

生物生态协同的水质改善和稳态水生生态系统构建关键技术及应用

成果简介:

面向国家新时代经济社会高质量发展和水生态健康的重要战略需求，团队围绕污水处理厂工艺优化、尾水深度净化、受纳水体生态修复等方面开展了系统研究和技术攻关，从源-排-汇全链条改善水生态环境质量。研发了生态型生物强化的污水高效脱氮除磷、深度净化和再生回用的新型人工湿地及其组合工艺、生物质控藻和逆境生境清水草型稳态构建等系列技术，并获得广泛应用。氮和磷削减率分别在85%和80%以上，受纳水体沉水植物大面积恢复并稳定自然更替，生物多样性指数提高60%以上。获授权专利105项，牵头制订《城市污水再生利用城市杂用水水质》等国家及行业标准5项，出版专著3项，发表Water Research等环境领域文章300余篇。荣获省部级科技奖励、行业/协会奖励23项。

Introduction:

In order to achieve the critical strategic needs of national high-quality economic and social development in the new era and water ecological health for the country, the team led by Prof. Wu Zhenbin conducted systematic research and had technical breakthrough around the process optimization of sewage treatment plant, deep purification of tail water and ecological restoration of receiving water body, so as to improve the quality of water ecological environment from the whole chain of source, discharge and sink.

The team developed a series of technologies, including the high efficient removal of nitrogen and phosphorus from wastewater using ecological and biological enhancement, a new type constructed wetland and its combination process for deep purification, biomass-based algae controlling and macrophytes-dominated clear water state constructing in adverse habitats. With these technologies, the nitrogen and phosphorus are reduced by more than 85% and 80% respectively. Besides, the team successfully restored the submerged macrophytes in the receiving body in a large area and achieved these species stable growth and succession naturally with the season, and thus the biodiversity index increased by more than 60%.

In total, the team holds 105 authorized patents, formulated five national and industrial standards, published three monographs and more than 300 articles in environmental fields, and won 23 provincial and ministerial S&T awards and industry / association awards.



东莞燕岭湿地生态园人工湿地工程

Constructed wetland project of Dongguan Yanling wetland ecological park



杭州西湖生态修复区，10年沉水植物群落自然更替
Natural replacement of submerged plant community in 10 years at Hangzhou West Lake ecological restoration area



2021年4月，俞正声等领导视察武汉东湖生态修复工程

Yu Zhengsheng and other leaders inspected the Wuhan East Lake water ecological restoration project in April 2021



CCTV 新闻“还看今朝—喜迎十九大特别节目”报道海口美舍河生态治理工程

CCTV's special program on the 19th National Congress of the CPC reported Haikou Meishe river ecological treatment project

Technology and application of water quality improvement and steady state aquatic ecosystem construction based on synergism between biotechnology and ecotechnology

推荐单位 / Recommended Unit

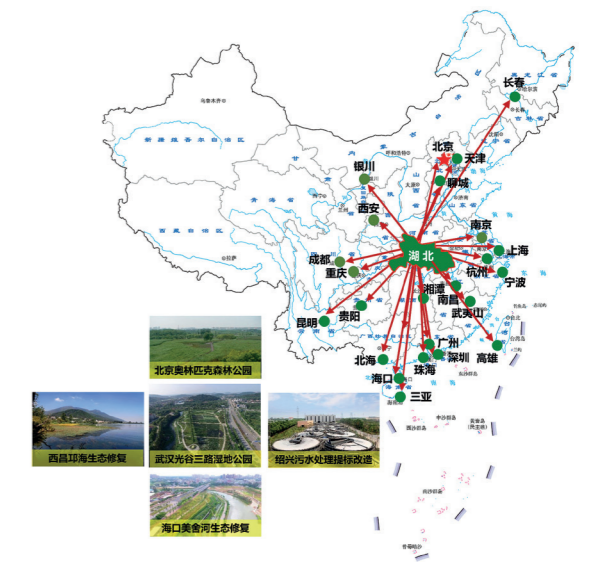
中国科学院水生生物研究所
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完成单位 / Accomplished Unit

中国科学院水生生物研究所
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合作单位 / The Main Cooperation Units

中国市政工程中南设计研究总院有限公司
Central & Southern China Municipal Engineering Design and Research Institute Co., Ltd.
武汉理工大学
Wuhan University of Technology
深圳市碧园环保技术有限公司
Shenzhen Biyuan Environmental Protection Technic Co., Ltd.



技术成果应用推广到全国 25 个省市自治区

The achievement has been promoted to 25 provinces, cities and autonomous regions in China

社会效益和经济效益:

团队在25个省市自治区规划、设计、建设工程408项，累计处理规模达1368.86万吨/日，削减COD74.95万吨/年、TN14.98万吨/年、TP0.75万吨/年，生态修复河湖水体面积224.06平方公里，引领我国水环境治理和水生态修复技术的研究及广泛应用。其中东莞生态产业园燕岭人工湿地工程是目前国内处理规模最大的垂直流人工湿地，实现了每天10万吨尾水深度净化，出水达到地表水IV类。杭州西湖突破了低透明度、“香灰土”底质等技术瓶颈，修复区水体透明度提高50厘米以上；四季呈现丰富多样的“水下森林”景观，沉水植物连续10年实现群落自然更替，成为国家水专项湖泊类标志性成果。中央电视台、人民日报等多家媒体机构聚焦报导了团队的相关工作并给予了高度评价。

Social and Economic Benefits:

The team is now leading the research and application of aquatic environmental management and aquatic ecological restoration in China. So far, they have planned, designed and constructed 408 projects in 25 provinces, cities and autonomous regions, resulting in a cumulative treatment scale of 13.6886 million tons per day, COD reduction of 749,500 tons per year, TN and TP removal of 149,800 and 7,500 tons per year, and an ecological restoration area of 224.06 square kilometers.

The Yanling constructed wetland project in the Dongguan wetland ecological park, as a highlight of the achievement, is the largest vertical flow constructed wetland in China. It has achieved deep purification of 100,000 tons of tail water per day, and the treated effluent reached Grade IV based on China's Environmental Quality Standards for surface water.

Additionally, the restoration project in the Hangzhou West Lake has successfully overcome the technical bottlenecks - low transparency and “fragrant ash soil” bottom material, in water recovery restoration projects. The water transparency in the restoration area increased by more than 50 cm. The West Lake is an “underwater forest” landscape that provides a rich and diverse landscape for four seasons, and the submerged macrophytes communities have succeeded naturally for 10 consecutive years.

This achievement has become an exemplar of the National Major Science and Technology Program for Water Pollution Control and Treatment in lake category. In state-run media, such as CCTV, People's Daily, descriptions of the work are detailed and highly praised.

团队成员 / Team Members:



吴振斌
Wu Zhenbin

中国科学院水生生物研究所
主要贡献：团队负责人，主持研发关键核心技术，组织成果应用和工程实施。

Institute of Hydrobiology, Chinese Academy of Sciences
Main contributions: Team leader, in charge of the R&D of key and core technologies, project implementation, and achievement promotion and application.



肖恩荣
Xiao Enrong

中国科学院水生生物研究所
主要贡献：新型人工湿地组合工艺研发及应用。

Institute of Hydrobiology, Chinese Academy of Sciences
Main contributions: Research and application of combined process of new-type constructed wetlands.



刘碧云
Liu Biyun

中国科学院水生生物研究所
主要贡献：生物活性物质长效防控水华藻类技术研发。

Institute of Hydrobiology, Chinese Academy of Sciences
Main contributions: R&D of bioactive substances for long-term control of algae bloom.



周巧红
Zhou Qiaohong

中国科学院水生生物研究所
主要贡献：新型人工湿地净化机理及其应用。

Institute of Hydrobiology, Chinese Academy of Sciences
Main contributions: The new-type constructed wetland purification mechanism and its application.



李树苑
Li Shuyuan

中国市政工程中南设计研究总院有限公司
主要贡献：高效低碳同步脱氮除磷技术研究与应用。

Central & Southern China Municipal Engineering Design and Research Institute Co., Ltd.
Main contributions: Research and application of high-efficiency low-carbon simultaneous nitrogen and phosphorus removal technology.



夏世斌
Xia Shibin

武汉理工大学
主要贡献：新型生物基载体材料研发及应用。

Wuhan University of Technology
Main contributions: Research and application of biomass-based novel fibers.



张义
Zhang Yi

中国科学院水生生物研究所
主要贡献：底质生境修复技术研发。

Institute of Hydrobiology Chinese Academy of Sciences
Main contributions: R&D of sediment restoration technology.



武俊梅
Wu Junmei

中国科学院水生生物研究所
主要贡献：新型人工湿地关键技术研发及应用。

Institute of Hydrobiology, Chinese Academy of Sciences
Main contributions: Development and application of key technologies for new type of constructed wetlands.



林静
Lin Jing

深圳市碧园环保技术有限公司
主要贡献：人工湿地生态治理技术的工程化及产业推广。

Shenzhen Biyuan Environmental Protection Technic Co., Ltd.
Main contributions: The engineering development and industrialization promotion of constructed wetland ecological treatment technology.



张丽萍
Zhang Liping

中国科学院水生生物研究所
主要贡献：生物活性物质分离鉴定技术研发。

Institute of Hydrobiology, Chinese Academy of Sciences
Main contributions: R&D of isolation and identification technology of bioactive substances.