2014 China-US Joint Annual Symposium

Water, Energy, and Ecosystem Sustainable Development

Conference Program

October 26-28, 2014, Hefei, China

China-US 2014 Joint Symposium

"Water, Energy and Ecosystem Sustainable Development"

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INTRODUCTION

Population growth, urbanization, and changes in consumption patterns, together with dwindling water resources, bring great challenges for sustainable development. The economies of the US and China are the globally dominant drivers of resource utilization, energy consumption, and environmental pollution. Sustainable development is dependent on these two nations exchanging perspectives to develop a joint agenda for international solutions to future needs. Therefore, they have formed a close cooperative partnership to exchange perspectives at all levels and work together to improve water resources, ecosystem management, and sustainable bioenergy production.

The China-US Joint Research Center for Ecosystem and Environmental Change (JRCEEC) (http://jrceec.utk.edu/) was established in 2006 to enhance collaboration among Chinese and US scientists to address the combined effects of climate change and human activities on regional and global ecosystems and to explore technologies for the restoration of degraded environments. Now, the Center's partners include the University of Tennessee (UT), Oak Ridge National Laboratory (ORNL), Purdue University, three institutes within the Chinese Academy of Sciences (CAS) (Research Center for Eco-Environmental Sciences, Geographic Sciences and Natural Resources Research, and Institute of Applied Ecology), and the University of Science and Technology of China. In May 2011, a JRCEEC-based new partnership, the US-China Ecopartnership for Environmental Sustainability (USCEES), was approved by the US Department of State and the Chinese National Development and Reform Commission (NDRC) within the framework of the US-China Strategic and Economic Dialogue. The new EcoPartnership program formally interacts with the 13 existing and five new EcoPartnerships sanctioned. Both JRCEEC and USCEES aim to promote bilateral collaboration to address the interconnected challenges of environmental sustainability, urbanization, rural prosperity, climate change, and food and energy security by leveraging and enhancing the capacity of member universities, research institutes, and industry through the promotion of research collaboration, academic exchange, student education, technology development, and policy enhancement. The partnership also accelerates information and technology exchange to generate more effective policy, technology and research solutions for sustainable development.

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The secretarial staffs will stay at Anhui Jinling Grand Hotel for your convenience.
Room number: 1012, Internal phone number: 81012

VENUE

The China-US 2014 Joint Symposium will be held at the Anhui Jinling Grand Hotal, which is located at 2666 Guangxi Road, Hefei, China. Detailed hotel information is available on hotel website http://www.jinlinggrandhotel.com/.

Hotel accommodations have been reserved at reduced rates for registrants.


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紫蓬镇
紫蓬山国家森林公园
肥西县

Sunday, October 26, 2014

13:30-21:00 Registration Anhui Jinling Grand Hotel, Lobby
18:00-20:30 Reception Anhui Jinling Grand Hotel, Dining room, 2nd Floor

AGENDA - Monday, October 27, 2014

7:00-8:30	Breakfast – Dining room, 2nd Floor
	Opening Ceremony Place: Jinling Ballroom, 2nd Floor Chair: **Qing-Xiang Guo**, Professor, School of Chemistry and Materials Science, University of Science and Technology of China
8:30-8:45	Welcome address by **Chu-Sheng Chen**, Vice-President, University of Science and Technology of China
	Welcome address by **Gui-Bin Jiang**, Director, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences
	Welcome address by **Chun-Xia Wang**, National Natural Science Foundation of China
	Opening address by **Gary Sayler**, Scientific Committee Chair, Director of JIBS, UT/ORNL
8:45-9:10	Group Photo and Break – Just outside the Hotel
	Plenary Lecture Place: Jinling Ballroom, 2nd Floor Chairs: **Han-Qing Yu**, University of Science and Technology of China **Timothy Filley**, Purdue University
9:10-9:50	**Joseph M. Suflita**, The University of Oklahoma **Title:** Bioconversion of Energy Reserves to Methane: Opportunities for China-US Partnerships
9:50-10:30	**Yong Cai,** Florida International University **Title:** Mercury Pollution in China and US: Challenges and Perspective
10:30-11:10	**Chuan-Yong Jing**, Research Center for Eco-Environmental Sciences, CAS **Title:** Remediation of Groundwater Arsenic using TiO_2
11:10-11:50	**Gary S. Sayler**, The University of Tennessee **Title:** STC – GEMS2 (Global Environmental Methane System Science): A proposed NSF Science and Technology Center
12:00-13:00	Lunch – Dining room, 2nd Floor

AGENDA - Monday, October 27, 2014

	Session 1 – Lihua Room, 3rd Floor Chairs: **Brian Leib**, The University of Tennessee **Bo-Zhong Mu**, East China University of Science and Technology
13:30-14:00	Keynote address by **Chi-Hua Huang**, Purdue University **Title:** Challenges in Assessing Conservation Effects at the Field and Watershed Scales: From Dust Bowls, Mud Bowls and Algal Soups
14:00-14:30	Keynote address by **Ji-Dong Gu**, The University of Hong Kong **Title:** Linking C and N Cycles by Bacteria Capable of Nitrite-dependent Oxidation of Ammonium and Methane over a Pollution Gradient from the Pearl River Delta to the South China Sea
14:30-14:50	**Yun-Ting Fang**, Institute of Applied Ecology, CAS **Title:** Ecosystem N Status of the Boreal Forests in Northeastern China: Insights from ^{15}N Natural Abundance
14:50-15:10	**Wei-Ping Chen**, Research Center for Eco-Environmental Sciences, CAS **Title:** Source Identification and Regional Risk Assessment of Cd Polluted Paddy Soil
15:10-15:30	**Nian-Peng He**, IGSNRR, CAS **Title:** Composition, Spatial Patterns and Influencing Factors of Atmospheric Nitrogen Deposition in Chinese Terrestrial Ecosystem
15:30-15:50	Break
Chairs	**Joseph M. Suflita**, The University of Oklahoma **Ji-Dong Gu**, The University of Hong Kong
15:50-16:20	Keynote address by **Yao Fu**, University of Science and Technology of China **Title:** Catalytic Conversion of Biomass-derived Carbohydrates into Fuels and Chemicals in Aqueous Phase
16:20-16:50	Keynote address by **Bo-Zhong Mu**, East China University of Science and Technology **Title:** Role of Microbial Community in Petroleun Reservoirs: The Potential Application in Enhanced Energy Recovery
16:50-17:10	**Dong Jiang**, IGSNRR, CAS **Title:** Evaluating Energy Benefit of Cassava Based Fuel Ethanol in China with Biogeochemical Process Model
17:10-17:30	**Jun-Song Sun**, Shanghai Advanced Research Institute, CAS **Title:** Construction of *E. coli* for Industrial Scale Production of n-butanol
17:30-17:50	**Li Liu**, Shanghai Advanced Research Institute, CAS **Title:** Butanol Production from Lignocellulosic Biomass
18:30-20:00	Dinner, Anhui Jinling Grand Hotel, 5th Floor

AGENDA - Monday, October 27, 2014

	Session 2 – Daoxiang Room, 3rd Floor Chairs: **Gary S. Sayler**, The University of Tennessee **Chuan-Yong Jing**, RCEES, CAS
13:30-14:00	Keynote address by **Timothy Filley**, Purdue University **Title:** Linking PyOM Microbial Reactivity in Soil to Its Charring Temperature and Wood Source
14:00-14:30	Keynote address by **Jian-Ming Xu**, Zhejiang University **Title:** Varied Physiochemical Properties and Adsorption Capacities of Biochars Derived from Swine Manure Blended with Rice Straw Provide Increased Agronomic and Environmental Value
14:30-14:50	**Joe Zhuang**, The University of Tennessee, Institute of Applied Ecology, CAS **Title:** Colloid Transport with Wetting Fronts
14:50-15:10	**Fa-Dong Li**, IGSNRR, CAS **Title:** Geochemical and Isotopic Evidence of Shallow Groundwater Salinization in a Reclaimed Coastal Zone: The Yellow River Delta
15:10-15:30	**Brian Leib**, The University of Tennessee **Title:** Deficit Irrigation of Cotton on Variable Water Holding Capacity Soils in a Humid Region
15:30-15:50	Break
Chairs	**Brad Joern**, Purdue University **Raymond Zeng**, University of Science and Technology of China
15:50-16:20	Keynote address by **Bao-Hua Gu**, Oak Ridge National Laboratory **Title:** Complex Interactions between Contaminant Metals and Dissolved Organic Matter and Microbes on Metal Species Transformation and Transport in the Environment
16:20-16:50	Keynote address by **Min-Dong Bai**, Xiamen University **Title:** The Rapid Treatment for the Algae-bloom Water using Hydroxyl Radicals (•OH) Generated from Strong Ionization Discharge at an Atmospheric Pressure
16:50-17:10	**Xi-Juan Chen**, Institute of Applied Ecology, CAS **Title:** Removal of PPCPs in Wastewater Treatment Processes
17:10-17:30	**E Bai**, Institute of Applied Ecology, CAS **Title:** Pre-industrial vs. Contemporary Nitrogen Fluxes and Fates as Influenced by Global Croplands Expansion
17:30-17:50	**Xu-Dong Zhang**, Institute of Applied Ecology, CAS **Title:** Nitrogen Cycling in Agro-ecosystem and Nitrogen Environmental Risk Control
18:30-20:00	Dinner, Anhui Jinling Grand Hotel, 5th Floor

AGENDA - Tuesday, October 28, 2014

	Session 3 – Jinling Room, 2nd Floor Chairs: **Chi-Hua Huang**, Purdue University **Jian-Ming Xu**, Zhejiang University
8:30-9:10	**Plenary Lecture** by **Brad Joern,** Purdue University **Title:** An Overview of Agronomic and Environmental Projects in the Midwestern USA
9:10-9:40	Keynote address by **Hong-Zhu Wang**, Institute of Hydrobiology, CAS **Title:** Ecohydrological Rehabilitation of Shallow Lakes: Principles and Strategy
9:40-10:10	Keynote address by **Liem Tran**, The University of Tennessee **Title:** Determine the Most Influencing Stressors and the Most Susceptible Resources for Regional Integrated Environmental Assessment
10:10-10:40	Keynote address by **Ren-Jie Dong**, China Agriculture University **Title:** The Most Possible Route for BioEnergy in China - Based on Our Limited Experiences
10:40-11:00	Break
11:00-11:30	Panel discussion about **Global Environmental Methane System Science** Chair: **Gary S. Sayler**, The University of Tennessee
11:30-11:40	Closing Remarks Moderator: **Joe Zhuang**
11:50-13:00	Lunch, Dining room, 2nd Floor

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Abstract

Bioconversion of Energy Reserves to Methane: Opportunities for China-US Partnerships

Joseph M. Suflita[1], Bo-Zhong Mu[2] and Ji-Dong Gu[3]

[1]Department of Microbiology and Plant Biology, Institute for Energy and the Environment, University of Oklahoma, Norman, OK 73019 (jsuflita@ou.edu);[2]State Key Laboratory of Bioreactor Engineering and Institute of Applied Chemistry, East China University of Science and Technology, Shanghai 200237 China (bzmu@ecust.edu.cn); [3]School of Biological Sciences, University of Hong Kong, Pokfulam Road, Hong Kong SAR, P.R. China (jdgu@hku.hk)

Economic prosperity and national security depend on how societies manage a myriad of energy challenges. Quite naturally, societies will seek to diversify their energy portfolios in an effort to meet the ever-increasing demands from a burgeoning world population. Meeting such energy challenges in a manner that ultimately reduces atmospheric emissions and global change impactsis a lofty goal. A US-China partnership designed to convert domestic energy resources to methane will position both countries to take a leadership role in this important endeavor. The environmental benefits associated with methane as an energy source has the prospect of meeting such challenges in the near term. Examples are provided of the use of biotechnology to convert residual oil from a marginal reservoir, organic matter from shale deposits and coal to methane. Inoculation with an oil-degrading methanogenic consortium was utilized in all cases, but required with the marginal oil and shale experiments. For coal, the best results were obtained when the fossil substrate was initially oxidized with ozone followed by incubation with the consortium. The relationship of such transformations to metal biocorrosion will also be considered. Collectively, the results help illustrate how the interconversion of plentiful domestic energy reserves to methane could potentially play an important role in addressing global energy needs in an environmentally conservative fashion while minimizing apprehension associated with metal biocorrosion.

Mercury Pollution in China and US: Challenges and Perspective

Yong Cai

Department of Chemistry & Biochemistry and Southeast Environmental Research Center，Florida International University
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Mercury is one the most studied pollutants globally because mercury and mercury compounds have long been known to be toxic to humans and other organisms. The importance of controlling mercury emission from anthropogenic sources and limiting its impact to ecosystem and human being is evidenced by the recent Minamata Convention on Mercury. The convention is an international treaty designed to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds. After several years of meetings and negotiating, delegates from 140 countries reached an agreement and ratified on the text on January 19, 2013. Both China and US, two of the most important countries playing key roles in assuring successful implementation of the treaty, signed on the agreement. In light of the global effort needed for mercury study over the next few decades, both in controlling targeted activities responsible for the major release of mercury to the immediate environment and in studying the biogeochemical cycling of mercury and its impact to human and other organisms, this presentation will provide a brief overview of the current status on mercury research and discuss some of the challenges remaining. In particularly, this paper, from an environmental chemist's view, will address the needs in improving the methodologies for mercury research, research gaps in estimating global mercury mass budget, disconnections in total and methylmercury studies, inefficient integrations from fundamental laboratory experiment to large scale field work and to modeling, and the potential effects of global climate changes on mercury cycling.

STC – GEMS^2 (Global Environmental Methane System Science): A Proposed NSF Science and Technology Center

Gary S Sayler

Center for Environmental Biotechnology and UT-ORNL Joint Institute for Biological Sciences, The University of Tennessee, Knoxville, TN 37996, USA (sayler@utk.edu)

Background and Problems: Methane (CH_4) is a major global energy resource that is plentiful. Inherently sustainable CH_4 is a capstone gas representing a dominant flux in biogeochemical carbon cycling, contributor to climate change, a primary feedstock for chemical synthesis and a growing global market driver in energy production and conversion. CH_4 has also been proposed as a progenitor substance for primordial life and an astrobiology biomarker. Despite the vast information on its thermogenic and biogenic origins, there is great mechanistic and quantitative uncertainty on CH_4 sources and sinks. Such uncertainty influences the debate on CH_4 as a greenhouse gas, a primary energy resource, a feedstock for conversion technologies, eco-dynamics in global carbon cycling and biotechnical production from renewable resources and wastes. What will be the environmental impacts of a strategic switch to a CH_4 energy economy? What are the social, economic and political implications? Is CH_4 a bridge fuel to a more sustainable future planet, or is CH_4 the solution? On what basis should these decisions be made?

Goal: The goal of GEMS^2 is to provide answers and solutions by integrating across science, engineering and business models to create a broad conceptual understanding of CH_4 as a driver of ecosystem processes and services, and to use this understanding to create a lifecycle assessment framework for environmentally sustainable generation, management and utilization of CH_4. The GEMS^2 mission is to provide a continuum of fundamental science and technological advances that help integrate the use of CH_4 in both a strategic and sustainable manner in industrialized and developing countries. The project will provide interdisciplinary training in CH_4 environmental science and technology, and develop a diverse, internationally competitive and globally engaged workforce of scientists and engineers, which will enable and stimulate public debate, and provide a structured rationale for economic and environmental policy decisions and regulations.

Vision: GEMS^{2}will integrate across science, engineering and business models to create a broad conceptual understanding of CH_4 as a driver of ecosystem processes and services, and to use these advances to generate a lifecycle assessment framework

for environmentally sustainable generation, management and utilization of CH_4.

Grand Challenges/Breakthroughs: GEMS^2 will address the following challenges.

(1) CH_4 is a major greenhouse gas with a dominant temperature feedback loop forcing with unknown additive effects on greenhouse gasrelease. Major knowledge gaps exist concerning CH_4 cycling rates and the tipping point leading to irreversible climate change, emphasizing the critical need for life-cycle analysis of these phenomena.

(2) CH_4 is a crucial component for U.S. energy independence; however, the effects of current recovery practices (e.g., fracking) on greenhouse gas emissions, ocean acidification, drinking water quality and quantity, and ecosystems services have the public deeply concerned. There is an immediate need for education programs linking these issues to the latest research and technology developments to assess risks and predict long-term outcomes.

(3) Given the increased supply of CH_4 at decreasing cost, innovative bio-inspired chemical catalysis and interconversion technology is needed to efficiently capitalize on CH_4 feed stocks to generate value-added products, including alternate fuels and commodity chemicals.

(4) CH_4 is key to meet energy, geopolitical and economic challenges in a sustainable manner and the CH_4 economy will soon rival petroleum in global commodity market trading of LNG. New empirical and numerical models are desperately needed to evaluate, predict and control economic and environmental risks

Research Plan: GEMS^2 will be organized around six integrated core functions that bridge different focal areas of current CH_4 research thus enabling exciting new discoveries from research and education areas that heretofore have not communicated: (1) Ecosystems and Environmental Systems Science; (2) CH_4 Inter-conversion and Energy Science; (3) Environmental Systems Applications and Technology; (4) Translational Science in Economics and Policy; (5) Multidisciplinary Graduate Recruitment and Development, and (6) Public Engagement, Enhancement and Outreach, International Collaborations. Each of the six cores will have a Director and Faculty Leads for areas within each core. UTK will lead GEMS^2 and involve eight other institutions: Oak Ridge National Laboratory, Indiana University, Princeton University, University of Oklahoma, Montana State University, Juniata College, Georgia Institute of Technology, and University of Virginia.

Remediation of Groundwater Arsenic Using TiO_2

Chuanyong Jing

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Arsenic exposure threatens human health. Shanxi and Inner Mongolia are two provinces with highest groundwater As concentrations and most reported endemic As cases in China. The groundwater As can be removed by iron oxide adsorbents, which may produce large amounts of sludge and cause oxidative damage to humans. Alternatively, arsenic removal can be achieved using granular TiO_2 in our previous reports. The motivation for this study is to develop a practical drinking water treatment system and explore the arsenic adsorption mechanism in real-life groundwater in the column using multiple complementary techniques.

The granular TiO_2 column can treat 2,955 bed volumes of groundwater with initially 454 μg/L As(III) and 88 μg/L As(V) before the effluent As concentration exceeded 10 μg/L, corresponding to an adsorption capacity of 1.53 mg As/g TiO_2. The absorbent can be regenerated with NaOH, and then can be used to treat another 2,560 bed volumes of groundwater, corresponding to 1.36 mg As/g TiO_2. The adsorption and transport behaviors of arsenic and major ions in groundwater were also investigated. Ca, Si, and HCO_3 in groundwater would interfere with the As adsorption. As k-edge EXAFS results suggested Si would not interfere As adsorption structures on TiO_2, the reduction of As adsorption could be due to the competition of surface sites. While Ca could enhance As adsorption by the formation of Ca-As-Ti ternary surface complex. The charge distribution multi-site complexation (CD-MUSIC) and one-dimensional advective transport model were integrated to simulate the adsorption and transport behaviors of As and other major ions. With the addition of adsorption reactions of Ca, Si, and HCO_3, groundwater As, Ca, Si, and HCO_3adsorptionand transport behaviors in columns were modeled reasonably well.

Challenges in Assessing Conservation Effects at the Field and Watershed Scales: From Dust Bowls, Mud Bowls and Algal Soups

Chi-Hua Huang

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Email: Chi-hua.huang@ars.usda.gov

Soil water conservation and cropping management practices are traditionally developed to be implemented at field scales where direct benefits of the practices can be quantified. Many of these practices have been widely adopted and became textbook materials. As technologies in agricultural production changes, some new challenges arise. For examples, terraces built on sloping fields for water conservation and erosion control in the past when fields were frequently plowed and farming equipment were narrow may become operational impediments for no-till farmers these days when the surface erosion problem has been alleviated through conservation farming practices and equipment are becoming much wider. Another example is the installation of subsurface drainage has created a new transport pathway for nutrients from fields to receiving water bodies. Beginning in 2003, US Department of Agriculture started a nation-wide project to assess conservation effects at the watershed scale do document the environmental benefits from voluntary, incentive-based conservation programs. This project, called Conservation Effects Assessment Project or CEAP, has caused enormous challenges for scientists because the spatial and temporal scales involved in linking processes occurring at fields to responses at watersheds and basins. This presentation highlights some of the challenges evolved from the CEAP project and offers some potential opportunities that these challenges may be addressed.

Linking C and N Cycles by Bacteria Capable of Nitrite-dependent Oxidation of Ammonium and Methane over a Pollution Gradient from the Pearl River Delta to the South China Sea

Ping Han[1], Jing Chen[1], Bo-Zhong Mu[2], Joe Suflita[3] and **Ji-Dong Gu[1*]**

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Nitrogen and carbon cycles are fundamental to ecosystem function and also sensitive to anthropogenic perturbation. Bacteria responsible for nitrite-dependent oxidation of ammonium (anammox) and methane (n-damo) were investigated over a known anthropogenic pollution gradient from the Pearl River Delta to the South China Sea (SCS) to reveal the diversity and abundance as well as their relationship with environmental factors. Multiple PCR primer sets based on the genes encoding 16S rRNA, hydrazine oxidoreductase (HZO), cytochrome cd_1-containing nitrite reductase (NirS) and hydrazine synthase subunit A (HzsA) of anammox bacteria were used to reveal the diversity and abundance from the coastal Mai Po wetland (MP) to the SCS. Consistent phylogenetic results of these biomarkers for anammox bacteria, namely 16S rRNA, *hzo,* and *hzsA* genes were obtained from these samples. SCS were dominated by diverse *Ca*. Scalindua pylotypes while MP showed the highest diversity of anammox bacteria including *Ca.* Scalindua, *Ca.* Kuenenia and *Ca.* Brocadia. Based on phylogenetic analyses, deduced protein sequences were grouped into relevant clusters and new HZO clusters with lower similarity to the known anammox HZO sequences were also recovered. Results collectively indicate that the distribution of anammox bacteria is niche-specific within the different ecosystems and specific genera are pollution tolerant.

Both 16S rRNA and *pmoA* gene-based PCR primers were employed to study the diversity and distribution of n-damo bacteria in the surface and lower layer sediments at the MP wetland and also in surface and subsurface sediments of the SCS. The occurrence of n-damo bacteria in both the surface and subsurface sediments with high diversity was confirmed in both niches in this study. The *pmoA* gene-amplified

sequences in the present work clustered not only with some freshwater subclusters, but also within three newly erected marine subclusters, indicating the unique niche specificity of n-damo bacteria in this coastal wetland. The *pmoA* gene-amplified sequences clustered within three newly erected subclusters, namely SCS-1, SCS-2 and SCS-3, suggesting the unique niche specificity of n-damo bacteria in the coastal marine ecosystem. The abundance of n-damo bacteria at this wetland was 2.65-6.71×10^5 copies/g dry sediment quantified using 16S rRNA gene. Ammonium and nitrite strongly affected the community structures and distribution of n-damo bacteria in the coastal Mai Po wetland and SCS sediments. The results show that nitrite-dependent oxidation of ammonium and methane is much more pronounced in freshwater and anthropogenic impacted coastal ecosystems than the pristine ocean.

Ecosystem N status of the boreal forests in Northeastern China: insights from ^{15}N natural abundance

Yunting Fang, Shasha Zhang

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Boreal forests play an important role in sequestrating CO_2 from the atmosphere. It has been long considered that boreal forests are N-limited ecosystems and thus increased atmospheric N deposition is proposed to increase C sequestration. Under the context of global climate changes and N deposition, it is critically important to assess if ecosystem N status has changed over time since forest responses is dependent on ecosystem N status. In this study, we will evaluate the current ecosystem N status for four boreal forests in Northeastern China by 1) comparing leaf ^{15}N natural abundance (expressed as $\delta^{15}N$) with other boreal regions; 2) investigating soil $\delta^{15}N$ pattern along the soil profiles; and 3) comparing $\delta^{15}N$ of soil available N (NH_4^+ and NO_3^-) in soil profiles to soil ^{15}N natural abundance.

Our results show that average foliar $\delta^{15}N$ was -1.8‰ to 1.4‰ in the study four forests, being slightly higher the boreal forests in other regions and those predicted from global forest dataset. The variation (maximum minus minimum) of $\delta^{15}N$ between different forests was 3.9‰ to 5.2‰, being smaller than those in typical boreal forests. The maximum changes of $\delta^{15}N$ from litter to mineral soil of 50 cm were 5.5‰ to 9.6‰, being the low end of range for the forests with similar climate conditions. Ammonium was the dominant N form in the most soil layers, but nitrate accounted for on average 24% of total soil inorganic N (varied from 3% to 70%). In very N-limited forest soil, nitrate often is not detectable. The $\delta^{15}N$ values for soil ammonium were on average 4.5‰ lower than those for soil organic N, suggesting a small isotopic fractionation during ammonification. However, the $\delta^{15}N$ values for soil nitrate were on average 0.8‰ lower than those for soil ammonium. We expected much lower soil nitrate $\delta^{15}N$ values because nitrification discriminates against ^{15}N with an isotopic fractionation of -35‰. Higher than expected values indicate denitrification might have occurred and raise ^{15}N abundance of nitrate. This is further supported by positive and significant correlation of $\delta^{15}N$ and $\delta^{18}O$ of soil nitrate, which indicates occurrence of denitrification in a variety of environmental settings. Our results of ^{15}N natural abundance, combined with N concentration, suggest that the study boreal forests may have been progressing to N saturation, which is probably caused by elevated N deposition in the study region.

Composition, spatial patterns and influencing factors of atmospheric nitrogen deposition in Chinese terrestrial ecosystem

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The deposition of atmospheric nitrogen (N) is integral to the global N cycle. Understanding the spatio-temporal patterns and factors that influence N deposition is useful to evaluate its ecological effects on terrestrial ecosystems and to provide a scientific basis for global change research. In this study, we selected 41 stations from the Chinese Ecosystem Research Network to monitor atmospheric N deposition in rainfall. The precipitation was collected monthly during 2013 and total N (TN), total dissolved N (TDN), ammonium (NH_4^+–N), and nitrate (NO_3^-–N) were measured. Our results show that the deposition fluxes of TDN, NH_4^+–N, and NO_3^-–N were 13.69, 7.25, and 5.93 kg N ha^{-1} a^{-1}, respectively. The deposition flux of TN and total particulate N (TPN) were 18.02 kg N ha^{-1} a^{-1} and 4.33 kg N ha^{-1} a^{-1} for China. TPN accounted for 24% of TN while NH_4^+–N and NO_3^-–N were 40% and 33% respectively, confirming that atmospheric wet N deposition was underestimated without including particulate N. Central and Southern China experienced a higher N deposition flux compared with the North-West, North-East, Inner Mongolia, and Qinghai-Tibet. Precipitation, N fertilizer use and energy consumption were significantly correlated with wet N deposition (all $p<0.01$). Models that included precipitation and N fertilizer explained ~80–91% of the variability in atmospheric wet N deposition. These results reveal the composition of the wet N deposition in China and highlight the importance of TPN. Furthermore, N fertilizer use was the main driving factors of atmospheric wet N deposition, which provides new insight and a theoretical basis for further study of the ecological effects of N deposition for policy and planning purposes.

Source identification and regional risk assessment of Cd polluted paddy soil

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The paddy soils in many parts of southern China have been severely impacted by Cd contaminations. We selected Youxianas a case, a prefecture located in the Hunan Province that was the one of the most productive regions of rice in China and through media exposures, was known nationwideas the region of “Cd-laced rice”. Source identification was conducted based on field investigation, spatial analysis, and model simulation. A regional-scale human health risk assessment of Cd contamination in paddy soils was conducted based on the total Cd contents of the 0 to 100 cmsoil profiles and the corresponded harvested rice grains along with the soil properties. Youxian in Hunan Province, China, a fertile river basin for rice production, has been devastated by the soil pollution. Emissions from coal mining, metal mining and smelting, and brick and tile kilns over the past fifty years caused the Cd content of surface soils rising by 5 to >10 folds to 0.42 to 0.92 mg kg^{-1}and51.7 to 89.9% of the soil borne Cd were deemed bioavailable resulting in elevated Cd levels in harvested rice grains, ranging from 0.06 to 1.83 μg g^{-1}. Comparing to the indigenous conditions prior to the soil pollution, the human health risks indices had risen on average 3.68 folds across the entire basin with the maximum reached 11 folds. For approximately third of the area, the ecological risks due to elevated soil Cd had reached levels the plant growth might be adversely affected and yield reductions would be imminent.

Catalytic Conversion of Biomass-derived Carbohydrates into Fuels and Chemicals in Aqueous Phase

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Replacing fossil resources with renewable sources, such as lignocellulosic biomass, requires the development of novel catalytic system for the conversion of biomass into fuels and chemicals. A key challenge for the conversion of biomass-derived hydrophilic saccharide derivates is to achieve highly effective and selective removal of oxygen functionalities, while the hydrogenation reaction is one of the most cost-effective methods. In our work, a series of water-soluble semi-sandwich typed transitional metal based catalyst have been developed aiming at the hydrogenation of biomass carbohydrate derivatives.

γ-Valerolactone (GVL) has been identified as an important chemical platform that can be transformed into liquid hydrocarbon fuels. It can be obtained from levulinic acid (LA), which should be produced from lignocellulosic biomass through a simple and robust hydrolysis process. Through the investigation of the factors such as the center metal atom, ligands and outer ions, half-sandwich iridium complexes can be used to convert LA into GVL in excellent yields under mild conditions with a high TON of 78,000. Furthermore, furfural, which is a bulk biomass-based chemical produced from lignocellulosic biomass, can be selectively transformed into furfuryl alcohol or GVL catalyzed by semi-sandwich iridium complexes via the control of pH value. The feature of the research is that the water-soluble semi-sandwich typed transition metal based catalyst can be recovered and reused by simple extraction method, and the catalyst system is compatible to the upstream hydrolysis process.

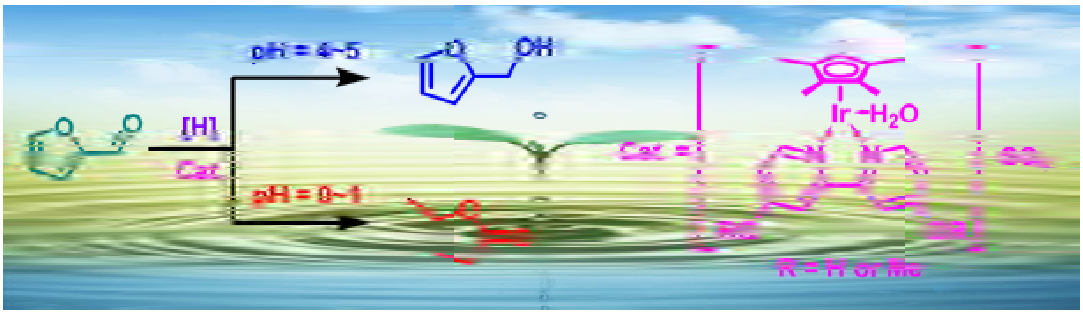

Fig. 1 pH makes it different

Role of Microbial Community in Subsurface Petroleum Reservoirs: The Potential Application in Microbial Enhanced Energy Recovery

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A better understanding of microbial communities and their function in petroleum reservoirs is of great interest for new technology developments in microbial enhanced energy recovery (MEER), an environmentally friendly approach to extend the lifetime of petroleum reservoirs and to recover more oil and methane than currently available technology. Petroleum reservoirs may be able to function as bioreactors in the process of MEER. Over the last decade, a body of convergent observations has highlighted the great diversity of indigenous microorganisms in subsurface petroleum reservoirs by using systems biology techniques. Lessons from these studies reveal that various groups of microorganisms are responsible for releasing crude oil trapped in the pores of porous media of petroleum reservoirs via degradation of oil hydrocarbons and production of oil-releasing agents such as fatty acids, alcohols, polysaccharides and biosurfactants. In addition to the microbial community information, new biochemical pathways responsible for the anaerobic biodegradation of alkane and aromatic hydrocarbons has also been confirmed in both the laboratory and oil field production waters. Herein we report and consider the role of microbial communities on the transformation of petroleum hydrocarbons in subsurface petroleum reservoirs by focusing on: (1) bacterial and archaeal communities in petroleum reservoirs with different temperatures, (2) the functional genes involved in the biochemical process of MEER, (3) the detection of diagnostic metabolites of microbial metabolism in petroleum reservoirs, and (4) the composition of metabolic products beneficial to energy recovery purposes.

Evaluating energy benefit of Cassava based fuel ethanol in China with biogeochemical process model

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Bioenergy is expected to be an important role in the future energy system. Cassava is believed to be one of the most promising energy plants for fuel ethanol production in tropics and subtropics. In China, energy plants based bioenergy have to be developed on marginal lands to avoid the impacts on food security. The yield of Cassava varied dramatically under different environmental conditions, so that efficient approach for yield estimation of Cassava on marginal lands is highly needed. This paper presented an method for assessing energy potential of Cassava with a biogeochemical process model. Spatial distribution of marginal lands was firstly identified. A GIS-based biogeochemical process model, GEPIC model, was adopted to simulate the spatial and temporal dynamics of the major processes of the soil-Cassava -atmosphere-management system. The model was calibrated and applied successfully in the Guang Xi Province, Southwest China. The results indicated that the potential bioenergy of cassava on marginal land under rained condition in Guangxi province is 1,909,593.96 million MJ, which is equal to the energy of 17.0844 million tons of standard coal; the potential energy of cassava under irrigation condition is 2,054,017.73 million MJ, which is equal to the energy of 18.3765 million tons of standard coal.

Construction of *E. coli* for industrial scale production of n-butanol

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Transforming *Escherichia coli* into n-butanol producing strains is usually achieved by overexpressing synthetic butanol pathway in plasmids under inducer triggered promoters, in this study we attempted to confer *E. coli* strains capability of automatic excretion that makes piloting or scale-up bioproduction of n-butanol possible, thereby, we adopted a different strategy during stain improvement, initial with development of a novel genetic modification kit that can turn model *E. coli* into butanol producing microorganisms. The kit is primarily composed by two vectors, which were used as templates for PCR preparation of DNA fragments for chromosomal integration resulting in simultaneously delivery of two synthetic operons into *E. coli* and bringing in-frame gene deletions in targeted native loci. A core element in this kit is P_{hya}, a native auto-inducible anaerobic promoter, found to be robustly boost the transcription of the artificial operon during anaerobic growth. Duo plasmids carrying strain Bw2V, when applied in anaerobic fermentation with medium containing glucose, produced butanol up to 2.8 g/L in bioreactor; mutant strain BuS2, integrated with single copy of same pathway in genome, also allowed the biosynthesis of butanol at the titer of 1.4 g/L.

Butanol production from lignocellulosic biomass

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The lignin-derived phenolic compounds present in lignocellulosichydrolysate might have an adverse impact on acetone-butanol-ethanol (ABE) production by *Clostridium beijerinckii*ZL01. In this study six model phenolic compounds including 4-hydroxybenzaldehyde, 4-hydroxybenzoic acid, vanillin, vanillic acid, syringaldehyde, and syringic acid were evaluated as the potential inhibitors to investigate their effects on cell growth and ABE production by *C. beijerinckii*ZL01. The results showed that these compounds could lead to a decrease in cell growth and ABE production. Moreover, the aldehydes inhibited ABE production to a greater extent than the corresponding acids. Vanillin was found to be the most toxic inhibitor, with 0.2 g/L of vanillin producing only 2.347 g/L butanol and 3.521 g/L total solvents, compared to 12.908 g/L butanol and 17.615 g/L total solvents for the control. Meanwhile, more-toxic aldehydes could be converted to less-toxic compounds to a greater extent than acids by *C. beijerinckii* ZL01 for cell's survival.

Linking PyOM microbial reactivity in soil to its charring emperature and wood source

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Understanding the link between the chemical and structural properties of pyrogenic organic matter (PyOM) and its subsequent reactivity in soil is critical to predict how future increases in forest fires will affect C and N cycling and how the intentional use of PyOM in agriculture will influence agoecosystem function. Herein, we present the results of the laboratory mesocosm component of an experiment on the influence of wood species and charring temperature on soil C and N dynamics in sandy soils from a northern temperate forest. PyOM was produced from highly enriched $^{13}C/^{15}N$-labeled red maple (RM; *Acer rubrum*) and jack pine (JP; *Pinusbanksania*) in separate pyrolysis batches of 5 hours at 0 (native wood), 200, 300, 450 and 600 °C. PyOM amendments to soil were made at 11% total soil C. The additive effect of a labile C source on PyOM and native soil C and N was also measured by adding sucrose to one third of samples. After 4 months of this ongoing incubation, $^{13}CO_2$ evolution indicates that both pyrolysis temperature and species played a significant role in PyOM and native SOC mineralization. For both species the degree of mineralization of PyOM decreased with increasing temperature and PyOM ≥200 C decreased SOC mineralization relative to controls while lower temperature (200 C) PyOM showed no change. Sucrose addition appeared to have no effect on PyOM degradation however, in treatments with high temperature PyOM (>300ºC), sucrose addition increased native C mineralization. Additionally, the mineralization of RM PyOM was enhanced relative to JP at temperatures < 600 C and soils in contact with RM PyOM exhibited significantly lower SOC mineralization at 300 and 450ºC. These results highlight interactive temperature and species effects and are consistent with our detailed spectroscopic, elemental, and stable isotope analysis of the PyOM samples across this pyrolysis gradient, which shows significant physicochemical changes at 300 C for JP and 450 C for RM. Efforts will be made in this paper to link PyOM structural and chemical properties to the PyOM and native SOC turnover rates.

Varied physiochemical properties and adsorption capacities of biochars derived from swine manure blended with rice straw provide increased agronomic and environmental value

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Swine manure (Sm) is produced in large quantities from high intensity piggeries. It can be converted into biochar, which can provide considerable agronomic and environmental benefits to soils, e.g. enhanced soil nutrients, increased soil pH, and reduced mobility and bioavailability of pollutants, etc. However, some properties of the Sm biochars limit their abilities to improve soil fertility and little is known about the properties of the biochar derived from Sm blended with lignocellulosic-based feedstock i.e. rice straw. In this study, the feedstocks were prepared by adding different proportions of rice straw (Rs) to the Sm feedstocks (Sm:Rs = 3:1, 1:1 and 1:3 w/w, respectively) within a pyrolysis temperature range from 300 ˚C to 700 ˚C. The physiochemical characteristics (e.g. pH, ash, carbon, yield, surface area etc.) showed that the pyrolysis temperatures, and the proportions of Rs added, both influenced the properties of the biochars. Principal components analysis (PCA) showed that the high pyrolysis temperatures of 600 ˚C and 700 ˚C resulted in much larger differences in biochar properties, compared with the low pyrolysis temperatures of 300 ˚C, 400 ˚C and 500 ˚C. The XRD spectra suggested that the biochars produced from swine manure with different rates of rice straw contained the mineral crystals from both Sm and Rs, as was the case in the functional groups from FTIR spectra. The SEM spectra indicated that the porous structures increased as the proportion of Rs increased. The Zn(Ⅱ) adsorption batch experiments showed that as the proportion of Sm increased, the Zn(Ⅱ) adsorption capacity of biochars at 300 ˚C increased, and the relatively low pyrolysis temperature produced better biochars for Zn(Ⅱ) adsorption. The mineral components (SiO_4^{2-} and CO_3^{2-}), the oxygen functional groups (-OH and -COOH) and the surface areas of the biochars were responsible for Zn(Ⅱ) adsorption. In conclusion, to meet varied agronomic and environmental requirements, the different conditions including pyrolysis temperatures and proportions of added Rs should be quantified, and the improved effects and production costs should be comprehensively evaluated prior to use.

Colloid Transport with Wetting Fronts

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Colloid transport represents an important mechanism of contaminant movement in vadose zone. Numerous researches have addressed colloid transport in porous media, but the vast majority of them focused on water-saturated (groundwater) environments, even though most pathogens and toxicants enter groundwater via transport through the shallower soil which is only partially water-saturated. Further, most of studies of unsaturated systems are limited to steady state flow, while in nature, flow in partially saturated porous media is dominated by transient wetting events (e.g., storms or flushing toilets). Early work attributes colloid retention under partial saturation to attachment to air-water interface or straining in thin water films. However, more recent work on colloid transport under transient unsaturated flow conditions has called this prevailing paradigm into question. The work presented here uses a horizontal column experimental approach to examine the transport of a fluorescent latex microsphere (970 nm)with transient wetting fronts, and evaluates its dependence upon solution ionic strength (affecting electrostatic forces) and solution surface tension (affecting capillary forces). Distribution of the resident colloid concentrations within the wetted zone was also characterized along with the measurement of pore water saturation. Results show that the decrease in solution ionic strength and surface tension could increase colloid mobility under both unsaturated and saturated flow conditions. The amount of retained colloids exponentially decreased with travel distance. Effect of surface tensions is larger at lower than higher ionic strengths. The speed of colloid travel in porous media slows down with decreasing surface tension, but colloids are distributed more evenly within the column along the travel path.These results provide insights into theunderstanding of transport of pathogens and colloid-bound contaminants in different geological settings under natural flow conditions. The study might be useful for developing novel strategies to mitigate human and environmental health risks in public water supplies.

Geochemical and isotopic evidence of shallow groundwater salinization in a reclaimed coastal zone: The Yellow River Delta

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This paper aims to improve the current knowledge of groundwater salinization processes of a young coastal aquifer in the Yellow River Delta (YRD) and to assess the impact of both the transfer of irrigation water from the Yellow River and seawater intrusion, using a combination of hydrochemical-isotopic measurements. In terms of aquifer dynamics, the addition of irrigation water without any abstraction has caused a sharp rise in the water table and the serious groundwater salinity acts together with an almost complete attenuation of inter-seasonal water table fluctuation. The major ion/Cl ratios generally closely follow the mixing line between freshwater end-member (the Yellow River) and saline water end-members (salt groundwater or seawater), indicating the importance of mixing under natural and anthropogenic influence. The examination of groundwater stable isotope (ranging from -9.0 to -3.5‰ for $\delta^{18}O$ and from -73‰ to ~-29‰ for δD, respectively) and chloride concentrations (~2 to 629 meq/L) confirm that the saline end-member is associated with salt water rather than present seawater, and most groundwater samples are plotted on mixing lines between the Yellow River and salt groundwater. The similar range in stable isotopes ($\delta^{18}O$ and δD) and Cl compositions between salt water and confined aquifer supports the hypothesis that upwards seepage of confined saline water intruded the shallow aquifer. Moreover, the deviations in some cases from mixing line imply water-rock interaction is also important in dominant control on groundwater chemistry, such as cation exchange, SO_4 reduction and NaCl solution. The brackish water was characterized by slight excess of Na and deficit of Ca compared to non-reactive mixing line. This indicates that the coastal aquifer is generally freshening with respect to extensive irrigation network, as well as the transfer from the Yellow River for ecological recharge into wetland.

Deficit Irrigation of Cotton on Variable Water Holding Capacity Soils in a Humid Region

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The goal of this research was to determine the level of deficit irrigation that would produce the highest cotton yield and quality. In 2006 thru 2009, drip tape was used to create nine deficit irrigation treatments compared to a rainfed control in a RCB Design. Irrigation was initiated at square, bloom, and post-bloom by opening manual valves on the drip lines while irrigation levels were created by different drip tapes that supplied 1.5, 1.0, and 0.5 inches per week. Irrigation amounts were reduced if rainfall supplied the required water. Delta Pine 143 and Phytogen 375 were used on a Memphis soil (high water holding capacity) at the West Tennessee Research and Education Center, Jackson, TN. During the growing season, soil water tension, nodes above white flower and cracked bowl were monitored. At harvest, seed cotton was weighed, fiber samples were collected, plant height was measured, and bowl location was mapped. After harvest, gin out was determined and cotton samples were classed.Deficit irrigation was the best means to irrigate cotton in a high water holding – silt loam soil. Irrigating early at a high rate caused irrigated yield reduction while requiring the highest amount of water. The optimum timing and amount of deficit irrigation was dependent on the yearly rainfall patterns but the greatest response to irrigation was observed when irrigating two weeks post bloom. This approach to cotton irrigation needed to be tested in lower water holding capacity soils where watering early at high rate may be necessary but may not match the optimum deficit irrigation strategy for high water holding capacity soils. Following this first study, a field was located that was known to contain variable soil due to the depth of silt loam over course sand. In order to utilize this field for a plot experiment, the soils needed to be differentiated by location. A combination of Ground Penetrating Radar (better for deeper sand layers), Electrical Conductivity (better for shallower sand layers) and verification with soil cores was used to delineate zones. Three soil zones were identified with an average depth to sand of 20, 30 and 50 inches with corresponding average water holding capacity of 0.7, 1.1 and 1.9 in/ft. This field was irrigated at different times and at different amount during the 2010 to 2012 growing seasons

similar to the initial study.Irrigated cotton yield was maximized in the deep silt loam by irrigating later with less water than in soil where the sand was closest to the surface. In fact, when more water was added to maximize yield in the sandy soil, yield was reduced in the silt loam. At this point, the sandy soil yield was increasing at 2 twice the rate that the silt loam yield was decreasing as more irrigation was added. Therefore, the point at which yield for the entire field would be equal no matter whether you irrigated to maximize yield in the sand or the silt loam was 25% sand and 75% silt loam. So if you had, 35% sand and 65% silt loam you should irrigate to maximize yield in the sand to get the highest yield for the entire field even though it is not the predominant soil type. Correspondingly, if the field contained 15% sand and 85% silt loam areas, irrigation decision should not be made to keep the driest parts of the field from stressing because the overall yield in the field would be lower.

Complex Interactions between Contaminant Metals and Dissolved Organic Matter and Microbes on Metal Species Transformation and Transport in the Environment

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Naturally dissolved organic matter (DOM) consists of redox reactive but chemically heterogeneous organic compounds that exist ubiquitously in aquatic and terrestrial environments. DOM forms complexes with metal ions such as mercury (Hg), affects their mobility and reactivity, and directly or indirectly participates electron transfer reactions and thus enhances microbial reduction or oxidation of these metals and/or radionuclides. This presentation focuses on coupled chemical and biological reactions between these metal ions, DOM, and microbes and their influences on metal speciation and transformation in the environment. DOM is found to enhance microbial reduction of metal ions under anaerobic conditions, but it can also act as an electron acceptor and enhance metal oxidation under oxidizing conditions. Furthermore, DOM can cause Hg reduction and oxidation simultaneously under strict anaerobic conditions. Quinones and semiquinones in DOM are the dominant redox reactive moieties leading to the oxidation or reduction of metal ions, whereas thiolates in DOM result in oxidative complexation of Hg under anoxic conditions. Similarly, certain strains of microorganisms such as *G. sulfurreducens* PCA are able to reduce Hg(II) at relatively low cell biomass to Hg ratios, but reduction becomes inhibited at increasing cell to Hg ratios due to increased adsorption or Hg-thiolcomplexation on the cell envelope, resulting in increased methylation. This research highlights the multifunctional roles of DOM and microbes and their coupled reactions with metals and radionuclides in determining chemical speciation, redox transformation, bioavailability, and transport in the environment.

The rapid treatment for the algae-bloom water using hydroxyl radicals (•OH) generated from strong ionization discharge at an atmospheric pressure

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In recent 20 years, 75% lakes appear different degree of eutrophication in China. Many lakes, such as famous Taihu Lake, Chaohu Lake, Dianchi Lake, Donghu Lake and Dongting Lake and so on, are originally beautiful and pleasant waterscape, have become inferior to five categories surface water. A large number of algae in source water increase the difficulty of the raw water treatment, lead to each index, especially the sensory index, unable to reach the national drinking water standard, after drinking water is treated by conventional treatment process. Meanwhile, released algal toxins seriously threaten to human health.

Using a physical method of strong ionization discharge to accelerate electrons and excitated gas molecules at an atmospheric pressure, O_2 or air gases are ionized and dissociated into oxygen activated particles such as O_2+, O(1D), O(3P), O_3 and so on, and then to be mixed into water with high mass transfer efficiency. The hydroxyl radicals (•OH) are formed by a series of plasma chemical reactions, meanwhile to produce H_2O_2 and introducing reagent of HO_2^-. The time of •OH formation by the high-pressure jet method is only 1s, the total concentration of oxygen free radicals are >20 mg/L, the •OH content is 90 μmol/L as 6~14 times high as that of traditional O_3+UV and H_2O_2+UV method. Algae and pathogenic microorganisms in high algae-laden water are rapidly killed in a large scale by •OH radicals in the process of oxygen activated particles dissolved in the gas-liquid unit. The time of •OH killing algae is only within 0.1ms~6s, the algae concentration is decreased to <10 cells/mL, pathogenic microorganism is under detected limit. At the same time, organic contaminated compound such as algal toxins and odorous substance are rapidly oxidizing degradation into CO_2, H_2O and inorganic salts, the remaining •OH radicals are decomposed into O_2 and H_2O, and water quality is purified. The algal toxin is reduced to <1μg/L, and 2-methylisoborneol (2-MIB) and Geosmin (GSM) are decreased to <10ng/L. All indexes reached the National Standard “hygiene standards for drinking water” (GB5479-2006), so that high algae-laden water after •OH treatment could be directly drunk.

Removal of PPCPs in wastewater treatment processes

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Pharmaceuticals and personal care products (PPCPs) which contain diverse organic groups, such as antibiotics, hormones, antimicrobial agents, synthetic musks, etc., have raised significant concerns in recently years for their persistent input and potential threat to ecological environment and human health. To investigate the occurrence and fate of PPCPs in the environment, analytical methods for the quantification of PPCPs in wastewater, sludge and deposit were developed.

The fate of PPCPs in a wastewater treatment plant (biological degradation, sorption to sludge, input into the receiving surface water) was investigated during a field study. From the laboratory-scaled experiment biodegradation products of Triclosan (a common used biocides) such as 2,4-dichlorophenol, 4-chlorocatechol, triclosan-methyl, monohydroxy-triclosan, dihydroxy-triclosan and triclosan O-sulfate have been identified. Furthermore, two technologies have been studied for further removal of PPCPs in wastewater and sludge. Complete removal of PPCPs from wastewater could be achieved by using ozone and more than 90% removal of PPCPs from sludge could be found by using reed bed sludge treatment process.

System dynamics analyses of movement laws of field soil water and water use efficiencies for fifty years -- A case study of Yucheng Comprehensive Experimental Station

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Field water cycle involves the continuous movement of water including processes such as precipitation, irrigation, infiltration, water exchange between soil water and groundwater, soil surface evaporation, and plant transpiration. Due to the non-linear, multivariable, information feedback and temporally changing characteristics, system dynamics (SD) is one of the most suitable methods to simulate and quantify the behavior of complex systems. This paper has applied the established model by Khan et al. (2009) to winter wheat, summer maize and cotton which are the main crops based on the field water balance relation of Yucheng Comprehensive Experimental Station (YCES) of the Chinese Academy of Sciences (CAS) within the Panzhuang Irrigation District. Conclusions of the simulation were as follows: (i) The model could simulate the dynamics of water balance components of winter wheat and summer maize comparatively accurately compared with the observed values of the lysimeter. (ii) As can be seen from long-term continuous simulation of wheat-maize from 1959 to 2009, precipitation and soil water gradually decreased, ET and capillary rose, whereas irrigation firstly increased then dropped. (ii) Judging by the long-term simulation of cotton from 1960 to 2009, we are fully justified that precipitation and ET experienced a slight decrease and capillary rise and soil water had an upward trend in the past 50 years, while cotton usually did not need to be irrigated during the growth periods besides 60 mm pre-sowing water. (iii) There was a positive correlation between deep percolation and precipitation for wheat, maize and cotton. (iv) Mean values of water use efficiency (WUE) of winter wheat, summer maize and cotton were 12.53 kg/hm^2·mm, 18.40 kg/hm^2·mm and 3.48 kg/hm^2·mm in the YCES, respectively. Water use efficiencies were consistent with the regions' measured results showed that the model could reflect the water cycle in the field comparatively accurately again.

An Overview of Agronomic and Environmental Projects in the Midwestern USA

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Sustainable food, feed and fiber production is a critical global issue. Optimum management of commercial fertilizers, especially nitrogen (N) and phosphorus (P), is of growing importance in the USA due to challenges associated with nutrient enrichment of our surface- and ground-water resources. Livestock manure nutrient management presents even greater localized challenges due to inconsistencies in manure nutrient composition and application patterns when applied to the field, as well as challenges associated with less than optimal application timing resulting from inadequate storage. In addition, mining activities can drastically alter surface soil chemical, physical and biological properties, and restoring these mined lands for optimum production can require significant resource inputs. In this presentation, we will present and discuss the large state to state differences in commercial fertilizer recommendations and manure nutrient availability algorithms across the USA and suggest possible approaches to improve these recommendations based on soil properties, topography and weather. We will also present an overview of a few projects related to soil and sediment P sorption and release dynamics and introduce a couple of newly initiated studies focused on improving the productivity of reclaimed mine lands. Our hope is that this overview of recent and current research will lead to significant collaborations among the program partners.

Ecohydrological Rehabilitation of Shallow Lakes: Principles and Strategy

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Many shallow lakes in China and the world are suffering eutrophication, and have shifted from a clear-water state dominated by submersed macrophytes to a turbid-water state dominated by phytoplankton. We found that the main direct driving force of the regime shifts istotal phosphorus in lake water, but not total nitrogen; that total phosphorus thresholds vary little at moderate depths and area in lakes from temperate to subtropical (probably to tropical) zones, but decrease notably when depth exceeds a lower limit, and increase sharply when depth is below an upper limit. According to our recent works and related researches, we propose the following principles to rehabilitate eutrophic shallow lakes. First, in a hypertrophic stage, the only option is to control the phosphorus loading, and measures to restore submersed macrophytes cannot work. Second, rehabilitation of natural hydrological regimes of lakes and catchments is very important. It can effectively intercept diffuse pollution in catchments, and also increase the thresholds of regime shifts. Third, only in eutrophic to mesotrophic stages, restoration of submersed macrophytes and the clear water state can be realized without much energy input other than solar one. Since the lake eco-crisis is the central manifestation of many stresses in catchments, a single measure cannot work in general. Therefore, we propose a holistic management strategy of lakes and their catchments, which effectively integratesenvironmental-hydrological-ecological-economical-socialtechniques and measures.

Determine the Most Influencing Stressors and the Most Susceptible Resources for Regional Integrated Environmental Assessment

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A comprehensive assessment of environmental quality and/or vulnerability at almost any scale typically involves some kind of multivariate calculation over multiple variables and large amounts of data. An initial strategic priority was to use existing data from monitoring programs, model results, and other spatial data. Because most of these data were not collected with an intention of integrating into a regional assessment of environmental conditions and vulnerabilities, issues exist that may preclude the usefulness results from various existing integrated assessment methods.

This paper provides an overview of various spatial integration methods developed and currently used by the U.S. Environmental Protection Agency as well as presents a newly-developed method which is able to resolve several common data issues in an integrated assessment. The method is based on graph theory in identifying the most influencing stressors and the most susceptible resources in a region given the fact that those stressors and resources influence and are influenced each other to different extents. Furthermore, the method allows all environmental quality indicators to be used directly without any reduction in dimension (e.g., as in principal component analysis) nor losing variance while being able to tolerate possible non-normality of the indicators as well as non-linear relationships among them. Hypothetical and case-study examples are given to illustrate the method. Results show that the method is suitable and valuable for integrating multiple indicators into a single index, a common task in integrated environmental or vulnerable assessment.

The Most Possible Route for BioEnergy in China - Based on Our Limited Experiences

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BioEnergy, in the types of gas, liquid and solid, is the energy from any kind of biomass. In China it mainly means biogas and bio-syngas, bioethanol and biodiesel, pellets and briquettes, and the secondary electricity and heat from biomass combustion. On the other hand, “no food (feed) for fuel” policy limited the bioenergy resources to almost only organic residues. This naturally results in a integration of bioenergy generation and ecological environment protection.

The biomass power generation is thought to be the most challengeable of option because of feedstock constraints. The liquid biofuels are subject to feedstocks but have some breakthroughs in deriving diesel from kitchen waste and ethanol from animal corn-based feed production. Bioethanol from cellulosic feedstock would have the potential and need further technical innovation to reduce the cost.

Technologies for gaseous fuels and briquettes production are the most mature. With biogas production is almost the only option for wet organic waste treatment. However in China the digestates introduce a serious challenge into the whole chain and caused a lot of practical failures. The gasification and briquetting would be the easiest way to convert solid biomass into commercial energy. Some economical (scale and business model) and technical (tar and equipment lifespan) problems need to be carefully handled case by case.

It is calculated that although there is estimated too big scale of feedstocks for bioenergy production in China, to moderate and appropriate estimation of feedstock supply is the base of bioenergy successful story.

An Novel Disinfection Method for Drinking Water Treatment Based on Strong Electric Field Discharge and Hydrodynamic Cavitation

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Reactive oxygen species (ROS, e.g., •OH, $•O_2^-$, $^1O_2$, H_2O_2, O_3) produced in advanced oxidation technologies (AOT) are well accepted to be one of the most lethal factors that are responsible for bacteria inactivation during the drinking water treatment. However, the low production of ROS by existing AOT technologies (such as photocatalysis, ozonation) limits their widely applications in water treatment. In this study, an efficient method for reactive species producing and waterborne pathogens eliminating was developed, which consist of strong electric field discharge and hydrodynamic cavitation. The critical factor of reactive oxygen species for bacteria inactivation was investigated. *Escherichia Coli* as typical bacteria was used to evaluate the disinfecting efficiency. As a result, through the developed method, total oxidants (TO) producing in water could reach a concentration higher than 10 ppm. 10^6 cfu/mL of *Escherichia coli* could be completely eliminated in 5 s at a low TO concentration of 0.3 ppm. Hydroxyl radicals (•OH) produced with the method were supposed to be the critical factor for bacteria inactivation during the treatment. Owning the high production of ROS, the developed method as a clean water treatment technology can offer additional advantages over a wide range of applications.

Microbial response to oil in the Eastern Mediterranean deep sea environments

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The waters of the Eastern Mediterranean are characterized by high salinity, elevated deep-water temperatures and ultra oligotrophic conditions. The Eastern Mediterranean has great potential for oil and gas production. It is reported as one of the most oligotrophic regions on the earth, in which the primary productivity is phosphorus limited. What's more, the bottom water temperature in this region is between 12 to 14°C, which is much warmer than many other deep basins. However, little work has been done to characterize the microbial community and its response to oil in this unique marine system using the latest molecular techniques. There is no relevant report on the change of hydrocarbon and toxicity during the oil spilling, even though which are crucial to the marine ecosystem health and fish industry. We investigated the change of hydrocarbon, toxic and microbial communities in Eastern Mediterranean deep sea environment using a combination of high throughput GC-MS, bioreporters, and DNA sequencing analyses. We also researched the relationship among toxicity, microbial community structure and oil biodegradation in deep-sea basins. The 7 reporter assays (HK44, 5RL, TVA8, 2060, BLYES, BLYAS, BLYR) in the CEB of UTK, relatively accurately detect the bioavailability of BTEX and PAHs, acute toxicity and endocrine. The toluene and naphthalene equivalent concentrations decreased 1-2days, and the toxicity had a similar trend. The equivalent concentration of E2 decreased much slowly, which is a bad news to the marine ecosystem health and fish industry. Chemical analysis for alkanes and PAHs in contaminated seawater samples supported the bioassay data. Our data suggest that the 7 reporter assays may function as a potential time indicator for the age of the spill. 16S rRNA gene sequencing revealed a succession in the microbial community over time, with an increase in abundance of *proteobacteria*and *Marinobacter* during the process. This study is one of the first to provide a comprehensive characterization of hydrocarbon, toxicity and microbial communities in Eastern Mediterranean deep sea environment, which will broaden our knowledge about the influence microbial response to crude oil, oil biodegradation and toxicity change in deep sea environments.

Anaerobic digestion, an indispensable treatment process for the disposal of sludge from municipal wastewater treatment plants in China

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In China, increasing numbers of municipal wastewater treatment plants have been built to deal with growing populations and increasing water use and disposal. Through investigated the production and characters of the sludge from the municipal wastewater treatment plants and the treatment and disposal method, it founded that most designers do not take into account sludge treatment and disposal when designing and constructing municipal wastewater treatment plants. In the past, municipal wastewater treatment plants ended sludge treatment when the water content declined to about 80%, which meets the national standard for landfill. And it has been the most common disposal method since 1993. However, landfill sites no longer want to accept sludge because of the damage it causes to their facilities. Accordingly, composting, incineration, thermal drying and anaerobic digestion are being investigated as solutions to the disposal of waste sludge. As a result, Chinese government has developed an economic support plan and formulated policies to promote development of the sludge treatment industry. The sludge treatment industry in China will likely undergo great growth in the next few years. Anaerobic digestion is the most common process used for sludge minimization and stabilization in many developed countries, but there have been very few successful anaerobic digestion sludge treatment facilities in Chinese municipal wastewater treatment plants. Nevertheless, anaerobic digestion is regarded as an environmentally-friendly treatment method because it can recycle the energy required for treatment and reduce the release of greenhouse gases. Anaerobic digestion is the treatment method preferred by most people engaged in sludge treatment research and policy, and it will have a rapid and sound development in China.

Sino-US Comparative Analysis of Shale Gas Gevelopment and Utilization

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As clean, efficient and high-quality unconventional natural gas resources, exploration and development of shale gas can effectively enhance the proportion of natural gas in primary energy consumption structure, to improve energy structure and ensure energy security. Attacking from the perspective of feasibility assessment, nineteen indicators are selected from critical factors of market prospect, eco-safety, resources, mode of occurrence, and general conditions of exploration and development to formulate a feasibility assessment indicator system for China's shale gas exploration. A comparative study on cases of the United States and China is done to evaluate the appropriateness of recent China's extensive shale gas exploratory effort. The results of the study indicate: (1) Market demand, cost and price, core technology, gas deposit, water resources contamination, water supply and government policy are critical factors swaying the exploration of shale gas; (2) The scoring of comparative study indicates significant gap between the feasibility levels of shale gas exploration of China and US, which are in the moderately lower and moderate regions respectively; (3) The gap between the values of feasibility ascribes to the great disparities of the shale gas deposit and the criteria of general exploration and development between China and US. Whereas the actual situations of the shale gas exploration in the two countries, the score resulted from the comparative study shows significant correlation.

Tolerance of macrophytes to sediment anoxia and implication for vegetation restoration of eutrophic waters

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In ecological restoration projects conducted in eutrophic waters of China, vegetation recovery is usually restricted by highly organic-enriched sediment characterized with anoxic conditions. The effects of sediment anoxia on a submersed macrophyte species *Hydrilla verticillata* and the rhizospheric biogeochemistry were investigated in a simulation experiment. It was indicated that moderate level of sediment anoxia could stimulate biomass accumulation and root growth, but more severe anoxia inhibited shoot elongation and carbon synthesis. The submersed macrophytes showed some degree of tolerance when exposed to sediment anoxia, which could be suggested by the improved anaerobic respiration and metabolism activities. The responses of rhizospheric microbial community and biodiversity to anoxia were studied as well and there was an affinity between sediment anoxia, rhizospheric microorganism and plant tolerance. The study suggested submersed macrophytes restoration may be easier in some eutrophic waters with moderately anoxia sediment.

Impact of nitrogen loading on the seedlings' emergency and early growth of seed bank from a river in the Chaohu Lake Basin

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There is severe eutrophication and ecosystem degradation in Chaohu Lake, the fifth largest freshwater lake in the Yangtze flood plain of China. The aim of this experiment was to identify the role of water level and nitrogen loading (ammonium and nitrate) on seedlings emergency and early growth of seed bank from a river of the Chaohu Lake Basin. The moist condition was suitable for germination of the species in Hangbuhe River's seed bank. With increasing nitrogen loading in the water column, the competition advantage of aquatic species declined and the growth of terrestrial species were promoted. While under flooding condition, when the nitrogen concentration increased, the growth of the aquatic ones, especially *Vallisneria natans* (Lour.) Hara, were inhibited. When the concentration of NH_4^+-N was 0.37 mg/L in the water column, the early growth of *V. natans* tended to be inhibited in the experiment. The result showed that flooding was the primary limiting factor on seed germination and seedling establishment in the Chaohu Lake Basin, and the inhibiting effects of nitrogen might be the main drive mechanism of macrophytes degradation in flooded condition. Therefore, reducing the water level and improving the water quality may promote the germination of seed and colonization of aquatic plant community in restoration engineering.

In-situ fabrication of supported iron oxides from synthetic acid mine drainage: High catalytic activities and good stabilities towards electro-Fenton reaction

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Acid mine drainage (AMD) contains a large amount of ferrous iron and the recovery of iron oxides from the AMD has been of extensive research interest. Here we report a novel air-cathode fuel cell strategy to in-situ utilize ferrous iron in the AMD for the fabrication of heterogeneous electro-Fenton catalysts. Such a fuel cell strategy demonstrated the advantage of controllability and flexibility that carbon supported iron oxides, including FeOOH/GF, Fe_2O_3/GF and Fe_3O_4/GF, could be obtained via regulating the calcinating condition. Experiments on the RhB degradation suggested a higher electro-Fenton catalytic activity of Fe_3O_4/GF than the Fe_2O_3/GF and FeOOH/GF composites, which was attributed to the presences of Fe(II) and octahedral site in the Fe_3O_4 structure. Both the HO• and HO_2• radicals were generated from the decomposition of H_2O_2, while the HO• radicals were responsible for the majority of RhB degradation. The heterogeneous electro-Fenton reaction occurring on the iron oxide/GF composites at neutral pH were suggested to be completely surface-catalyzed without participation of soluble iron species. The iron oxides maintained their structures in the electro-Fenton process, therefore exhibiting good stabilities for the recycling utilization. The air-cathode fuel cell technology has a potential for iron recovery from the AMD, and provides an effective way for fabricating heterogeneous electro-Fenton catalyst with high catalytic activity and good stability.

Application of algal hydrolysate in the enhancement of ethanol production process from lignocelluloses

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Enzymatic process was one of the critical steps in the bio-refinery process. To improve the enzymatic efficiency different additives including inorganic and organic substances have been added. In the current paper algal hydrolysate was used to replace the buffer solution in the enzymatic process. The hdyrolysate was made from the algal biomass harvested from Lake Chaohu. Results indicated that additive hydrolysate could promote the enzymatic efficiency of corn stover by 50% compared to the process using the citrate buffer solution. The hydrolysate was separated into several fraction based on the molecular weight and each fraction was characterized. Results indicated that the algal hydrolysate with the lower molecular weight (0-1000) was the major function parts and had a significant influence on the enzymatic process. Role of Ca^{2+} involved in the neutralization process of acid hydrolyzed algal solution was also analyzed. Results showed that the increase in net glucose yield was attributed to the binding of hydrolyzed algal proteins and Ca^{2+} to lignin, which protected cellulase from binding to lignin. The enzymatic hdyrolysate of corn stover was able to be directly used in the yeast fermentation without supplement of external nutrients. This study demonstrates a potential approach of using harvested bloomed algae as a co-substrate to significantly enhance the ethanol production from lignocellulosic biomass.

Nutrients release and bacterial pathogen indicators inactivation in surface soil amended with dewatered sewage sludge in pot experiment

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Huge volumes of dewatered sewage sludge (DSS) are generated annually from wastewater treatment plants in China, which component is very complicated and contain organic matter, nutrients, and pathogens. Due to the concern to the environment, land application has become an environmental friendly disposal method for recycling the nutrients and organic matter in the sludge. In this study, pot experiments were carried out to investigate the nutrients release and bacterial pathogen indicators inactivation in typical surface soil in Hefei area amended with DSS during three months periods. The results showed that the pH, ammonia nitrogen and available phosphorus in surface soil flocculated with the amendment of DSS and kept at high level, indicating the application of dewatered sewage sludge should be carried out in dry season. After three months, the total coliforms, fecal coliforms and Salmonella spp were under the detected limit.

Analysis of polyphosphate during the enhanced biological phosphorus removal process using Fourier Transform Infrared (FTIR) spectroscopy

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Two enhanced biological phosphorus removal (EBPR) reactors were operated with synthetic wastewater at using different Chemical Oxygen Demand/Phosphorous (COD/P) ratios. The sludge samples at different sample time were lyophilized and characterized by Fourier Transform Infrared (FTIR) spectroscopy. Results showed that profiles of the infrared spectra from the two reactors were similar but the spectral intensities were different. The spectral intensities at 1260cm^{-1} and 890cm^{-1} of the sludge samples from the reactor at low COD/P ratio were relatively stronger, but those of the reactor at high COD/P ratio were relatively weaker. The principal component projection plot of FTIR spectra analyzed with principal components analysis (PCA) showed that the sludge samples at same COD/P ratios assembled together implicating the principal component projection plot could discriminate the sludge samples from different reactor. The infrared peak intensity at 890cm^{-1} decreased in the anaerobic phase and increased during the aerobic phase which varied correspondingly to the release and absorption of phosphate. The infrared peak near 890cm^{-1} was separated and integrated with Gaussian peak fitting method. The integrated areas were correlated to the polyphosphate content in the sludge. Furthermore, the infrared data were selected between 840cm^{-1} and 1200cm^{-1}, and partial least squares (PLS) was used to establish the correlation model between the FTIR spectra and polyphosphate content. The established model can be used for the prediction of the polyphosphate content. Results showed that the prediction values were in good accordance to those determined by chemical method. This work provides new method for the recognition of polyphosphate in the sludge and provides the basis for the rapid determination of polyphosphate.

Microbial community analysis on fermentative biohydrogen production from phenol-containing wastewater

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The anaerobic sludge was employed to produce hydrogen in the presence of phenol at 400-7000 mg COD/L. The maximum hydrogen yield, hydrogen production rate and substrate degradation rate were 0.87 mol H_2 mol^{-1} glucose, 2.68 mL H_2/h and 99.94%, respectively with addition of 800 mg COD/L phenol. Actate, propanoic acid and butyrate were the main metabolite and butyrate production was positively correlated with the phenol concentration. Denaturing gradient gel electrophoresis analysis demonstrates thatthe addtion of phenol had a considerable effect on the microbial community structure of anaerobic sludge. The optimum microbial communities for fermentative biohydrogen production from phenol-containing wastewater were *Oxalobacteraceae* bacterium QD1, *Acidovorax* sp. Tpl-22, *M. paucivorans* strain VTT E-032341, *Janthinobacterium* sp. TP-Snow-C26, *Janthinobacterium* sp. 7, *Clostridium* sp. BS-1, *C. cellulosi* strain D3, and *Janthinobacterium*.

Properties of bio-oil from co-pyrolysis of biomass impregnated with urea over CuO/ZSM-5 catalysts

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The pyrolysis of biomass is a promising technique to convert biomass into liquid product called bio-oil, and has received increasing attention in recent years. However, the poor properties of bio-oil and the deactivation of catalysts mainly caused by carbonyl group and other unsaturated bond limits its industrial application. In order to overcome those drawbacks, the co-pyrolysis of biomass impregnated with urea was conducted in a fixed bed reactor in this study, and the effects of ZSM-5 and CuO/ZSM-5 catalysts on the co-pyrolysis were also researched. Results show that the content of carbonyl compounds in the bio-oil prepared by co-pyrolysis reduced, and some new kinds of high value nitrogenous heterocyclic compounds were obtained. The presence of catalysts, especially CuO/ZSM-5 catalysts in the co-pyrolysis process, can greatly promote Maillard reaction and increase yields of aromatic and nitrogenous heterocyclic compounds with high value of practical application.

Aromatics and Olefins Production from Sewage Sludge Catalytic Fats Pyrolysis

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In this study, sewage sludge catalytic pyrolysis was explored for the production of olefins and aromatic hydrocarbons and nutrient-rich bio-char. Pyrolysis temperature and catalysis temperature were investigated to obtain an optimal condition in terms of hydrocarbons production. The optimal pyrolysis and catalysis temperatures were 500°C and 600°C, respectively. Carbon yields of olefins and aromatic hydrocarbons were 24% and 19%, respectively. For comparison, lignocellulosic biomass (red oak) was tested under the same conditions, which produced maximum carbon yield of olefins and aromatic hydrocarbons of 15% and 19%, respectively. E*x-situ* and *in-situ catalytic*process were compared in this study. Results show that e*x-situ* process owns higher yield of olefins, while *in-situ* process generates more aromatic hydrocarbons.

Persistence of mitochondrial DNA markers as fecal indicators in water environment

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Fecal contamination in water has received growing research and environmental concern throughout the world, and effective identification of pollution sources is critical for the attenuation or elimination of such pollution. Mitochondrial DNA (mtDNA), as a genetic marker directly from intestinal exfoliated cells of hosts, has recently been considered as a good source indicator for fecal pollution.

Persistence of host-specific genetic markers may vary under different environmental conditions, which hampers the application of the mtDNA technologies in source tracking of fecal contamination. Understanding the temporal (seasonal) stability of mtDNA markers in environmental waters is essential for their practical applications.

In this study, we investigated the influence of temperature and sunlight on mtDNA markers in river water microcosms under different laboratory conditions as well as temporal changes of their persistence in field environments. The results of this study give a better understanding of the fate of mtDNA as a fecal indicator in environmental water, which helps to monitor water quality and control fecal contamination in practice.

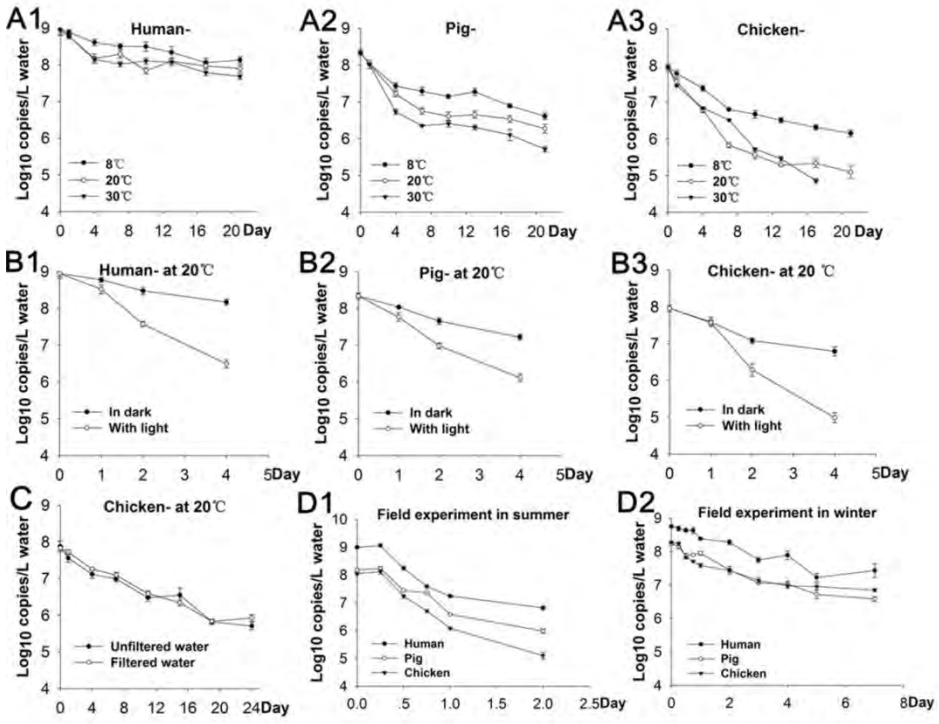

Figure1 *Decay curves of mtDNA markers under different conditions. (A1) Human-, (A2) pig-, and (A3) chicken-mtDNA markers in microcosms (unfiltered river water) incubated at different temperatures in dark; (B1) human-, (B2) pig- ,and (B3) chicken-mtDNA markers in microcosms (unfiltered river water) incubated with light/in dark at 20°C; (C) chicken-mtDNA markers in microcosms (unfiltered/unfiltered river water) incubated at 20°C in dark; human-, pig- ,and chicken-mtDNA markers in field experiment in summer (D1) and winter (D2). Initial fecal concentration was 1 g feces/L and the data are showed as mean ± standard deviation.*

Each group (human-, pig- and chicken-) of mtDNA markers decreased faster within the first several days and tended to be more stable during the cultivation process under different environmental conditions. Higher temperature increased the decay rates, and T90 (time needed for 90% reduction) values of the three mtDNA markers under dark condition (8°C, 20°C and 30°C) were between 2.0 and 13.8 days. Light exposure (10000 lux) had a strong accelerating influence on the decay rates of mtDNA markers, resulting in T90 values between 1.7 and 2.2 days for the three mtDNA markers at 20°C.In addition, predation from plankton in environmental water also increased mtDNA markers decay rates. Among the three mtDNA markers, human-mtDNA marker persisted the longest, followed by pig- and chicken-mtDNA markers. In summer, copy numbers of all three mtDNA markers reached the detection limit within 2 days, while in winter, three mtDNA markers could persist more than 1 week and still be detectable. Therefore, mtDNA markers are suitable for indicting more recent event of fecal contamination in summer and more applicable for fecal source tracking purpose in winter due to their longer persistence.

Changes and recovery of gut microbiota and host metabolism in mice exposed to tetracycline-HCL

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Antibiotics can disturb gut microbial community and host metabolism. However, the relationship of changes in gut microbiota and host metabolism remains unclear, and their recovery after antibiotics exposure needs further characterization. In this study, male mice were exposed to 0.5, 1.5 and 10g/L tetracycline hydrochloride (TET) for 2 weeks, then recovered without TET for another 2 weeks. The 2-week TET exposure significantly increased the abundances of antibiotic resistance genes (ARGs) and mobile genetic elements (MGEs), especially, in the 10 g/L TET group (Fig.1). Abundances of *Firmicutes* increased in the 0.5 and 1.5 g/L TET group, but *Bacteroidetes* increased in the 10 g/L TET group (Fig.2). The energy production and conversion and lipid transport and metabolism of gut microbiota increased in the 0.5 and 1.5 g/L TET groups (Fig.3). The increases of these pathway-related host-gut co-metabolites were found in mouse urine, indicating gut microbiota influenced host metabolism (Fig.4). After 2-week recovery, these changes caused by low level TET exposure are reversible, except for *tet* genes. However, for high level TET, these changes are irreversible. Our results suggested that TET exposure changes the gut microbiota community and functions, which further influences the host metabolites. Different TET level has different recovery effects. During the application of TET, their dosage should be effectively considered and controlled. But even low level TET exposure, the ARGs should be paid attention.

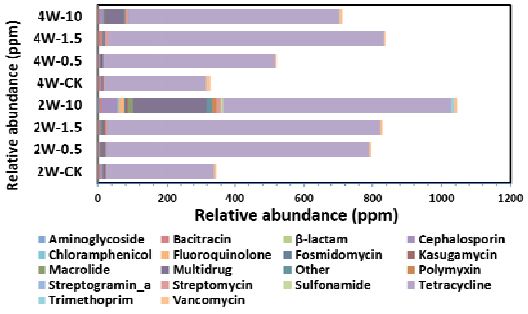

Fig.1 Abundances and diversity of ARGs in each group.

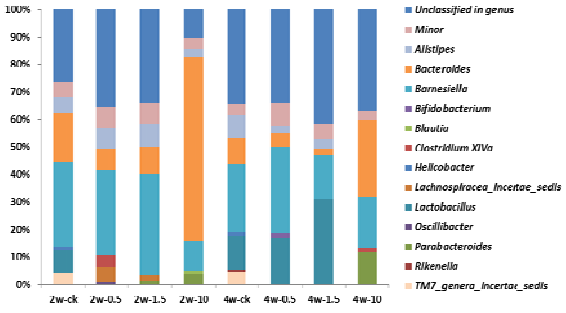

Fig.2 Abundances (%) of the major (> 1% in any sample) orders in the 8 samples.

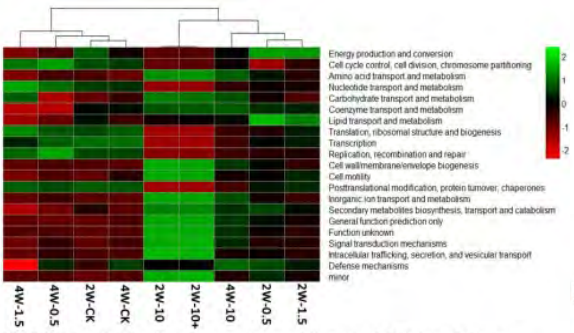

Fig.3 Relative distribution of sequencing reads in major COGs in each Groups.

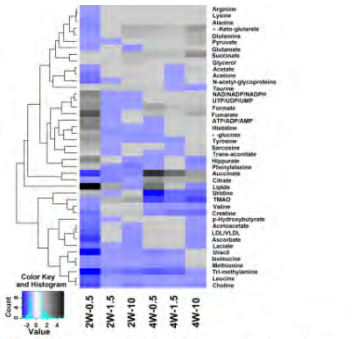

Fig.4 Altered metabolites of mouse urine in each group.

Comparative assessment of bioelectrochemical system, activated sludge and anaerobic treatment processes for municipal wastewater treatment

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The task of wastewater treatment is shifting from simply decontamination to comprehensive utilization and resources recovery, for which biological approaches are considered as the most promising options. This review provides a comparative assessment on three prevailing biotechnologies (i.e., activated sludge, anaerobic treatment and bioelectrochemical system) for municipal wastewater treatment. A semi-quantitative evaluation was conducted in six assessment criteria: treatment efficiency, energy consumption, process robustness, long-term stability, economics and environmental footprint. A comprehensive assessment of each technology in multi-factors is achieved by using a radar chart. The estimated overall ratings of activated sludge, anaerobic treatment and bioelectrochemical system are 2.3, 3.0 and 3.0, respectively, indicating that anaerobic treatment and bioelectrochemical system are generally more attractive than activated sludge for municipal wastewater treatment. It is suggested that a promising way for sustainable wastewater treatment would be to integrate multiple technologies. This assessment may offer useful guidance on the future development of wastewater treatment technology.

Enhancement of biodieselproductivity in the heterotrophic cultivation of *Chlorella vulgaris* with acetate under nitrogen deficient stress

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How to combine fatty acids production with COD recovery from wastewater via microalgae is becoming a hot research topic. In this study the heterotrophic cultivation of *Chlorella vulgaris NIES-227* were investigated systematically under six types of media (combinations of nitrogen repletion/depletion and phosphorus repletion/limitation/depletion) with acetate as carbon source. Both maximum fatty acids content (60%) and fatty acids productivity(26 mg/L/day) were obtained in nitrogen depletion with phosphorus repletion (N-&P), which were 3.8and 1.6 times higher than those in nutrient complete medium (N&P), respectively. Meanwhile, the conversion efficiency of COD to fatty acids increased from 12% (N&P) to 37% (N-&P).During the whole experiment, the supply level of phosphorus showed less of an effect on fatty acids productivity, which was different from the phenomenon in autotrophic cultivation. This study demonstrated that nitrogen starvation was the real “fatty acids trigger” in heterotrophic cultivation with acetate. Furthermore, it implies a potential to elegantly combine biodiesel production with wastewater treatment to turn wasted COD to high value product (fatty acids).

Pre-industrial vs. contemporary nitrogen fluxes and fates as influenced by global croplands expansion

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Land use and land cover changes, and widespread fertilizer applications for food production, are among the most important effects of human actions on the global nitrogen (N) cycle. Here we quantify changes in fates and fluxes of N that have accompanied global cropland conversion from pre-industrial to modern times. We combine natural N isotope constraints on pre-industrial N cycling with global mass-balance modeling to investigate the role of cropland conversion on gaseous N emissions (i.e., NH_3, NO, N_2O, N_2) and hydrological N leaching fluxes. Our analysis reveals a near doubling in fixed N inputs to the terrestrial biosphere owing to cropland expansion, amounting to a modern increase of 165.43 Tg N yr^{-1} vs. our pre-industrial estimate. This shift has resulted in the export of 104.52 Tg N yr^{-1} to the hydrologic system and 96.16 Tg N yr^{-1} of gaseous emissions to the atmosphere, representing a 39.13 Tg N yr^{-1} increase in the amount of N lost from the terrestrial biosphere. NH_3, NO, N_2O and N_2 emissions increased from 8.56, 16.61, 11.66 and 31.91 Tg N yr^{-1}, respectively, in 1860 to 17.66, 23.62, 15.23 and 39.66 Tg N yr^{-1}, respectively, in 2000. We show that N_2 losses were less than 75% of the total rise in reactive N (Nr) losses (Nr gases plus leaching), however, revealing limited capacity for this inert sink to mitigate global human N alternations. Our study thereby establishes constraints on the effects of cropland expansion on the forms and fluxes of N throughout the land surface, with implications for human health and welfare, biodiversity declines, and climate change effects related to the global N cycle.

A modified two-point titration method for volatile fatty acids determination in anaerobic systems

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In recent years, anaerobic digestion of wastewater treatment has been widely applied for its potential of producing renewable energy in the form of biogas, small land requirement and low excess sludge production. Volatile fatty acid (VFA) concentration is one of the most sensitive parameter to start up and successfully control of anaerobic systems. Two-point titration method has been widely adopted for VFA determination in anaerobic systems, but this method didn't consider the loss of bicarbonate in the form of CO_2 during titration but also should know the concentration of other sub-buffer systems such as phosphate and ammonium in advance. Therefore, a modified two-point titration method was developed for VFA measurement in this study, and the samples from laboratory-made and anaerobic reactors were taken for validation of this new method. The results indicate that the two-point titration method presented here was not only accurate within the relative error of 10% and being rid from the influences of coexisted buffer systems, along with good reproducibility, but also rapid for that the time consumed by a sample was about 10 to 20 minutes at the titrative speed of 0.7 ml/min. The method presented here was demonstrated to be quicker and simpler compared to others for VFA determination, and thus makes it more possible for on-site monitoring of VFAs in anaerobic systems.

Nitrogen and source identification of water in an agricultural and forest complex watershed in subtropical China

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The influence of land use on potential fates of nitrate (NO_3^-) in agricultural and forest complex watershed has not been documented extensively. The dual stable isotopes of NO_3^- ($\delta^{15}N_{nitrate}$, $\delta^{18}O_{nitrate}$) play an important role in tracing and interpretation of ecological processes and providing information regarding the nutrient sources and biogeochemical cycles of a system.

Here, we described an agricultural and forest watershed in Jiangxi province, China to examine how land-use setting influences fates of NO_3^- in surface and shallow ground waters. Inorganic nitrogen in surface-, ground water and rainfall, environmental isotopes ($\delta^{15}N_{nitrate}$, $\delta^{18}O_{nitrate}$) of surface and ground water were measured to evaluate the nitrogen deposition, nitrogen pollution and nitrate sources identification.

The results showed that: (1) in natural pond and the Jiazhu river, $\delta^{15}N_{nitrate}$ values ranged from 5.6 ‰ to 10.7 ‰ and $\delta^{18}O_{nitrate}$ values ranged from 1.2 ‰ to 6.6 ‰, respectively, indicating that nitrate could have come from either organic sources (such as manure and plant compost), or from the soil; (2) in the fishponds and shallow groundwater (including drinking wells and monitoring wells in the paddy field), $\delta^{15}N_{nitrate}$ values ranged from 11.7 ‰ to 29.4 ‰ and $\delta^{18}O_{nitrate}$ values ranged from 0.1 to 13.6 ‰, respectively, indicating that nitrate was most likely to have come from organic sources (e.g. manure, domestic sewage, and septic systems). The results suggested that the presence of organic nitrogen sources, such as manure applications to vegetable plots, nitrogen rich fish-farming pond effluent, and domestic sewage, near drinking wells should be avoided.

Forward Osmosis-Enhanced Struvite Precipitation for Efficient Phosphorus Recovery from Wastewater

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Recovery of phosphorus (P), as a non-substitutable strategic resource, from wastewater is regarded as an essential route to meet the future P sustainability and meanwhile protect the aquatic environment. Among the various technical options for P recovery, struvite precipitation is gaining increasing popularity recently due to simultaneously capture of ammonia and P and the production of an excellent slow-release fertilizer. However, this method typically needs higher P concentration for efficient recovery and is costly due to dosage of high-value chemicals, which severely limits its practical application. In this study, we report a more efficient approach for P recovery from wastewater by combining struvite precipitation with FO process. This approach showed several advantages over conventional precipitation methods: 1) the P and ammonia in wastewater were substantially concentrated due to a constant extraction of water while effective rejection of P by a forward osmosis (FO) membrane; 2) MgCl, which serve as the draw solution and may be well replaced by the non-exhaustible seawater, is reversely diffused through the FO membrane to the wastewater to form struvite crystals in a continuous way; 3) High-rate struvite precipitation on the FO membrane surface at feed solution side is favored by the accumulation of both P, ammonia and Mg^{2+} as well as increased local pH; 4) Convenient recovery of P from the membrane surface is allowed. The formation of struvite in this system was confirmed by a series of characterizations including scanning electron microscopy (SEM), energy-dispersive x-ray spectroscopy (EDX), and x-ray diffraction (XRD) analysis. This work implies a high potential of integrating FO with struvite precipitation process for cost-effective and environmentally friendly recovery of P from wastewater.

Removal of heavy metals from minetailingleachate using an alkali-soilsuspension: effects of environmental conditions and removal mechanism

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Generation and seepage of leachates from mine tailing ponds, which usually contain toxic metallic ions and compounds, is unavoidable because of their long-term, open-air storage. These potential leaks therefore pose a serious threat to downstream ecosystems. Herein, an alkali-soil suspension was adopted to quickly and inexpensively treat the leachates. Operational parameters were optimized through batch experiments, which were determined to be a pH of 8.5, a hydraulic retention time of 5 min, and solids concentrations of 20 g L^{-1} using synthetic wastewater. Under optimized conditions, more than 98% of Cu^{2+}, Zn^{2+}, and Cr^{3+} were removed at 30 °C,whileCd^{2+}removal was slightly lower (ca. 93%) for real copper and gold tailing leachates. The removal efficiencies slightly fluctuated with temperature and the organic matter content in soil. A series of instrumental analyses indicated that the main heavy metallic ions in leachates first formed amorphous hydroxides and then deposited on the soil surface under alkali conditions. Small quantities of complexation between metallic ions and organic matters were also occurred.

Improvement of denitrification and settleability of activated sludge by dosing pyrolytic biochar

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The insufficiency of carbon source in activated sludge process is a crucial problem influencing the denitrification effect, and is ubiquitous in WWTPs. In this study, we added biochar obtained from biomass pyrolysis to a bioreactor, and investigated the ability of biochar to serve as the sole carbon source for denitrification from synthetic wastewater. The results of batch experiments show that biochar obtained from lower temperature pyrolysis exhibits higher nitrate removal efficiency than that obtained from higher temperature. In addition, biochar can improve the settleability of activated sludge, which may be caused by changing the physicochemical characteristics of sludge (e.g., flocculating ability, ζ-potential, hydrophobicity, and EPS constituents). This finding indicated that biochar has the potential to improve the efficiency of activated sludge process.

Unique pH-mediated mechanism of photocatalytic degradation toward organic compounds in solution over acidified graphitic carbon Nitride catalyst

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Graphitic carbon nitride is an emerging environmentally friendly photocatalyst for organic pollutants degradation owing to its excellent stability and metal-free property. However, the visible-light-driven degradation mechanism of organic compounds remains unknown to date. In this study, the photocatalytic mechanism of zwitterion organic compounds and chromopores over acidified graphitic carbon nitride (ag-C3N4) was systematically investigated using rhodamine B (rhB) as a model. The results showed the apparent rate constant (k_{app}) of rhB degradation over ag-C3N4 is 11.59×10−3 min−1 at pH 7.0 and it increases to 103.5×10−3 min−1 at pH 3.0 under visible light. Our observations demonstrated that this substantial improvement in photodegradation efficiency is mainly attributed to H+-promoted generation of •OH and adsorption orientation of rhB molecules on ag-C3N4 surface. Step-by-Step N-deethylation and directly oxidizing rhB in bulk solution by indirectly generated •OH is the main degradation pathway which is quite different from conventional photosensitization mechanism on the surface of metal oxide semiconductors. pH can also change the degradation pathway of zwitterions by changing their adsorption orientation onto the surface of catalyst. This research could provide insights into the photochemistry of the emerging C3N4 catalysts.

The Ecological Restoration and Water Quality Improvement of a Heavily Polluted River: a Case Study of Shuangqiao River, the Chaohu Lake*

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Shuangqiao River, one of the most contaminated inflows of the Chaohu Lake, is the main flood channel of the Chaohu City. Its estuary is only 500m away from the intake of waterworks. Suffered from the municipal sewage, industry wastewater, surface runoff and contaminated sludge deposited for decades, the water quality is worse than grade V of surface water standard, thus threatens the drinking-water safety of citizens. Hence, an integrated treatment on aquatic environment of Shuangqiao River was carried out in 2010.

In order to treat the agricultural wastewater and the sewage come from the nearby villages, a multipond-constructed wetland system was built. Before introduced into this system, the agricultural wastewater was first collected by the agricultural drainage ditch, which was rebuilt to ecological ditch to reduce the pollutants and the suspended particles. And the domestic sewage, containing high contents of pollutants, was first introduced into a settling tank, then treated with a land infiltration unit, the effluent was then flow into the pond-constructed wetland system. In this way, the water quality and water flow of the influent could be maintained at stable conditions, thus guaranteed the normal running conditions of the pond-constructed wetland system. The area of this system is 12500m^2 and 4000 ton wastewater was treated per day. The removal rate of COD_{cr}, TP, TN and SS were 64%, 91%, 78% and 92%, respectively.

To control the internal contamination and treat the polluted water upstream, the river was dredged first, and an in situ purification system was constructed afterwords, including artificial plant floating bed, restoration of aquatic vegetation, riparian buffer zones and wetlands on the river mouth. The removal rate of COD_{cr}, TP and TN were 8.45%, 6.5% and 4.8%, respectively. Considering the average flow of the river is 104,400t/d, and the average concentrations of COD_{cr}, TP and TN were 31.9, 0.227 and 5.9 mg/L, the in situ purification system could remove 65, 0.28 and 5.84 ton of COD_{cr}, TP and TN annual.

In general, 26%, 25.2%, 16.4% and 22% of COD_{cr}, TP, TN and SS of this river were reduced through this eco-engineering project. The water quality and ecosystem were improved obviously. This study provided an integrated treatment strategy of the aquatic environment of Shuangqiao River basin, which could be refer to the pollution treatment of other inflow rivers of Chaohu Lake.

Flow diagram of the eco-engineering Multipond-constructed wetland system Plant floating bed

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