

13th IWA Specialized Conference on Small Water and Wastewater Systems

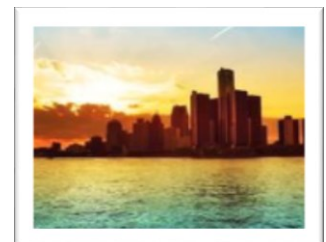
5th IWA Specialized Conference on Resources-Oriented Sanitation

14-16 September 2016, Athens, Greece

Urban sanitation technology development and Reinvent The Toilet Challenge (RTTC) in China

Professor Zifu Li

Centre for Sustainable Environmental Sanitation (CSES)
University of Science and Technology Beijing (USTB)



OUTLINE



Urban sanitation technology development



Reinvent The Toilet Challenge (RTTC) in China

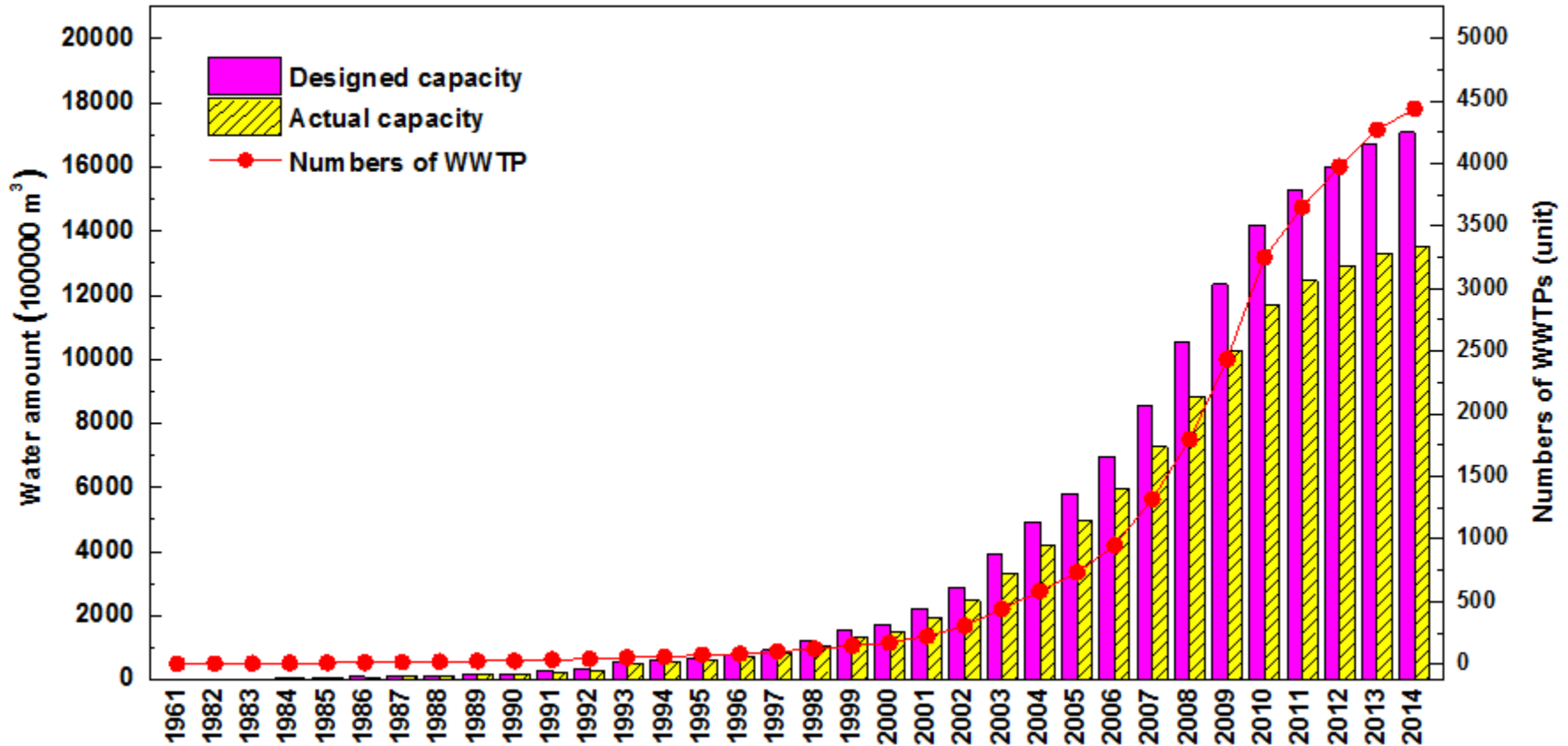


Toilet revolution campaign in China

Part 1:

The state of the art in the wastewater and toilet sections of China

Wastewater treatment capacity

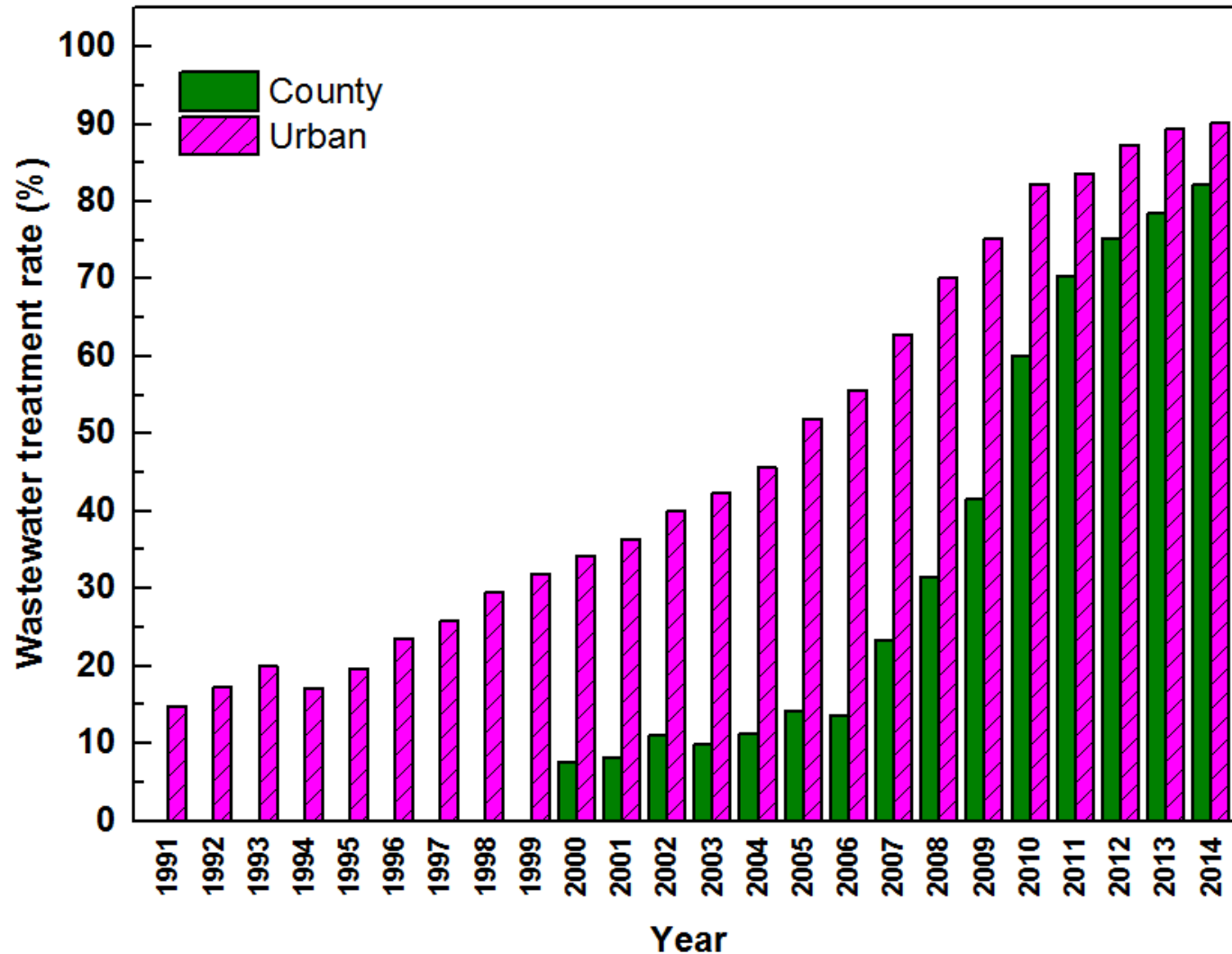


Source: Ministry of Environmental protection of the republic of China, 2015

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Percentages of wastewater treatment in China



Source: China Urban-Rural Construction Statistical Yearbook 2015

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Gaobeidian WWTP in Beijing, Capacity: 1 million m³/d in 1999



Bailonggang WWTP in Shanghai

Capacity: 2 million m³/d in 2013, 3.5 million m³/d in Future

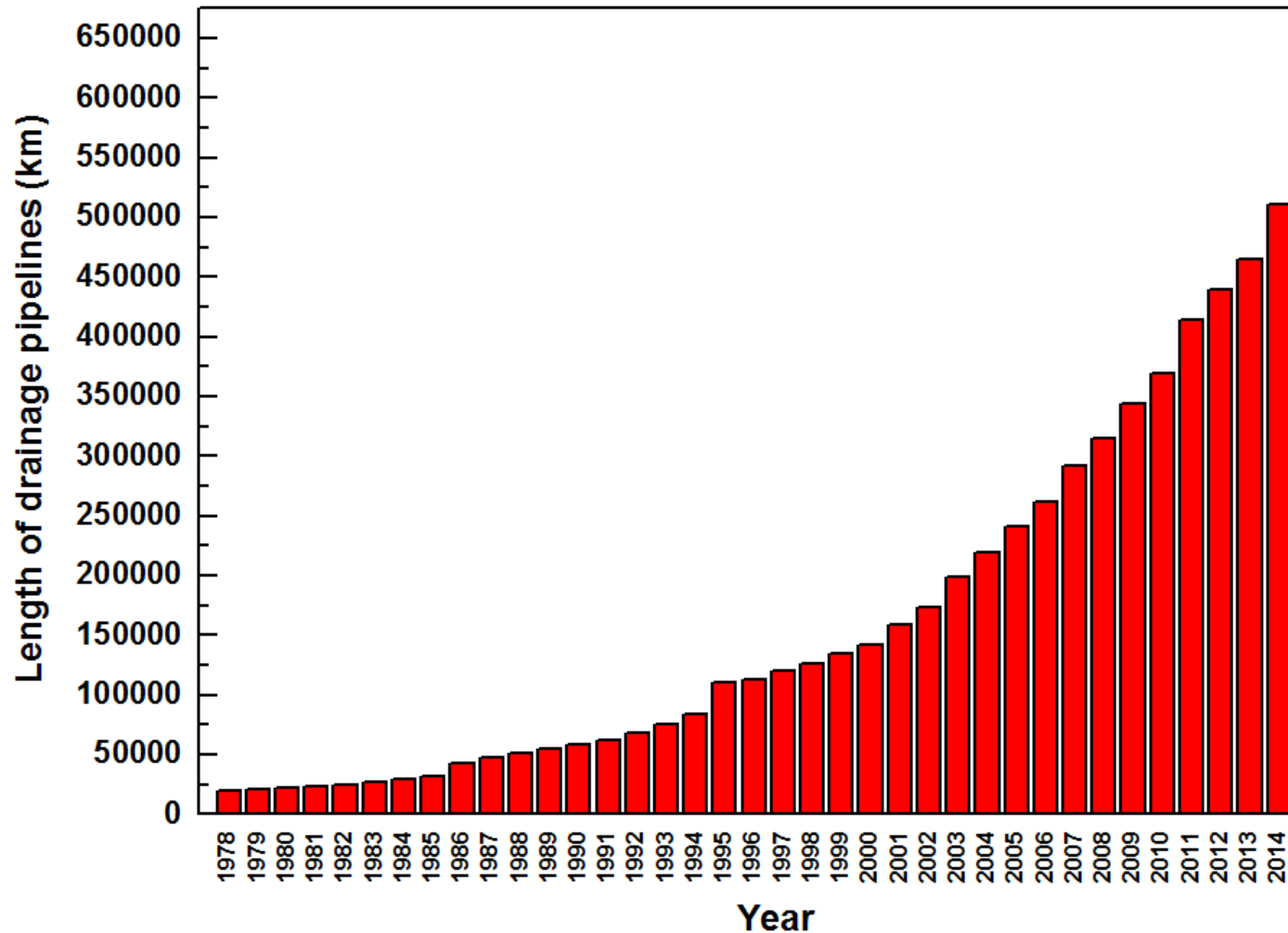
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Main technologies used in municipal WWTPs in China

Biological Technologies	Number of WWTPs	Percentage
A ² /O	1167	26.31%
Oxidation ditches	1160	26.15%
CASS	391	8.81%
A/O	377	8.50%
SBR	297	6.70%
Two-stage biological processes	185	4.17%
CAST	163	3.67%
Activated sludge	162	3.65%
Biolak	110	2.48%
BAF	88	1.98%
MBR	24	0.54%
others	312	7.04%

Length of drainage pipelines in China (1978-2014)

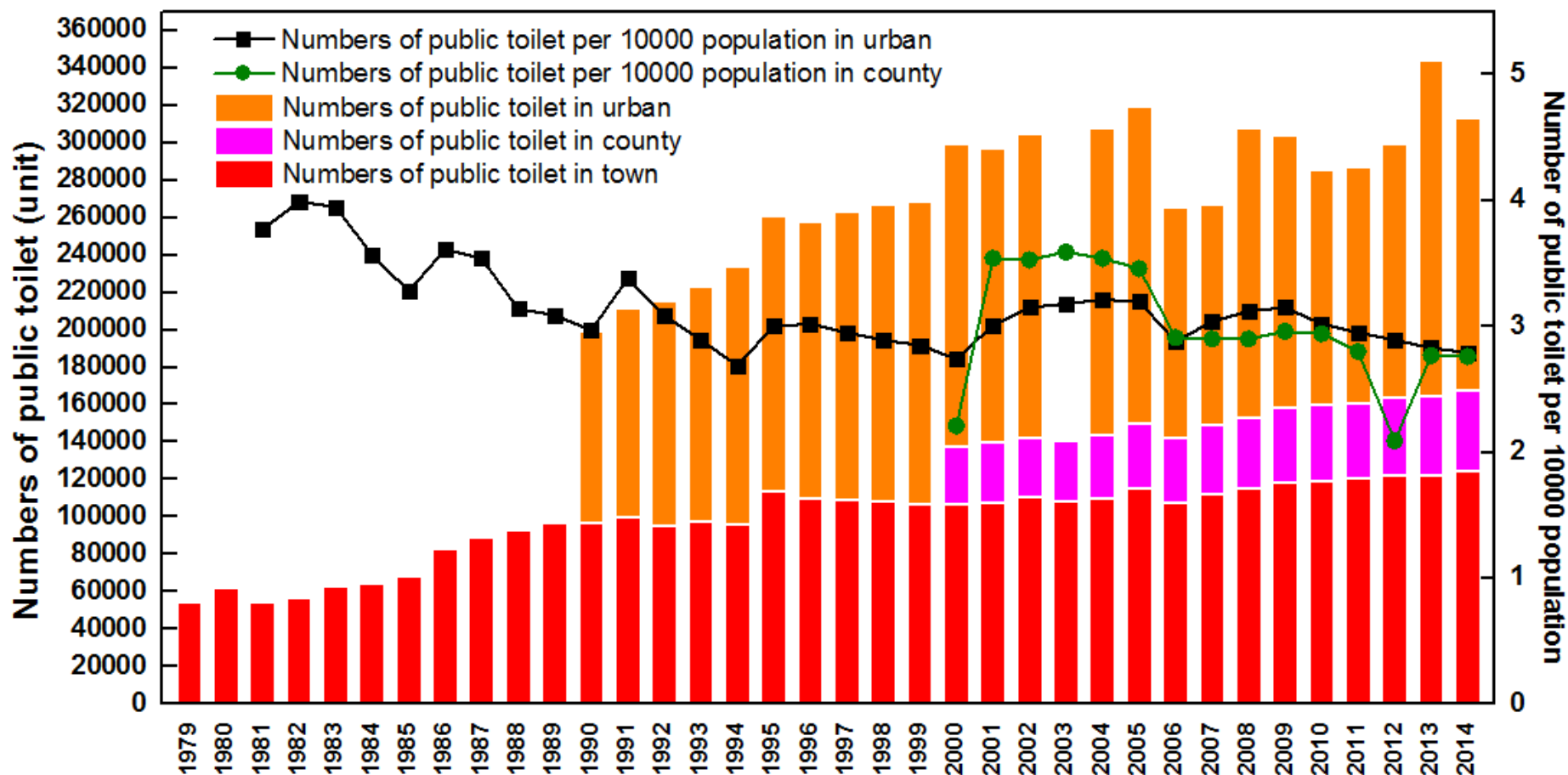


Source: China Urban-Rural Construction Statistical Yearbook, 2015

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Public toilets in China from 1979-2014



Source: China Urban-Rural Construction Statistical Yearbook, 2015

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Public Toilets in China



Public toilet in urban area

Public Toilets in China



Public toilet in rural area

Household toilets



Household toilet in urban area

Primitive Pit Latrine in Rural Areas

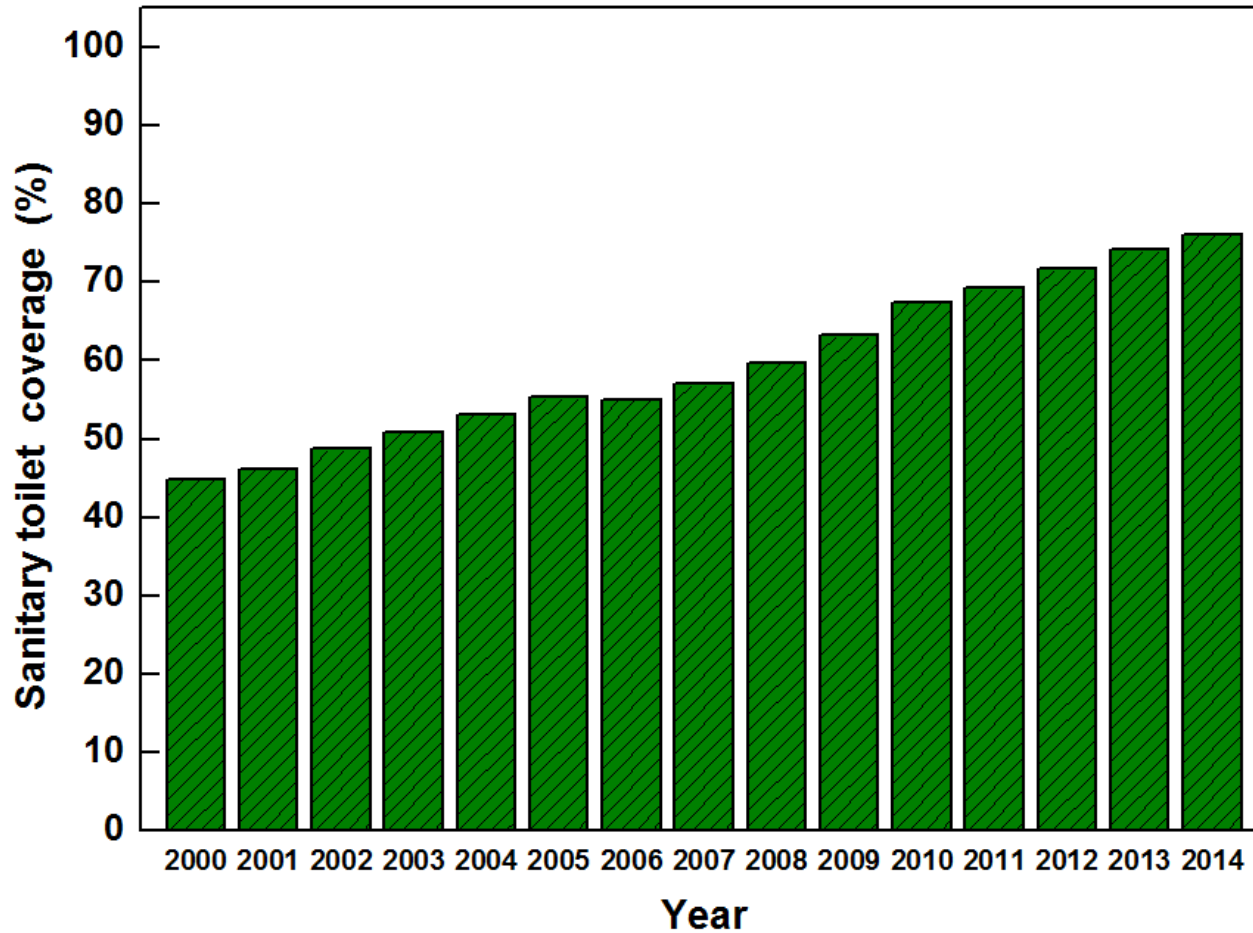
Odor, mosquitoes, unsafe.....



Household toilet in rural area

Household sanitary toilet coverage in rural areas

Source: China statistical yearbook on environment, 2012



Water and sanitation in China, the year 1990 and 2015

		1990	2015	
Population(*1000)		1,165,429	1,401,587	
Percentage urban population		26	56	
Urban	Improved	68	87	
	unimproved	Shared	5	6
		Other unimproved	24	7
		Open defecation	3	0
Rural	Improved	40	64	
	unimproved	Shared	2	3
		Other unimproved	49	31
		Open defecation	9	2
Total	Improved	48	76	
	unimproved	Shared	3	5
		Other unimproved	42	18
		Open defecation	7	1

Source: Progress on sanitation and drinking water, 2015 update and MDG assessment

Part 2:

Reinvent the Toilet Challenge in China

Reinvent the Toilet Challenge of Global Development Program by Bill & Melinda Gates Foundation

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WATER, SANITATION & HYGIENE: REINVENT THE TOILET CHALLENGE

FACT SHEET

SUMMARY AND ANALYSIS

The Water, Sanitation & Hygiene program of the Bill & Melinda Gates Foundation recently challenged 22 universities to submit proposals for how to invent a waterless, hygienic toilet that is safe and affordable for people in the developing world and doesn't have to be connected to a sewer. Eight universities were awarded grants to "reinvent the toilet."

The Water, Sanitation & Hygiene program initiated the Reinvent the Toilet Challenge to leverage advances in science and technology and create a new toilet that will transform

- Raise awareness about this research by publishing scientific papers in journals and articles in various media outlets

REINVENT THE TOILET CHALLENGE GRANTS

Upstream Innovation

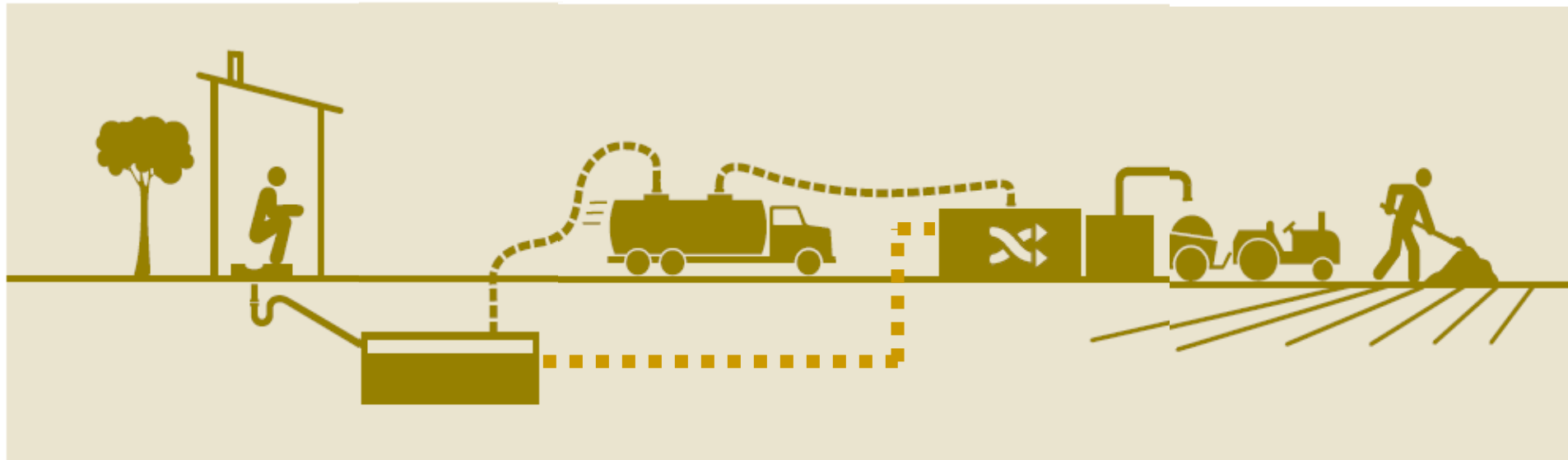
1. A toilet that produces biological charcoal, minerals, and clean water

Professor M. Sohail of Loughborough University and his team propose to develop a toilet to transform feces into a highly energetic combustible through a process combining hydrothermal carbonization of fecal sludge followed by

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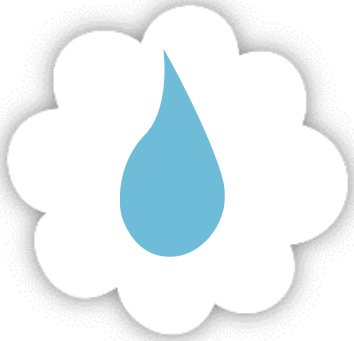
Wastewater treatment development (courtesy of BMGF, modified)



Toilet → Storage → Transportation → Treatment → Reuse/disposal

Reinventing the Toilet –

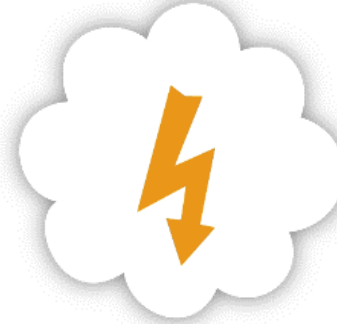
Innovations can save billions of lives
by turning human waste into...



Pure Water



Safe Fertilizer



Electricity



Heat



Fuel



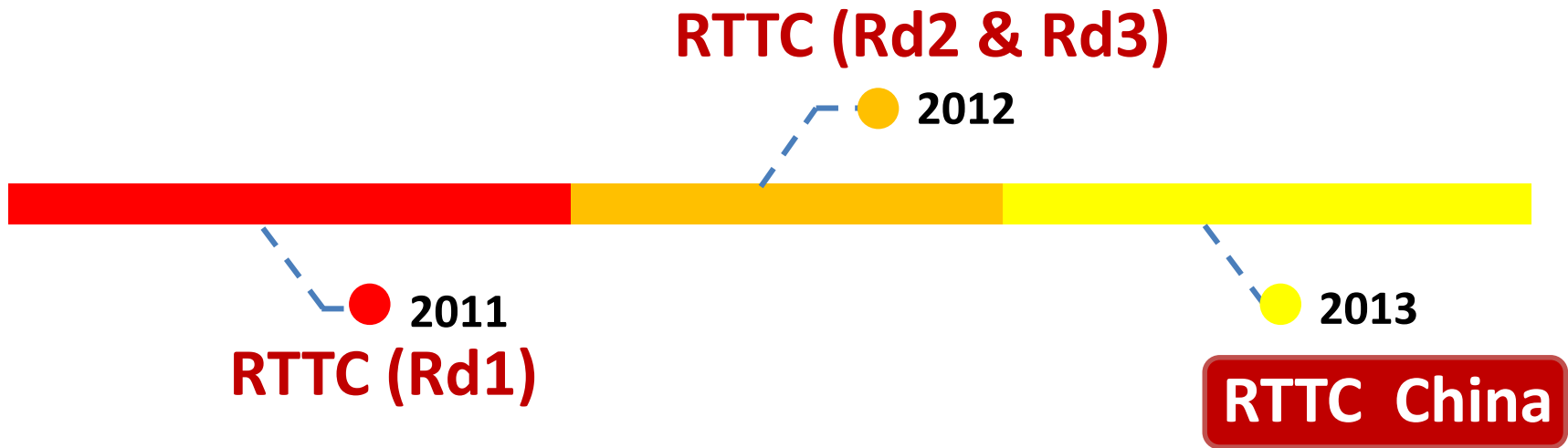
Salt

Evaluation Criterion

- Comfortable for user (no smell, no need to change position while using);
- Affordable (cost < \$0.05/user/day, capital and service costs included);
- Aesthetically appealing;
- Suppressing smell and removing pathogens from waste streams;
- For single family or for a community facility;
- Achieving the above without needing connection to networked power, water, or sewers; and
- Recovering by-products of financial value (e.g. fuel products, clean water, fertilizer) if possible.

Reinvent the Toilet Challenge of Global Development Program by Bill & Melinda Gates Foundation

The vision of this program is of a re-invented toilet that would not need to be connected to a sewer, would not require water, and would be clean and odorless. It would remove pathogens from the environment. It would treat waste as a resource, creating usable energy, agricultural fertilizer, and potable water, all for just pennies per person/day.



Reinvent the Toilet Challenge –China (RTTC China)



1st Round Launch Conference



2nd Round Launch Conference



OVERVIEW: The new toilets in RTTC-China



RTTC China-Round 1

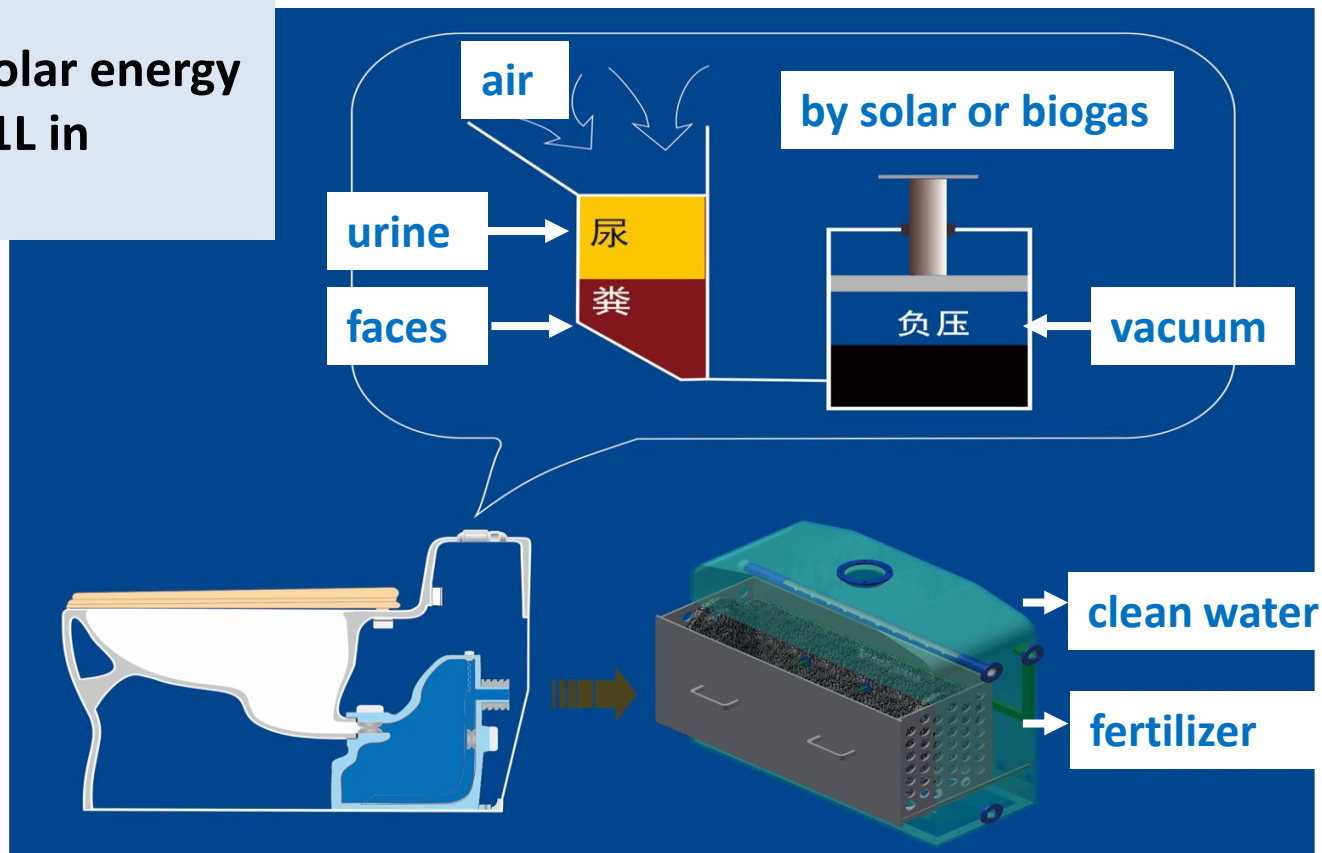
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Air flush toilet

(Beijing EnviroSystems Engineering and Technology Co.,Ltd)

- No sewer, no grid
- Can be driven by solar energy
- Cleaning water < 0.1L in average

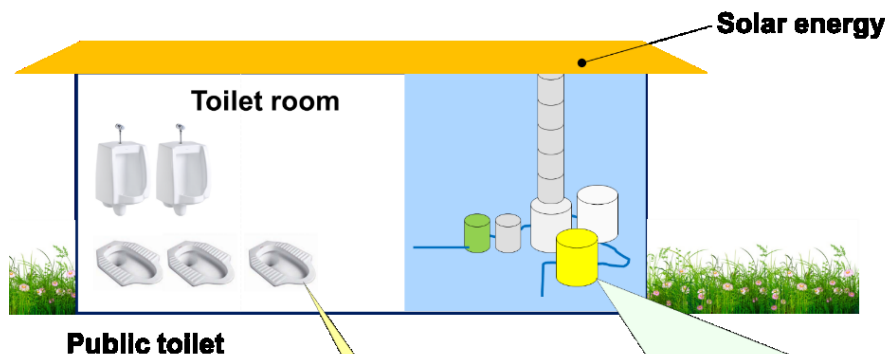


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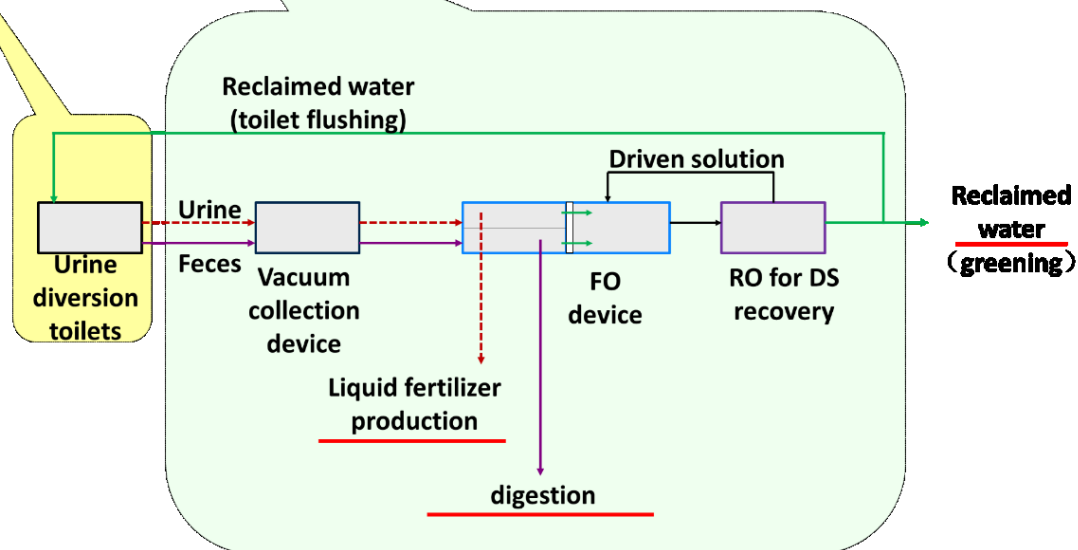
Application of an innovative flat sheet FO membrane module for concentration of source separated urine

(Tsinghua University)



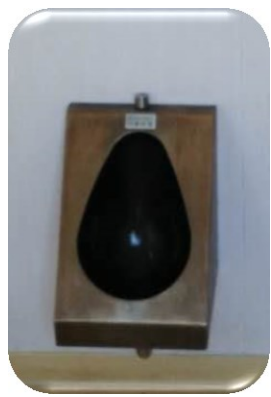
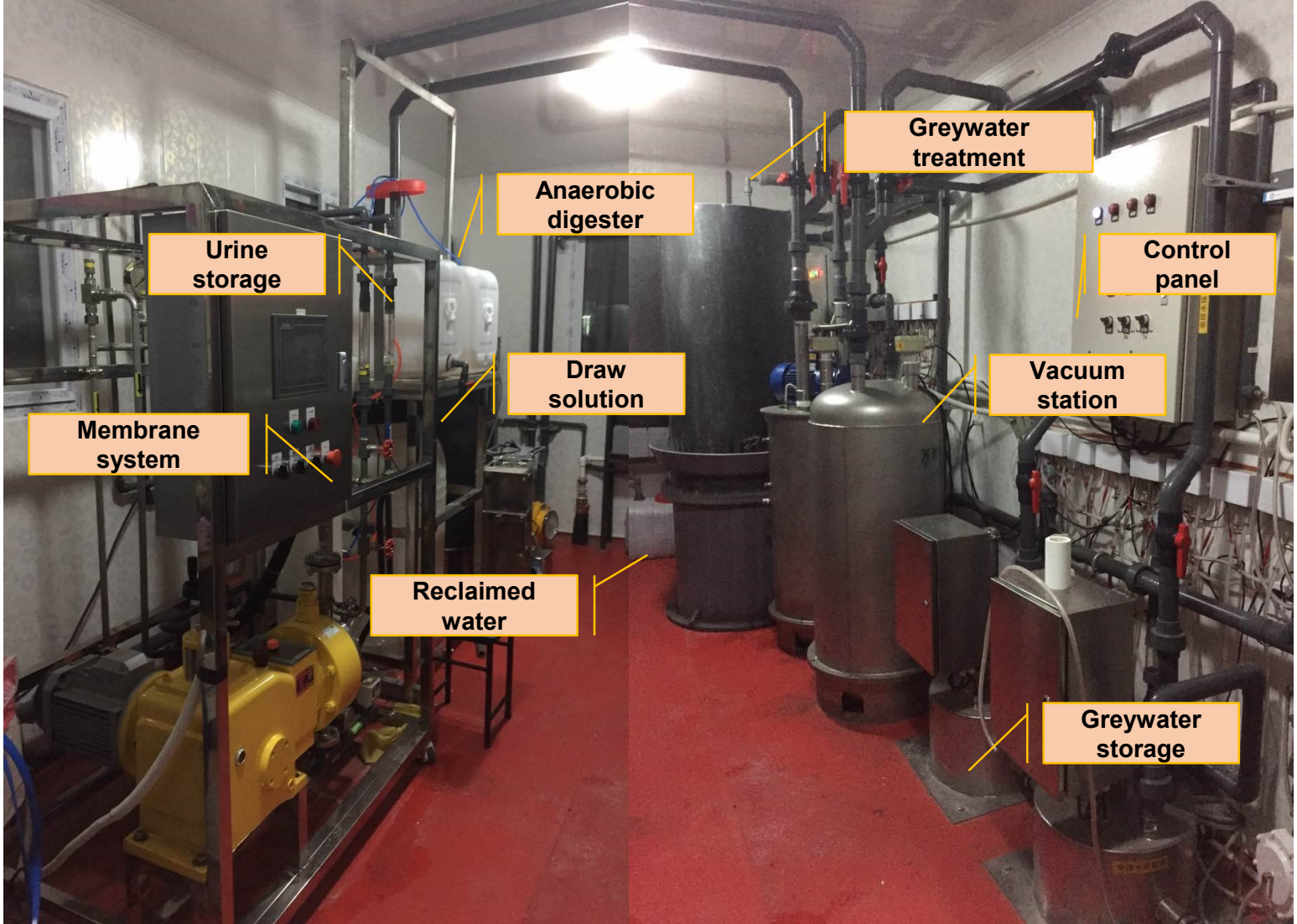
A RO membrane system is used to recovery draw solution in and produce clean water for flush and greening.

Based on a **source-separation toilet system**, the urine and feces are collected separately. The urine is concentrated by **the FO membrane system** and used as a high-efficient liquid fertilizer, the feces is digested to eliminated the pathogens.



Prototype testing





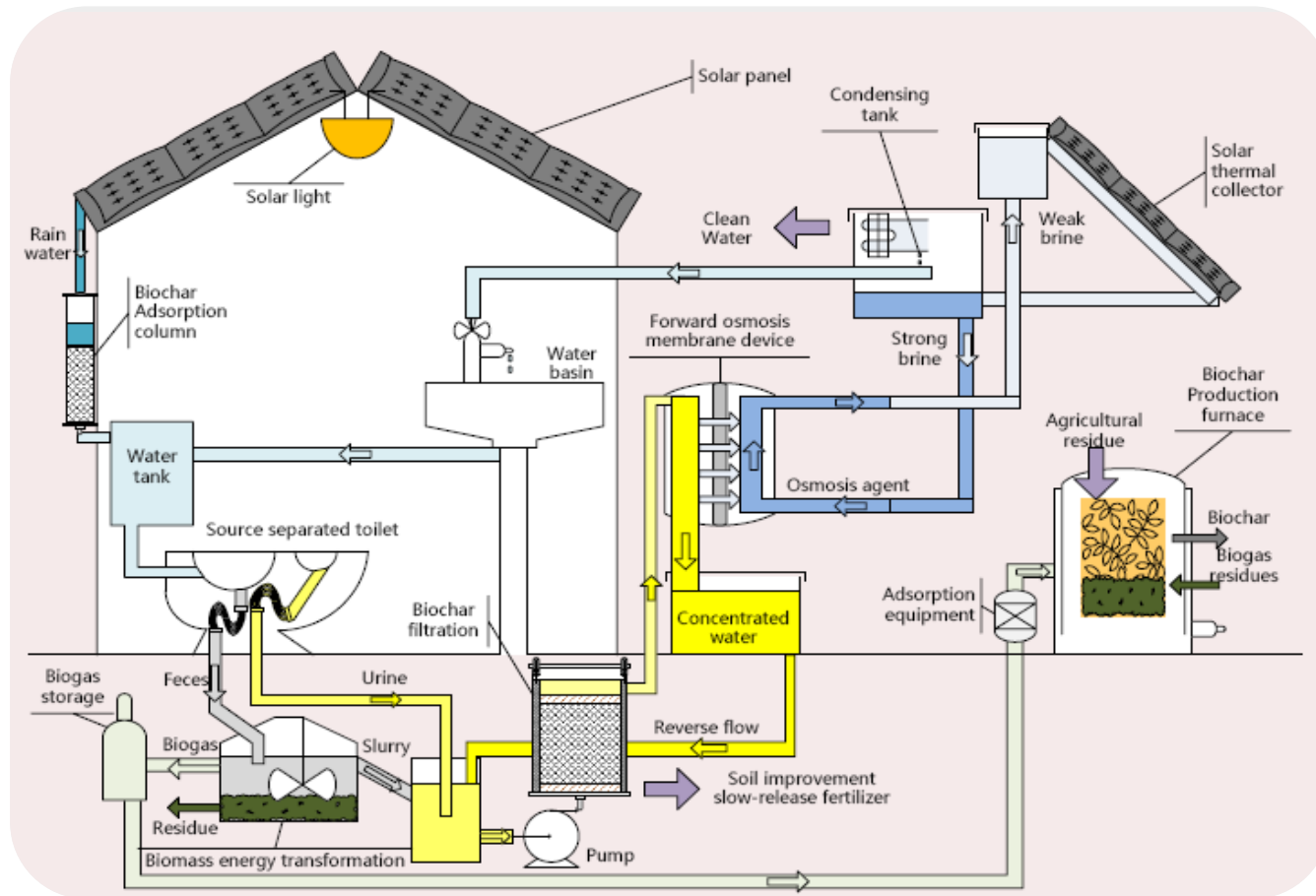
Air flush urinal



Urine diversion vacuum toilet



Toilet wastewater treatment and resource recovery system using FO as the key unit for household toilets with modified biochar pretreated (Tsinghua University)



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Centre for Sustainable Environmental Sanitation



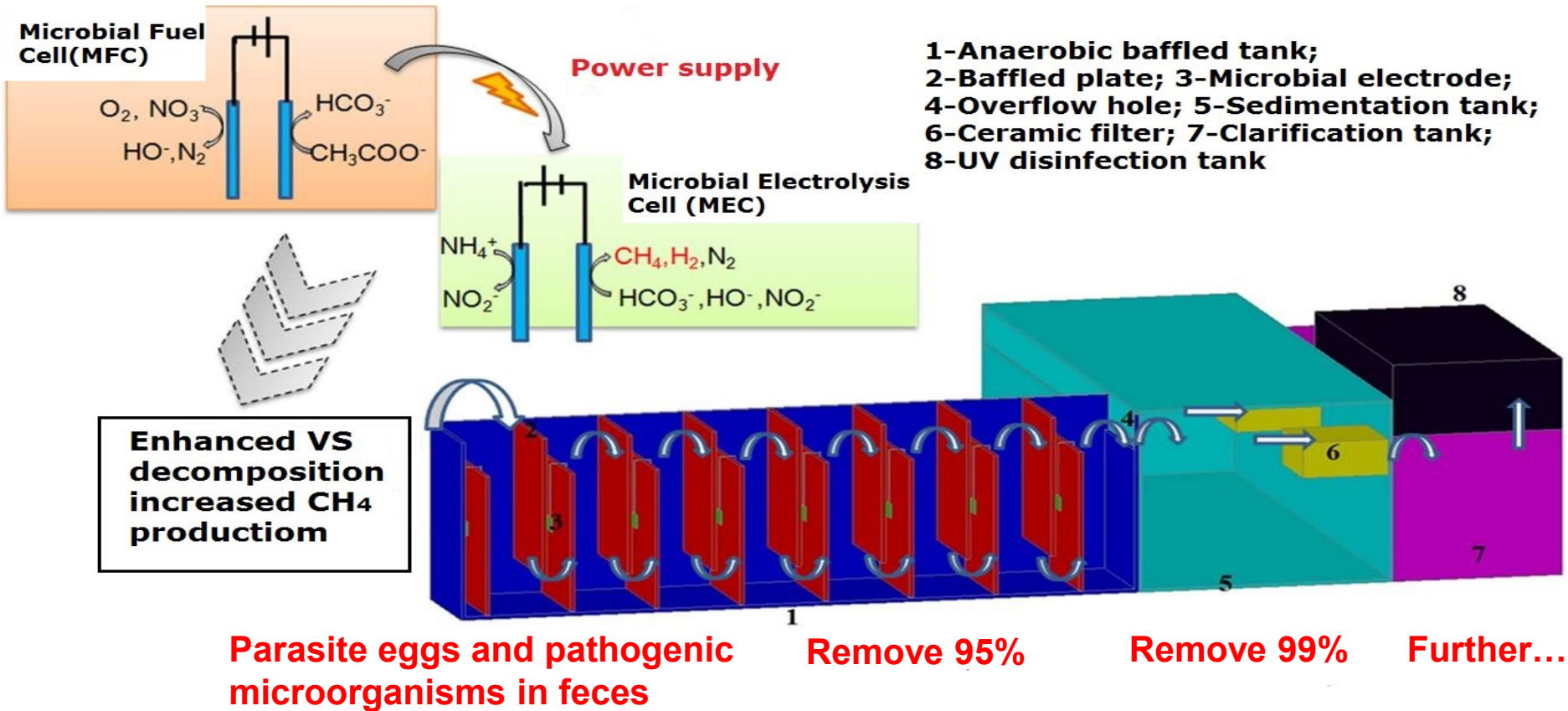
Prototype



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Configuration and operation of the treatment process of toilet fecal water by high-performance ABR-MFC-MEC system (Shanghai University of Technology)



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Prototype testing

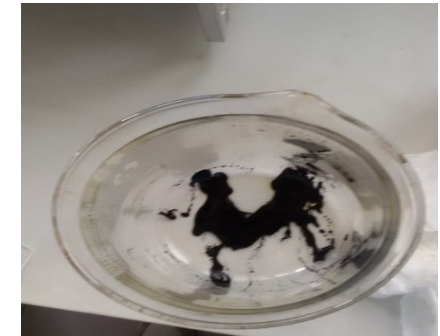
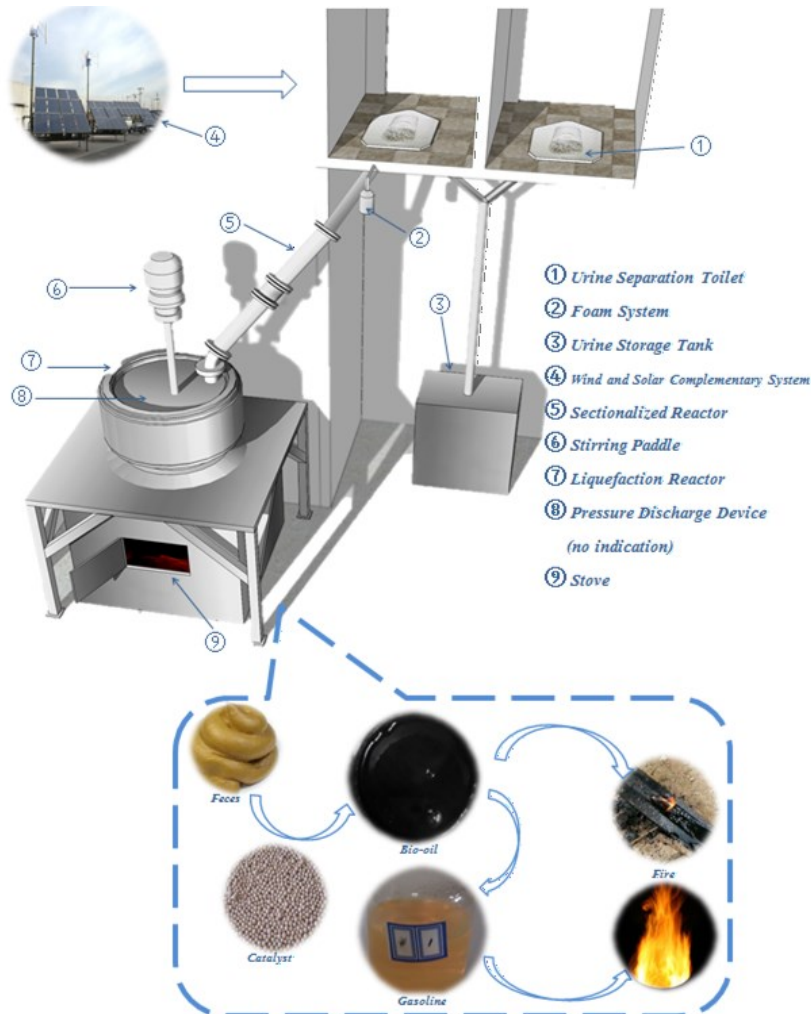


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The Development of Thermochemical Facilities by Using Feces to Produce Biomass Oil

(Beijing University of chemical technology)



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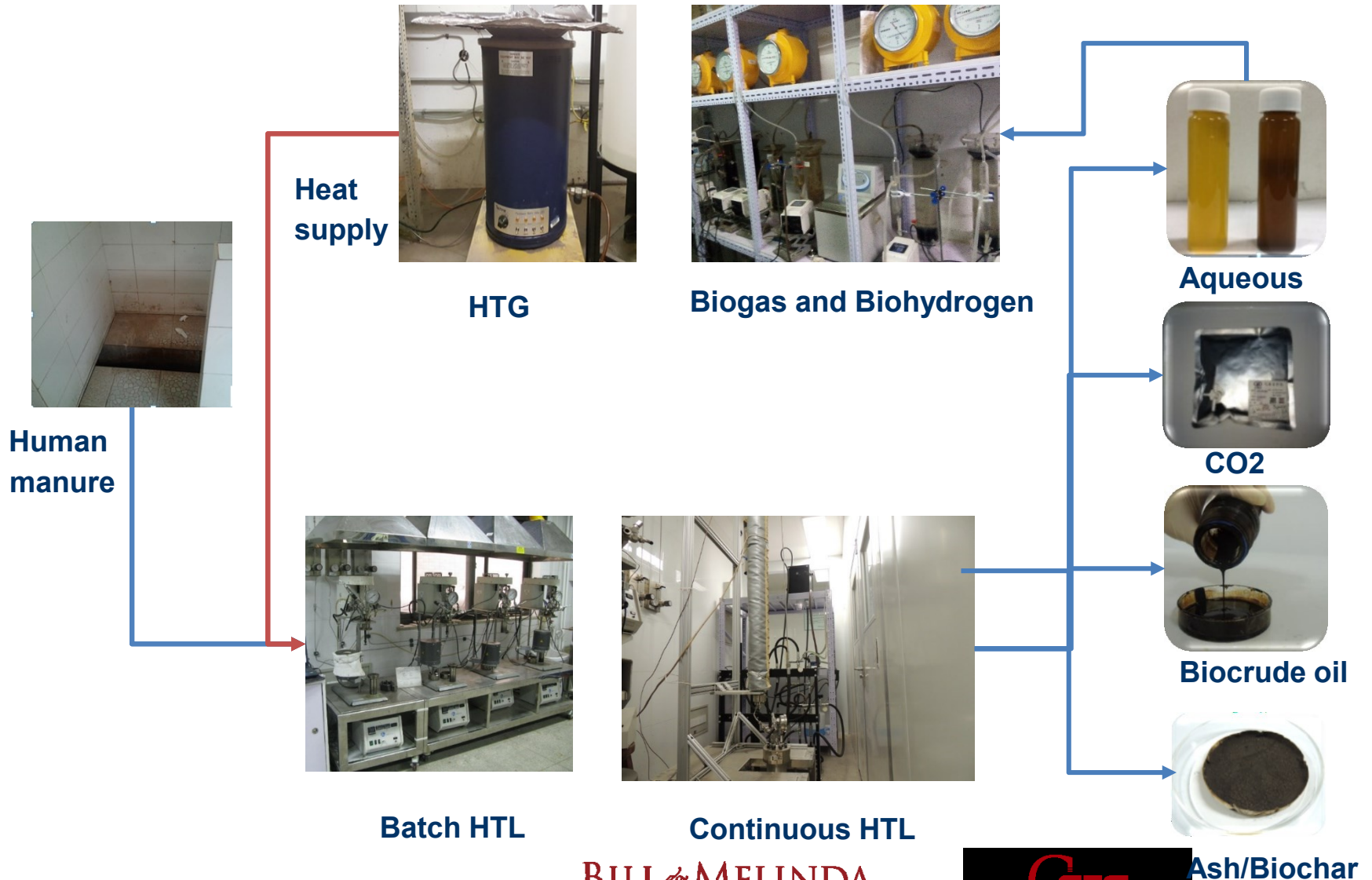
RTTC China-Round 2

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Treatment of human waste through integrated HTL-gasification technologies

(China Agricultural University)



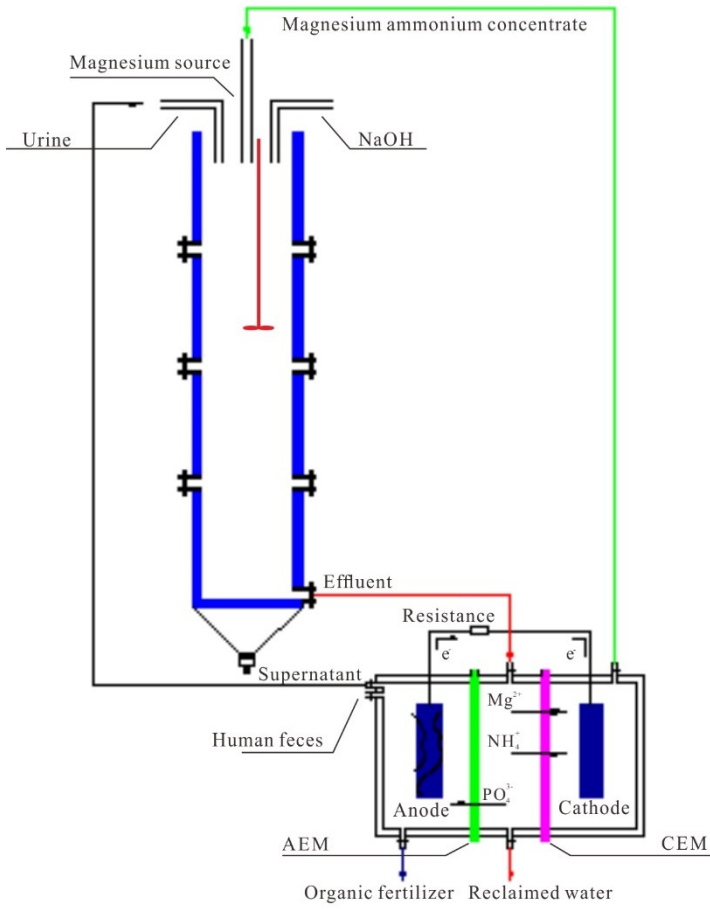
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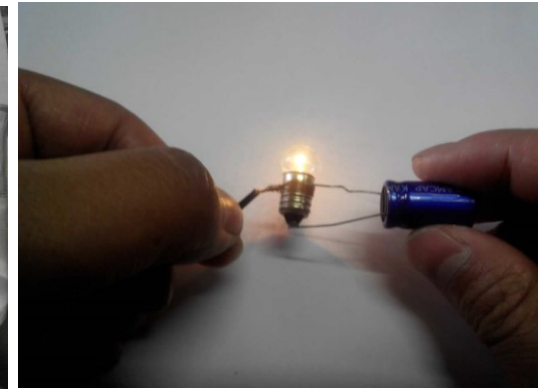
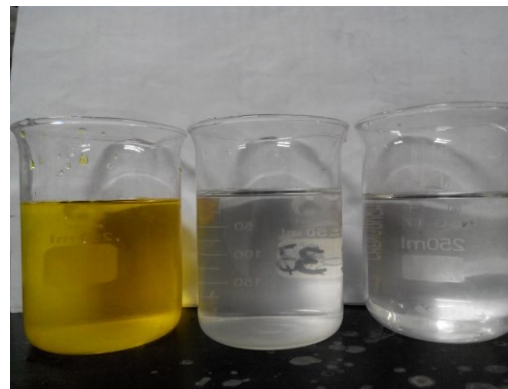
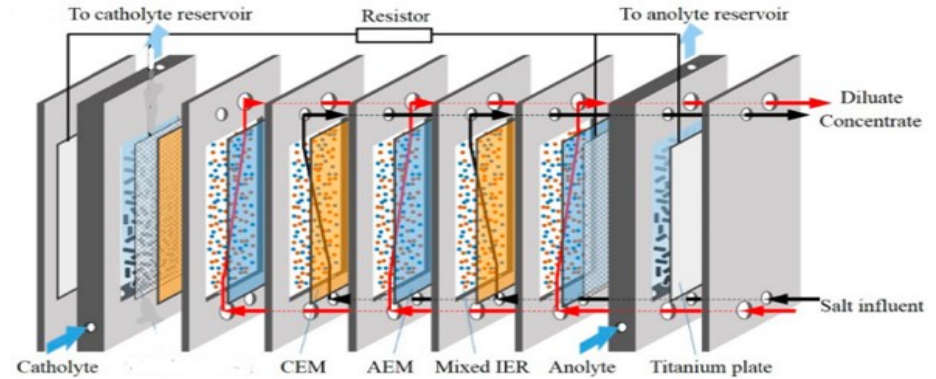
Treatment of human waste sewage by MAP crystallization-MDC coupled reactor and recovering valuable substance and energy

China university of Geosciences (Beijing)

Magnesium ammonium phosphate crystallization



Microbial desalination cell

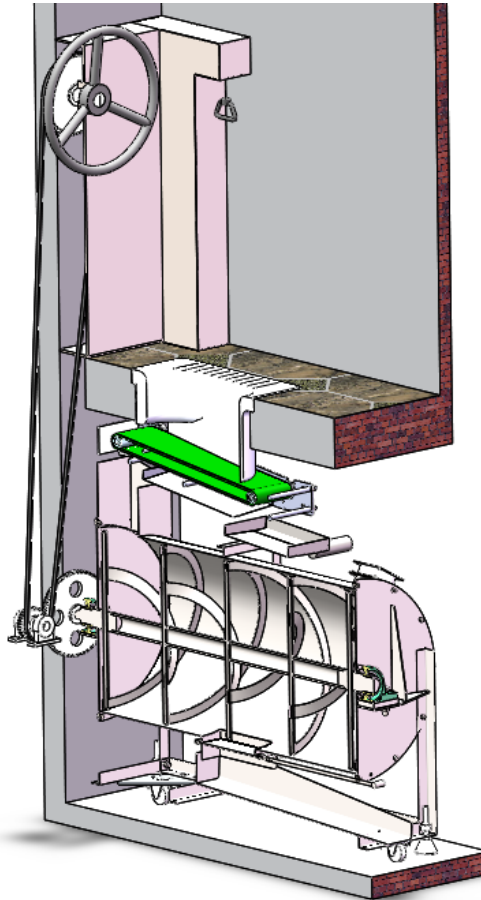


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A mechanical transmission type toilet without water flushing by using the source separation

(Hunan Hyso environment biological technology co.,LTD)



The source solid-liquid separation technology has been applied to achieve self-cleaning without water; Feces are disposed by artificial dynamic without external energy device and feces will be made into organic fertilizers by biological fermentation, Urine purification and recycling can be realized after anaerobic rotten and micro algae processing.

Research & Development of Biodegradable Foaming Liquid Exclusively for Foam Toilets

(Yunnan Huiyun Yeguang Engineering Co. Ltd.)

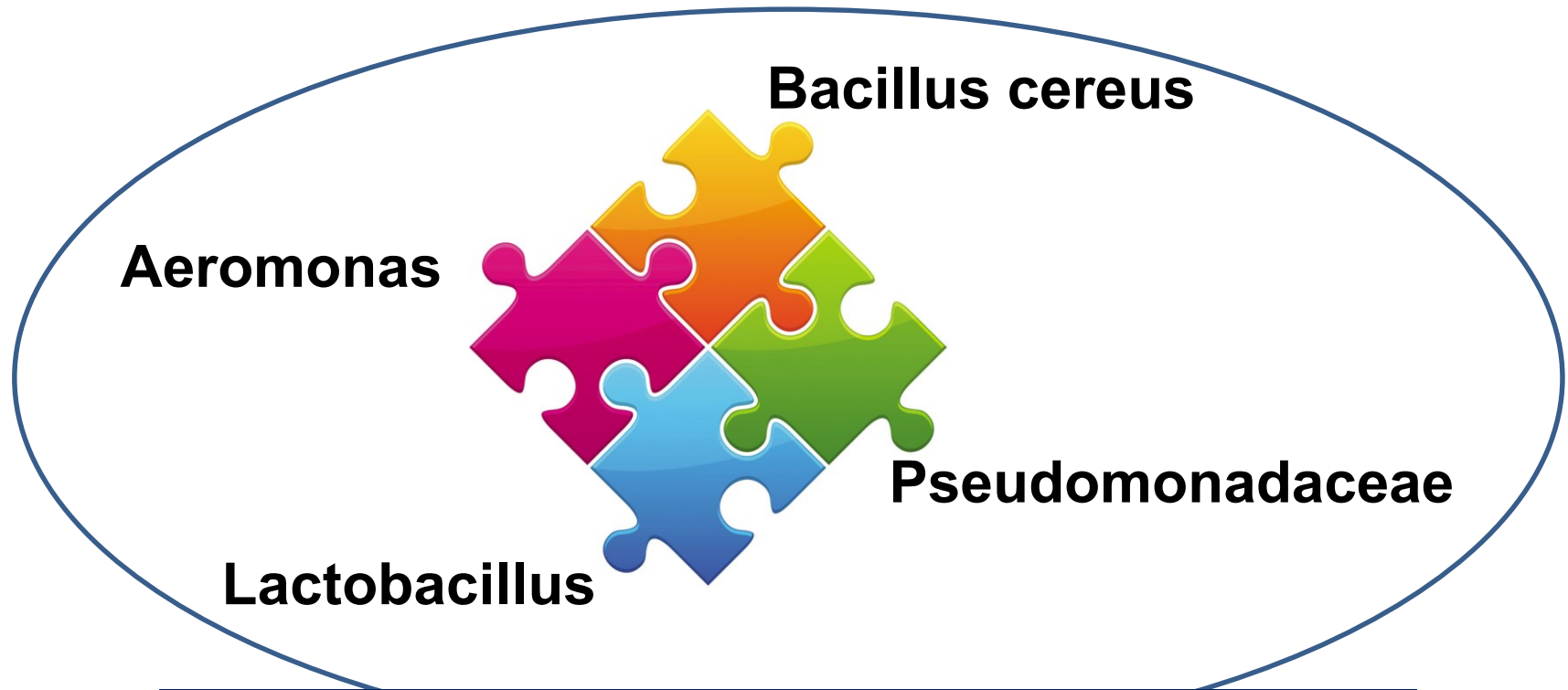


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Microbe reagent development for no-water or less-water flush toilet fecal sludge processing

(Dalian Jinzhou Jinshui Cleaning facilities Factory)



New EM for fecal sludge stabilization

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Part 3:

Toilet revolution campaign in China

03-05. 2015

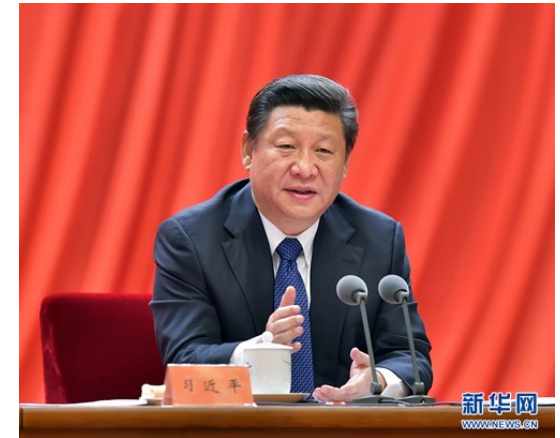
China National Tourism Administration (CNTA in short)
First National Tourism Reinvent Toilet Campaign

01-03. 2016

China National Tourism Administration (CNTA in short)
Tourism Toilet Design Contest

There is a great need to have a toilet revolution, so that the residents in rural area could get access to sanitary toilet

-----**16/07/2015**



President Xi Jinping

第一届全国厕所技术创新大赛颁奖

The First National Toilet Technology Innovation Contest Award



中国厕所革命研讨会

Seminar on Chinese Toilet Revolution

24 May 2016 , Yiwu

主办单位：
国家旅游局
比尔·盖茨基金会

Sponsors

China National Tourism Administration
Bill & Melinda Gates Foundation

Support

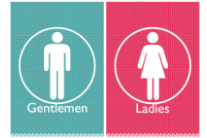
Zhejiang Provincial Bureau

Organized by

H... Ltd



The fifth space- new toilet in Beijing

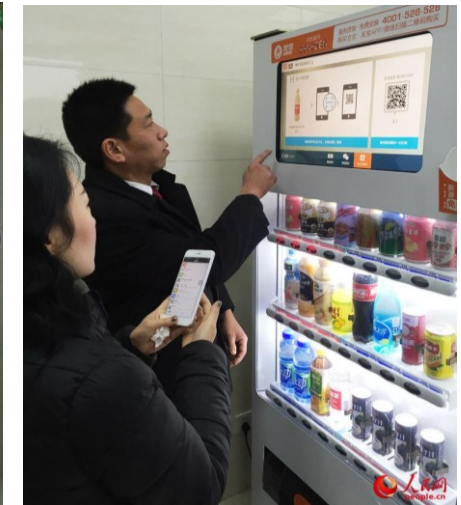


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The fifth space- new toilet in Beijing



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THANK YOU !

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