18.2 t/a, and TP emission reduction is 0.9, 2.1, 0.3 and 2.2 t/a, respectively, through four kinds of measures, eg. banning breeding sites, sewage interception and centralized treatment, ecological restoration, and silts removal. By the combination of internal and external river management measures, the inferior V-type water quality of Wenqing River was basically eliminated, and the length of IV-type water reach was increased to more than 90% of the control reach. The Modified Estuary Model (MEM) can effectively predict the water quality changes along the Wenqing River, and can provide early warning for the emergency improvement of water quality.

Keywords: Tidal river; Comprehensive treatment technology; Endogenous pollution; Exogenous pollution

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60. Effect of Al^{3+} on the pollutants removal and extracellular polymeric substances (EPS) under anaerobic, anoxic and oxic conditions

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Abstract: Aluminum ions produced by mining aluminum, electrolytic industry and aluminum-based coagulants enter the wastewater treatment plant and interact with activated sludge. It can contribute to suspended solids removal and affect activated sludge flocculation as well as nitrogen and phosphorus removal. In this study, the effect of Al^{3+} on pollutant removal, sludge flocculation and the composition and structure of extracellular polymeric substances was investigated under anaerobic, anoxic and oxic conditions. The results showed that when the concentration of Al^{3+} was 10 mg/L, the highest removal efficiencies of COD and TN were detected, while the dehydrogenase activity and sludge flocculation were also the maximal. The highest removal efficiency of TP was achieved when the concentration of Al^{3+} was 30 mg/L. The flocculability of sludge in anoxic zone was always higher than that in anaerobic and oxic zone. The addition of Al^{3+} promoted the secretion of EPS. The fluorescence peaks detected in each layer of EPS were tryptophan-like fluorescence peaks in

the absence of Al^{3+}. The fluorescence peaks of fulvic acids and tryptophan began to appear with the most protein species and the highest microbial activity under Al^{3+} concentration of 10 mg/L. Low concentration of Al^{3+} (<10 mg/L) could promote the removal efficiencies of COD and TN, but excessive Al^{3+} (>10 mg/L) weakened microbial activity and caused toxicity to microorganisms. Too high concentration of Al^{3+} (>30 mg/L) could also inhibit the release of phosphorus in the anaerobic zone by reacting with $PO4^{3-}$.

Keywords: extracellular polymeric substances; activated sludge; aluminum ion; A^2O; wastewater

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61. Efficient removal of As(V) from acid mine drainage by Zn(II)-MOF: crystal synthesis and response surface methodology adsorption

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Abstract: In order to find a new adsorption material with efficient removal of As(V) in acid mine drainage, a novel metal-organic framework material $\{[HN(C_2H_5)_3][Zn_2(ptmda)(\mu_2\text{-}OH)](H_2O)_{0.5}\}_n$ (Zn(II)-MOF), H_2ptmda is 4,4'-((p- tolylazanediyl)bis(methylene))dibenzoic acid) was synthesized by solvothermal method. The single factor adsorption experiments of As(V) in simulated wastewater were carried out by Zn(II)-MOF. The experimental results show that Zn(II)-MOF has a higher stability and a higher As(V) removal rate (> 95%) at pH 2–11. The adsorption process fitted to the Langmuir model and Pseudo-second-order kinetic model. In order to optimize the adsorption conditions of As(V) from acid mine drainage, the Box-Behnken response surface method was used. Studies show that adsorption time and shaking speed are both significant factors. The optimum adsorption conditions of Zn(II)-MOF for As(V) was: 0.1 g/50 mL of adsorbent dose, 300 min adsorption time, adsorption temperature 298 K, and shaking speed 180 r/min. Under the optimal conditions, the average removal rate of As(V) by Zn(II)-MOF is 98.51%. Furthermore, the theoretical predicted value is 98.7288 %, and with the

measured values of the relative error is only 0.2179%. Therefore, the optimized adsorption conditions obtained by Box-Behnken response surface methodology are reliable, and Zinc (II)-MOF can be used as arsenic (V) adsorbent for treating acid mine wastewater.

Key words: Zn(II)-MOF, Crystal synthesis, As(V), Response surface methodology, Adsorption

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62. Biological Conversion Pathways of Sulfate Reduction Ammonium Oxidation in Anammox Consortia

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Abstract: Sulfate reduction ammonium oxidation (SRAO) has been reported in literatures based on laboratory experiments over two decades. It was considered as an autotrophic biological transformation process mediated by anammox bacteria, in which ammonium as electron donor is oxidized by sulfate as electron acceptor. A few observations on transformations of nitrogenous and sulfurous compounds in natural environment were also speculatively attributed to this process. However, there are still many doubts and controversies to be convinced and clarified about this process. In this study, continuous reactor experiments and batch tests were conducted under similar and also different conditions reported in literatures, to verify the occurrence of SRAO phenomena, and identify the possible pathways behind substrates conversions. Mass balance and stoichiometry were checked based on the experimental results, and thermodynamics proposed by previous studies were critically discussed. It was concluded that the simultaneous conversion of ammonium and sulfate

in anammox consortia tended to occur only with high amount of inoculant biomass under incompletely anaerobic condition. No evidence that anammox bacteria possess the ability to oxidize ammonium with sulfate as electron acceptor has emerged. The different conversion pathway of SRAO phenomena from previous studies was suggested to explain the observations obtained in the experiments and substrate transformations in relevant conditions.

Keywords: Anammox bacteria; autotrophic; biological conversion; sulfate reducing ammonium oxidation (SRAO)

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63. Concentration and Speciation of Heavy Metals from Road-Deposited Sediments in Urban and Rural Areas of Beijing, China

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Abstract: Road-deposited sediments were analyzed for As, Cd, Cr, Cu, Mn, Pb and Zn, in terms of total concentrations, speciation, release and risks at twenty-three sites across six land types (the rural-urban fringe, commercial, residential, industrial, traffic and the natural areas) in Daxing district of Beijing, China in April 2018. Risk factors evaluating different aspects included contamination levels and ecological risk, I_{geo}, and RI; source of metal (natural or anthropogenic), EF; bioavailability, RAC. Six particle sizes vs. metal concentrations were also analyzed for heavy metals from rural-urban fringe samples. We have found albeit variations, the contamination for As, Cr and Cd in the rural-urban fringe area, especially for Cr. Industrial sites exhibited highest average values for all heavy metals except As, and Cu, Cr, Cd and Pb in particular posed more risk. Traffic area showed signs of contamination for Cu, Pb and Zn. Commercial and residential areas presented low ecological risk. However, there were signs of As and Cu contaminations in both areas, and of Pb in the residential area

as well. Generally, the smaller particle sizes (< 80, 80– 150 and 150–300 μm) possessed higher concentrations of heavy metals compared to larger sizes (300–500 and 500–1000μm).

Keywords: road-deposited sediments, heavy metals, speciation, particle characteristics

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64. Identify human-induced influence on microbial community: a comparative study in the effluent-receiving areas in Hangzhou Bay

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Abstract: Microbial community structures are affected by both natural processes and human activities. In coastal area, a typical and conventional human activity is discharging effluent from wastewater treatment plant (WWTP) to sea, thus chronically the water qualities turn worse and marine ecology become unhealthy. Microorganisms are the important part in an ecosystem, and they play key roles in pollutants degradation and ecological restoration. However, by now there are few researches about how the WWTP effluent disposal influences the coastal microbial communities. In this study, sediment samples were collected from two WWTP effluent-receiving areas (abbreviated as JX and SY) in Hangzhou Bay. Firstly, based on the high-throughput sequences of 16S rRNA gene, the microbial community structures were analyzed. Secondly, by using PCoA, significant differences were determined between JX and SY in microbial community structures; and by RDA, COD, water temperature, s.AP, s.NH_4^+-N were identified as the key environmental factors for the community differences. By LDA effect size analysis, the most distinctive microbes

were found and their correlations with environmental factors were investigated. And finally, detrended beta nearest taxon index communities followed ‘niche theory’. An interesting and important finding was that in SY where received more and toxic COD, many distinctive microbes were related to the groups that are capable of degrading toxic organic pollutants. This research contributes to further understanding the land and sea microorganisms under long-term human pressure, and guides optimization to the local wastewater emission standard.

Keywords: Microbial community structure; Effluent-receiving area; High-throughput sequencing; Costal sediments; Wastewater treatment plant (WWTP)

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65. A novel sequence batch membrane carbonation photobioreactor developed for microalgae cultivation

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Abstract: In this study, a novel sequence batch membrane carbonation photobiorector was developed for microalgae cultivation. Herein, membrane module was endowed functions as microalgae retention and CO_2 carbonation. The results in the batch experiments expressed that the relatively optimal pore size of membranes was 30 nm, photosynthetically active radiation was 36 W/m^2 and the CO_2 concentration was 10% (v/v). In long term cultivation, the microalgal concentration separately accumulated up to 1179.0 mg/L and 1296.4 mg/L in two periods. The concentrations of chlorophyll *a*, chlorophyll *b* and carotenoids were increased about 23.2, 14.9 and 6.3 mg/L respectively in period I; meanwhile, the accumulation was about 25.0, 14.5, 6.6 mg/L respectively in the period II. Furthermore, the pH was kept about 5.5-7.5 due to intermittent carbonation mode, which was suitable for the growth of microalgae. Transmembrane pressure (TMP) was only increased by 0.19 and 0.16 bar in the end of period I and II, respectively. The pure flux recovered to 75-80% of the original value by only hydraulic cleaning. Scanning electron microscope images also

illustrated that carbonation through membrane module could mitigate fouling levels greatly.

Keywords: membrane carbonation, SBM-C-PBR, cultivate microalgae, membrane fouling.

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66. Numerical modeling of physical clogging induced by flocs suspended particles during managed aquifer recharge with reclaimed water

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Abstract: The clogging problem is always the greatest challenge during managed aquifer recharge, especially for physical clogging. How to effectively predict the occurrence and development of physical clogging has received increasing attention. In the study, the chlorinated secondary wastewater was recharged into a laboratory column filling with quartz sands. The results showed that the continuous injection of reclaimed water would cause the serious reduction of hydraulic conductivity in the porous media, with declining by 85.86 ± 1.22 % during 50 h injection. It was thought to be due to physical clogging by the deposition of suspended particles with flocculent-reticular structure, significantly increasing the surface area and the effective volume of particles deposits. A numerical model is based on the mass balance equations for liquid and suspended particles, coupling the particle transport-deposition model and the expressions correlating porosity, hydraulic conductivity, and the concentration of deposited particles, to realize a quantitative description of the occurrence and development of physical clogging. The parameters of the bulk factor, the attachment and detachment coefficient were calibrated

simultaneously. Then sensitivity analysis was conducted to quantitatively understanding the importance of the three parameters on physical clogging. COMSOL Multiphysics was employed and exhibited a significant correlation between the simulated data and the experimental data ($R2 > 41$ 0.90, $p < 0.01$). The prediction model was used to assess the risk of physical clogging during artificial recharge with reclaimed water in a field site.

Keywords: Physical clogging, Secondary wastewater, Hydraulic conductivity, Numerical model, Sensitivity analysis

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67. Inhibition of bromate formation by reduced graphene oxide supported cerium dioxide during ozonation of bromide-containing water Bromate inhibition by reduced graphene oxide supported cerium dioxide

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Abstract: Ozone (O_3) is widely used in drinking water disinfection and wastewater treatment. However, when applied to bromide-containing water, ozone induces the formation of bromate, which is carcinogenic. Our previous study found that graphene oxide (GO) can enhance the degradation efficiency of micropollutants during ozonation. However, in this study, GO was found to promote bromate formation during ozonation of bromide-containing waters, with bromate yields from the O_3/GO process more than twice those obtained using ozone alone. The promoted bromate formation was attributed to increased hydroxyl radical production, as confirmed by the significant reduction (almost 75%) in bromate yield after 30 adding t-butanol (TBA). Cerium oxide (less than 5 mg/L) supported on reduced GO ($xCeO_2$/RGO) significantly inhibited bromate formation

during ozonation compared with GO alone, and the optimal Ce atomic percentage (x) was determined to be 0.36%, achieving an inhibition rate of approximately 73%. Fourier transform infrared (FT-IR) spectra indicated the transformation of GO into RGO after hydrothermal treatment, and transmission electron microscope (TEM) results showed that CeO_2 nanoparticles were well dispersed on the RGO surface. The X-ray photoelectron spectroscopy (XPS) spectra results demonstrated that the Ce^{3+}/Ce^{4+} ratio in $xCeO_2$/RGO was almost 3-4 times higher than that in pure CeO_2, which might be attributed to the charge transfer effect from GO to CeO_2. Furthermore, Ce^{3+} on the $xCeO_2$/RGO surface could quench Br and BrO to further inhibit bromate formation. Meanwhile, $0.36CeO_2$/RGO could also enhance the degradation efficiency of N, N-diethyl-m-toluamide (DEET) in synthetic and reclaimed water during ozonation.

Keywords: Bromate, Catalytic ozonation, Graphene oxide, Cerium dioxide

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68. Formation and succession of microbial community structure in different ecological niches under reclaimed water acclimation

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Abstract: Using reclaimed water as resource for landscape water replenishment may alleviate the major problems of water resource shortage and water environment pollution. However, the safety of water and the risk of eutrophication remained doubted by the public. Our study aimed to reveal the difference between natural water and reclaimed water and discuss the rationality of reclaimed water replenishment from the perspective of microorganism. We analyzed the microbial community structure in natural water, reclaimed water and natural biofilm and the community succession was clarified along the ecological niches, water resources, liquidity and time using 16S rRNA gene amplicon sequencing. Primary biofilm without original community was added to study the formation of microbial community structure under reclaimed water acclimation. The results showed us that the difference caused by ecological niches was more than liquidity of water and different water resources. No significant difference was found of microbial diversity and community structure caused by the addition of reclaimed water. Based on the microbial conclusion in our study, reclaimed water replenishment was a feasible solution that can be used for the river water supply. Innovatively, we

introduced the study of biofilms and finally supposed that the monitoring of biofilms or sediments closely related to water was also significant for the early warning of water bloom, providing a unique perspective for management of eutrophication.

Keywords: reclaimed water, biofilm, replenishment, eutrophication, microbial community, 16S rRNA gene sequencing

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69. Variation of ammonia oxidation and the microbiome of partial nitrification systems responded to CuO nanoparticles under different pH levels

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Abstract: In this study, the effect of CuO nanoparticles (NPs) on partial nitrification (PN) process was investigated at various pH values. The short- and long-term experiments were carried out in six identical reactors, with and without CuO NPs, at pH values of 6.5, 8.0 and 10.0. The ammonia oxidation performance, reaction rates, copper content, and the microbial community were investigated. The results of this work suggested that CuO NPs inhibited the ammonia oxidation by aerobic ammonia-oxidizing bacteria (AOB), under both the acid and alkali conditions. AOB could resist the acid condition but was significantly suppressed when CuO NPs was fed, and the low pH did not aggravate the inhibition level. Almost all the bacteria lost bioactivity under the pH as 10.0, while anaerobic ammonia-oxidizing bacteria survived. The acid condition increased the Nitrosomonas relative abundance while the alkali condition lowered it. More than 60% of the supplied CuO NPs was discharged via effluent.

Keywords: CuO NPs; Partial nitrification; pH; AOB; Nitrogen removal

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70. **Fast removal of hexavalent chromium in water by the synergistic reaction of micron-scale Fe-Cu bimetallic particles under aerobic condition**

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Abstract： The iron-copper (Fe-Cu) bimetallic particles is synthesized base on the displacement reaction for removal to Cr(VI) in aqueous solution. in Fe-Cu bimetallic particles were characterized by scanning electron microscopy (SEM) and energy dispersive fluorescence spectroscopy (EDX). SEM and EDX images showed that the core of the bimetallic particles was Fe, and the planting Cu was deposited on the surface of Fe core. The influencing factors of Cr(VI) removal using the Fe-Cu bimetallic particles, including Cu mass loading (0-0.3 g/g), Fe-Cu dosage (20.0-80.0 g/L), initial Cr(VI) concentration (25.0-100.0 mg/L), initial pH (3.6-8.6) and stirring speed (100-600 rpm) were studied through a series single-factor experiments. Furthermore, the optimized experimental conditions (i.e., Cu mass loading of 0.3 g/g, and prepared temperature of 45℃.) were obtained through the response surface methodology (RSM). The results showed that Fe-Cu bimetallic particles could almost completely remove Cr(VI) solution within 20min in acidic and neutral conditions. The

reduction mechanism was discussed in this study based on a series experiments including EDX analysis of Fe-Cu bimetallic particles and component analysis of reaction aqueous solution and relevant references. In short, Fe-Cu bimetallic particles is synthesized successfully and have a good effect to rapidly remove for Cr(VI) from aqueous solution. This study provides a new idea for the treatment of Cr(VI) contaminate wastewater simply and feasibly.

Keywords: Cr(VI); Fe0; Removal; Fe-Cu bimetallic particles

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71. **Water-Level based Discrete Dynamic Control for Sewer-WWTP Integrated Operation**

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Abstract: This study aims to propose a sewer-WWTP (wastewater treatment plants) integrated real-time control method based on discrete dynamic water level, that could be realized only based on the PLC system without complex mathematical model. A discrete control model was developed to conduct the real-time control based on data-automation. The local water level was used as predictive power of an influent dynamic profile that uses inputs derived from the real-time sewer network flow. The control method has been successfully applied in practical integrated operation of sewer-WWTP following the sensitive flow disturbances of sewer system. The operational results shown that not only this method can provide a smoother pumping flow for treatment plant, but it also can reduce frequence and volume of combined sewer overflow (CSO) during the periods of heavy rainfall events with increasing transportation capacity of both the pumping station and WWTP influent system. Energy consumption analysis of the control strategy under different level set-points provided an evidence for energy cost optimization under situation of automatic constant water level control in pumping station.

Keywords: sewer system, integrated control, discrete control, water level

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72. Identifying important precursors and driving byproducts of cytotoxicity and genotoxicity during chlorination with a theoretical toxicity evaluation

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Abstract: Chlorination is the most widely used disinfection process for water treatment, but always accompanied by the formation of hazardous disinfection byproducts (DBPs). Various organic matters, like natural organic matter (NOM) and amino acids, could serve as the precursors of DBPs during chlorination, yet which kind of organic matter is of higher potential risk remains unclear. Besides, regulated DBPs such as trihalomethanes have received much concern, but the driving DBP for toxicity needs further investigation. This study aimed to identify the important precursors of chlorination by measuring DBP formation from NOM and amino acids, and to determine the main driving DBP for toxicity based on the contribution to cytotoxicity index (CTI) and genotoxicity index (GTI) with a theoretical toxicity evaluation. Results showed that NOM mainly formed C-DBPs, such as trichloromethane, while amino acids mainly formed N-DBPs, such as dichloroacetonitrile (DCAN).

DCAN might be a driving DBP because it contributed most to the toxicity index. Among all precursors, the concentration of DCAN (200 μg/L) and the value of CTI and GTI formed by aspartic acid and asparagine were the highest, indicating aspartic acid and asparagine were important precursors for toxicity formation, which should be removed as much as possible before chlorination to reduce the formation of DBPs. During the chlorination of NOM, tryptophan and asparagine solutions under different chlorine dose and reaction time, changes of CTI and GTI were consistent with changes of DCAN concentration, suggesting particular attention should be paid to the driving DBPs such as DCAN in future study.

Keywords: Chlorination; Dichloroacetonitrile; Aspartic acid; Asparagine; Toxicity

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73. **Anaerobic biodegradation of trimethoprim with sulfate as an electron acceptor**

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Abstract: Trimethoprim (TMP) is an antibiotic frequently detected in various environments. Microorganisms are the main drivers of emerging antibiotic contaminants degradation in the environment. However, the feasibility and stability of anaerobic biodegradation of TMP with sulfate as an electron acceptor remain poorly understood. Here, a TMP degrading microbial consortium was successfully enriched with municipal activated sludge as the initial inoculum. The acclimated consortium is capable of transforming TMP through demethylation, and then the hydroxyl-substituted demethylated product (4-desmethyl-TMP) was further degraded. Biodegradation of TMP followed a 3 parameter sigmoid kinetics model. The potential degraders (Acetobacterium, Desulfovibrio, Desulfobulbus, and unidentified Peptococcaceae) and fermenters (Lentimicrobium and Petrimonas) were significantly enriched in the acclimated consortium. The activated sludge and river sediment acclimated TMP-degrading consortium shared similar core microbiome. The

anaerobic biodegradation of TMP could be coupled with various electron acceptors such as sulfate, which provides new insights into the antibiotic fate in the environment and offers a new idea for the bioremediation of antibiotic-contaminated environments.

Keywords: trimethoprim (TMP) biodegradation; demethylation; sulfate reduction; core microbiome; antibiotic fate

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74. **Numerical simulation on the effects of applied voltage on mass transfer through cation exchange membrane for hypersaline wastewater treatment**

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Abstract: The pickled mustard tuber is an important condiment of Chinese food. The process of pickled mustard tuber production generates a large amount of hypersaline wastewater that can be treated through electrolysis separation. In the electrodialysis cell, the applied voltage directly determined the electric force. To fundamentally understand the mechanism of ion transport driving by the applied voltage, the theories of Nernst-plank-Poisson and Donnan equilibrium were used in numerical simulation. The main result was that increasing the applied voltage accelerated the mass transfer, increased the concentration at the interface between the membrane and the electrolyte for low applied voltage. The thorough performances of electrodialysis cell was studied by experimental trial. The results indicated that increasing the applied voltage improved the performances of the electrodialysis cell by enlarging the electric current and accelerating the mass transfer under the low applied voltage. However, the removal of salinity was achieved at costs of intensive energy consumption, sever water splitting and membrane breaking at high applied voltage. Thereupon, 4.0 V was the optimal voltage of electrodialysis cell

in this study, which can be used as a reference for the design of the scale of electrodialysis cell enlarging.

Keywords: Hypersaline wastewater, Ion exchange membrane, Applied voltage, Mass transfer, Potential drops, Numerical simulation

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75. **Recovery of Ni(II) from real electroplating wastewater using fixedbed resin adsorption and subsequent electrodeposition**

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Abstract: Effective recovery of high-value heavy metal from electroplating wastewater is of great significance, but recovering nickel ions from real electroplating wastewater as nickel sheet has not been reported. In this study, the pilot-scale fixed-bed resin adsorption was conducted to recover Ni(II) ions from real nickel plating wastewater, and then the concentrated Ni(II) ions in the regenerated solution were reduced to nickel sheet via electrodeposition. A commercial cation-exchange resin was selected and the optimal resin adsorption and regeneration conditions were investigated. The resin had the adsorption capacity of 63 mg/g for Ni(II) ions, and the average amount of treated water was 84.6 bed volumes (BV) in the pilot-scale experiments. After the adsorption by two ion-exchange resin columns in series and one chelating resin column, the concentrations of Ni(II) in the treated wastewater were below 0.1 mg/L. After the regeneration of the spent resin using 3 BV of 4% (w/w) HCl solution, 1.5 BV of concentrated neutral nickel solution (> 30g/L) was obtained and used in the following electrodeposition process. Using the

aeration method, alkali and water required in resin activation process were greatly reduced to 2 BV and 3 BV, respectively. Under the optimal electrodeposition conditions, 95.6% of Ni(II) in desorption eluent could be recovered as the elemental nickel on the cathode. The total treatment cost for the resin adsorption and regeneration as well as the electrodeposition was calculated.

Keywords: Nickel removal; ion exchange; electroplating wastewater; regeneration; Electrodeposition

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76. **Performance and mechanisms of β-FeOOH catalyzed peroxymonosulfate for organic pollutant degradation in water**

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Abstract: Iron-based catalysts as peroxymonosulfate activator are commonly used to oxidize and degrade azo dye. However, there are still some issues such as relatively low SO_4^- species, rendering low catalytic capabilities and high metal iron dissolution causing secondary pollution. In this study, environment friendly four crystallographic iron oxyhydroxides (FeOOHs) were successfully synthesized and applied to activate peroxymonosulfate (PMS) for Orange 7 (AO7) degradation. Compared with α-FeOOH, γ-FeOOH and δ-FeOOH, β-FeOOH exhibited the best catalytic performance as PMS activator towards to AO7 degradation. Compared with Fe0, Fe_2O_3, Fe_3O_4 catalyzed PS and PMS, β-FeOOH/PMS showed the best degradation effect on AO7, in which AO7 at initial concentration of 20 mg/L could be degraded after 180min reaction with 1.0 g/L β-FeOOH and 5.7 mM PMS. More importantly, radical quenching tests and Electron-spin resonance (ESR) analysis revealed that OH•, SO_4•−, O_2•− and $^1O_2$ were involved in the reaction process. The catalytic

mechanism proposed that β-FeOOH had an effective electron transfer rate performance, Fe^{3+} undertakes a reduction to Fe^{2+} during the β-FeOOH/PMS catalytic process. Then, the regeneration of Fe^{2+} on the hydroxylated surface of FeOOH promotes the formation of $FeOH^{+}$, which is crucial for PMS activation and reactive oxygen species (ROS) generation. The recyclability tests proved good stability and reusability of β-FeOOH. This study provides a kind of new understanding of peroxymonosulfate activation for environmental remediation and advances the iron-based oxyhydroxide in heterogeneous catalysis.

Keywords: β-FeOOH, Peroxymonosulfate, Singlet oxygen, Sulfate radical, Azo dye

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77. **Evaluating Urban Black and Odorous Water Body with Optical Absorption Coefficient: A Case Study of Huangpu River System (Shanghai, China)**

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Abstract: The pollution of urban rivers is a huge challenge for developing countries to achieve sustainable development. The Chinese government has begun to pay attention to the rehabilitation of heavily polluted urban rivers (i.e. black and odorous water bodies). Although a large number of studies focused on water environment remediation technology, there were few studies on the evaluation methods of black and odorous water body. In this paper, the differences between black and odorous and non-black and odorous water body was indicated by four evaluation indexes (dissolved oxygen, redox potential, ammonia nitrogen and transparency) (PC1+PC2=71.9%). The difference degree explained by the combination of total phosphorus, suspended particle, aluminum, iron, manganese, barium, nitrate, transparency, and inorganic substance in suspended particle (PC1+PC2=84.4%) is better than the four evaluation indexes. The optical absorption coefficient is correlated with water quality parameters affecting black and odorous water body. In addition, the difference of black and odorous and non-black and odorous water body was fully indicated by the particle absorption coefficient (PC1+PC2=100%). The absorption

coefficient of non-algae particle can be used as the evaluation index of black and odorous water body. The water body becomes black and odorous, when absorption coefficient of non-algae particle at 450 nm is greater than 2.5 m^{-1}.

Keywords: optical absorption coefficient, water quality parameters, black and odorous water body, non- black and odorous water body

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78. Trophic mode and organics metabolic characteristic of fungal community in swine manure composting

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Abstract: The succession of fungal trophic mode and metabolic characteristics were evaluated in swine manure composting by FUNGuild and Biolog methods. The result showed that the fungal community diversity reached to the highest level (76 OTUs) in the thermophilic phase of composting, then sustained decline to 15 OTUs after incubation. There were 10 fungal function groups in raw swine manure. Pathotroph-saprotroph fungi reached to 15.91% on Day_10 but disappeared on Day_60. Dung saprotroph-undefined saprotroph fungi grown from 0.19% to 52.39% during the treatment. The fungal community had more functional groups in the thermophilic phase, but the fungal communities in raw swine manure and manure compost had the highest degradation rate of amino acids and polymers, respectively. Redundancy analysis showed that oxidation reduction potential (49.6%), VS/Ash (45.3%) and moisture (39.2%) were the main influence factors on fungal succession in the swine manure composting.

Keywords: Fungus; FUNGuild; Biolog; Trophic mode; Composting; Oxidation reduction potential

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79. **Removal of Phosphate at Low Concentration from Water by Porous PVA/Al_2O_3 Composites**

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Abstract: The porous polyvinyl alcohol (PVA) /Al_2O_3 composite by supporting activated alumina on the cross-linked network of PVA was successfully prepared and its property for the removal of phosphate in aqueous solution was also evaluated. The structure of the PVA/Al_2O_3 was examined by scanning electron microscopy. It showed that the activated alumina particles with average size of 1 μm were evenly dispersed and fixed in the cross-linked network structure of PVA in SEM image. The effects of adsorption time, solution temperature, pH, initial concentration of phosphate, Al_2O_3 loading rate, PVA/Al_2O_3 composite dosage and coexisting ions on the phosphate removal by the porous PVA/Al_2O_3 composite were further studied. The results showed that the highest removal phosphate efficiency of 95% can be obtained with the Al_2O_3 loading rate of PVA/Al_2O_3 being 60 wt.% at pH of 4. The adsorption process of phosphate can be fit well with a pseudo-second-order model. The PVA/Al_2O_3 composite exhibited a high selective adsorption of phosphate in the presence of commonly coexisting anions in water.

Meanwhile, the PVA/Al_2O_3 composite material can be easily separated and recovered due to the granulation of adsorbent. PVA/Al_2O_3 composite also shows the excellent properties of regeneration and recycling use. It is proposed that the PVA/Al_2O_3 composite is a promising recyclable adsorbent for removing phosphate at low concentration from aqueous solution.

Keywords: polyvinyl alcohol, activated alumina, adsorption, phosphate

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80. **Diversity of culturable aerobic denitrifying bacteria in a rotating biological contactor combined with anaerobic-anoxic-oxic-oxic wastewater treatment system**

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Abstract: Recent studies have confirmed the existence of aerobic denitrifying bacteria, particularly exploring their diversity and heterotrophic nitrification-aerobic denitrification capability in a wastewater treatment plant (WWTP). In this study, the sewage treatment technology, which combined a rotating biological contactor (RBC) with an anaerobic-anoxic-oxic-oxic (A^2/O^2) process, demonstrated strong removal efficiency for nitrate pollutants. Five types of activated sludge in a WWTP were used to isolate 226 strains of aerobic denitrifying bacteria, which were classified into 12 genera based on the 16S rDNA. Pseudomonas stutzeri, Pseudomonas monteilii, and Gordonia cholesteroliborans were the most abundant aerobic denitrifying bacteria in the five types of activated sludge. Pseudomonas stutzeri, Pseudomonas pseudoalcaligenes, Pseudomonas chengduensis, Beijerinckia fluminensis, and Arthrobacter protophormiae demonstrated strong heterotrophic nitrification-aerobic denitrification capacity. Gordonia cholesteroliborans, Pseudomonas pseudoalcaligenes,

Pseudomonas chengduensis, and Beijerinckia fluminensis also showed aerobic denitrifying capacity, which was not reported previously. The Venn diagram and the relative abundance diagram revealed the different structures of aerobic denitrifiers among the five types of activated sludge. This study may provide a reference for screening and application of aerobic denitrifying bacteria in WWTPs.

Keywords: wastewater treatment system, nitrogen removal, heterotrophic nitrification, aerobic denitrification, aerobic denitrifying bacteria

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