中国城市化中实施生态(卫生)排水的必要性与可行性

Necessity and Feasibility for Ecological Sanitation in China's Urbanisation

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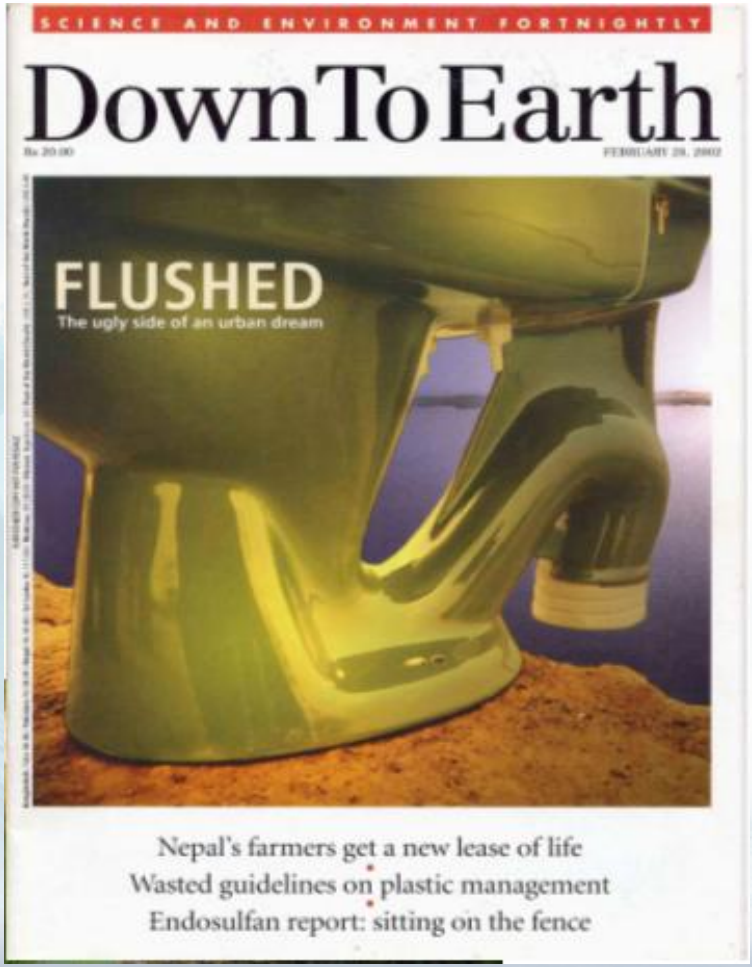
议题：

- 从西方排水模式历史发展中看必要性
  What the historical development in Europe is telling us
- 从中国现实需求中看必要性
  What is the actual demand of China
- 从现有技术看可行性
  The feasibility based on the available tools
- 展望
  Perspectives

从西方排水模式历史发展中看必要性
What the historical development in Europe is telling us

“冲厕–
都市梦的丑陋面”



从西方排水模式历史发展中看必要性
目标和技术的发展 Objective and Technical Development

1840s 0 修建城市下水道 flushing toilet -> sewer construction

1890s 50 污水生物处理含碳有机物 biological C - Degredation Plant

1980s 140 污水生物处理 biological nutrients removal

1990s 150 永无休止的污泥问题，资源循环问题 problems with sludge and nuetrients recovery

2007.8.29. 全球仅有极少数国家实现高污水收集率和末端净化 worldwide only few countries has high collection rate and end of pipe cleaning

从西方排水模式历史发展中看必要性
时代要求和理念的变迁 Demand and Ideology

1840s 0 方便 comfort

1890s 50 被动减少污染 passive protection

1980s 140 理解营养盐与富营养化 understanding eutrophication and nuetrients

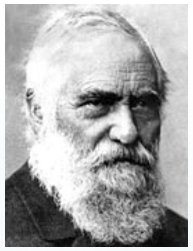
1990s 150 发现不可持续性 realise the problem of not sustainable nuetrients recovery

2007.8.29. 全球模仿的困难和问题 problems if it will be further spread

从西方排水模式历史发展中看必要性

1840s 0

Pettenkofer 1818-1901



1890s 50

No feedback

Karl Imhoff 1876-1965

1980s 140

No feedback

1990s 150

Ralf Otterpohl

2007.8.29.

决不是一个方案与技术优化的必然结果 not a result of the system optimization

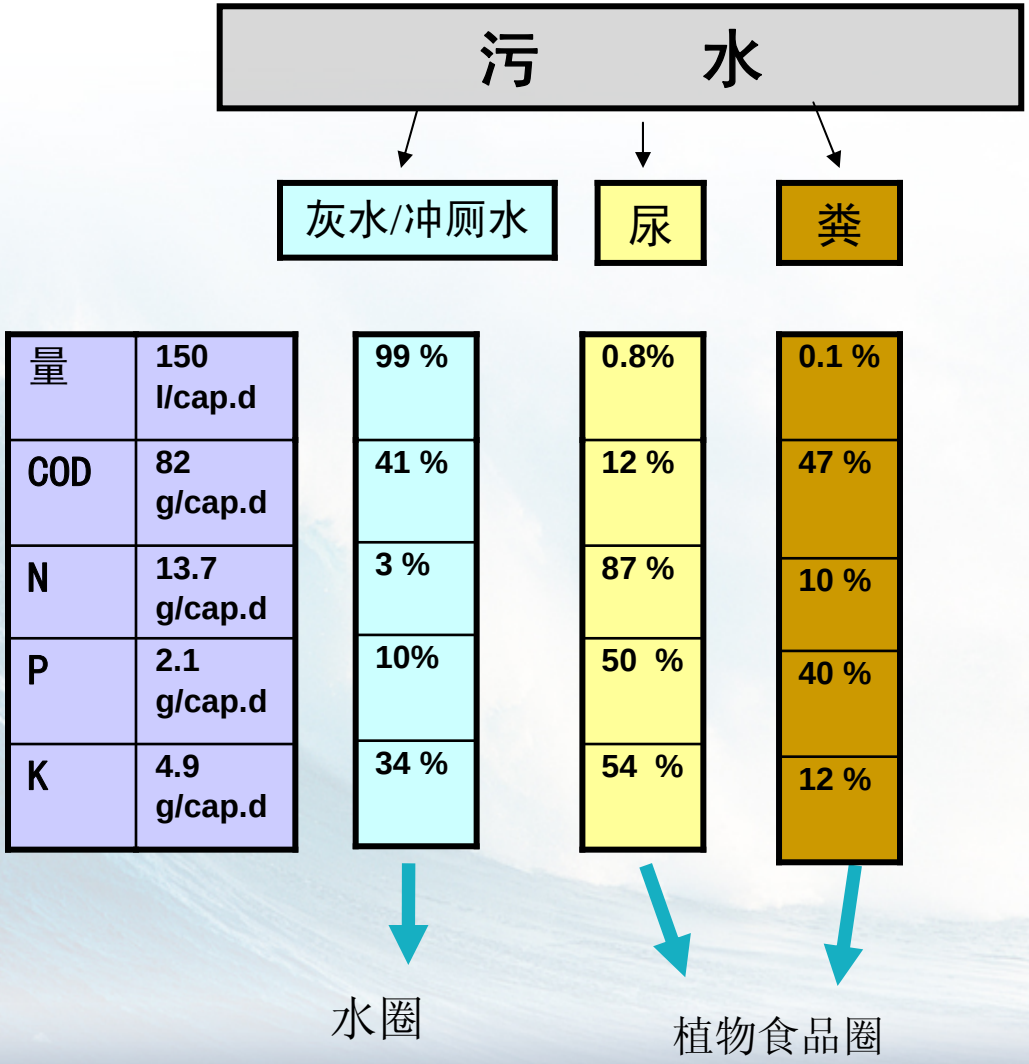
从西方排水模式历史发展中看必要性

既然污水要净化，资源要回收：

为什么先上百倍稀释，然后消耗大量财力物力…最后还达不到目的？

If the wastewater must be purified, resource should be recovered:

Any thinking one of today would ask why dilute it hundreds times then … and finally the target is not achieved?



从中国现实需求中看必要性
What is the actual demand of China

高速城市化Urbanization in China

Year	1980	1995	2005
Urbanisation grade	19.39%	28.85%	ca. 40 %
Urbanised population	191 mio.	352 mio.	ca. 520 mio.
Cities	223 cities	640 cities	Ca.662

每年城市化人口达1前7百万
From 1995 to 2005, each year 17 million people were urbanized.

从中国现实需求中看必要性
What is the actual demand of China

传统工业文明必然导致资源枯竭
中国需要生态文明的现代化

“The traditional industrial civilization will definitively lead to disappearance of the natural resources, what China needs now is an ecology-oriented civilization”.

从中国现实需求中看必要性
What is the actual demand of China

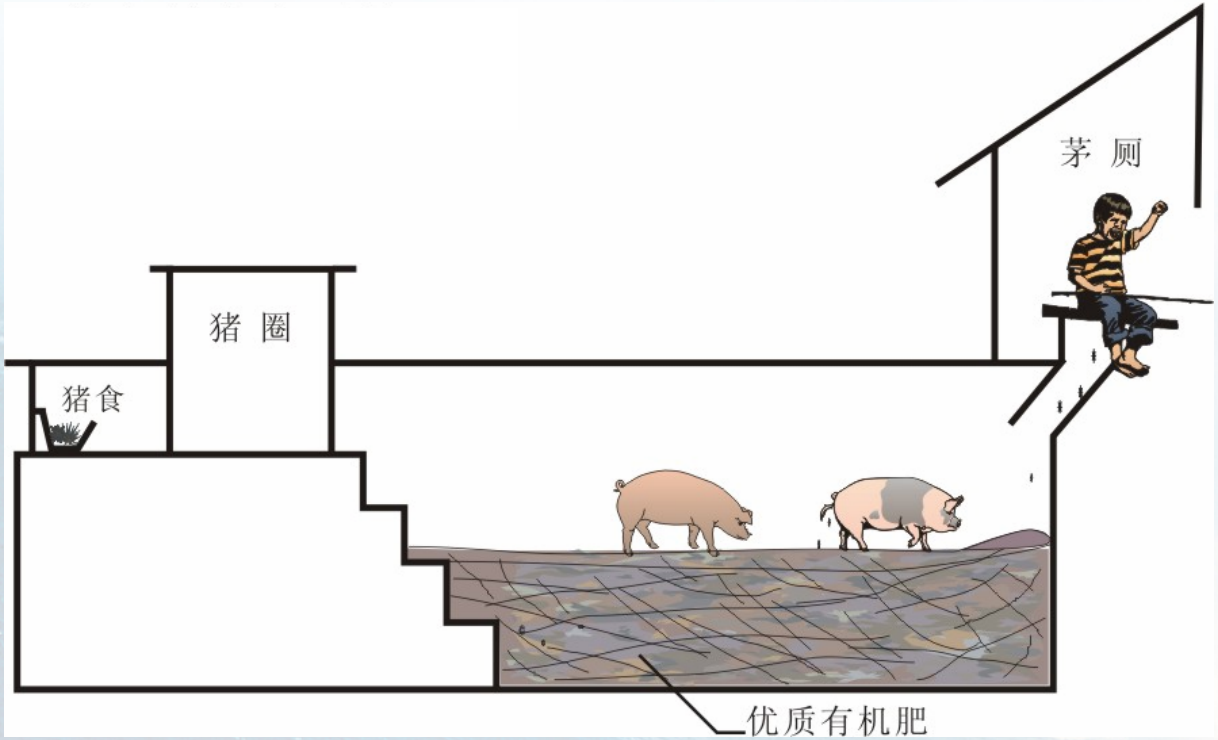
1. 水资源短缺要求更加节水
   More water saving because of the limited resource
   水环境容量有限现代污水处理厂出水水质不能满足水环境要求
   The effluent values of even modern European WWTP cannot meet the requirement of water bodies near cities
   城乡物质交换的良性循环
   Cycle economy between agriculture and cities
   不允许像西方国家长达一个多世纪的演化和沿革，从零到可持续发展一代人之内实现
   From zero to sustainability within one generation
   缺乏历史积累，所以要缩短资金链，污水控制与房地产开发捆绑
   Better combination of sanitation with land development of urbanization

从中国现实需求中看必要性
What is the actual demand of China

几百人至几万人为单元的源分离对策是解决现实需求的有效对策

Source Separation and Nutrients Recovery
with unit size of hundreds up to several ten thousands
Is the most efficient concept

从现有技术看可行性The feasibility based on the available tools



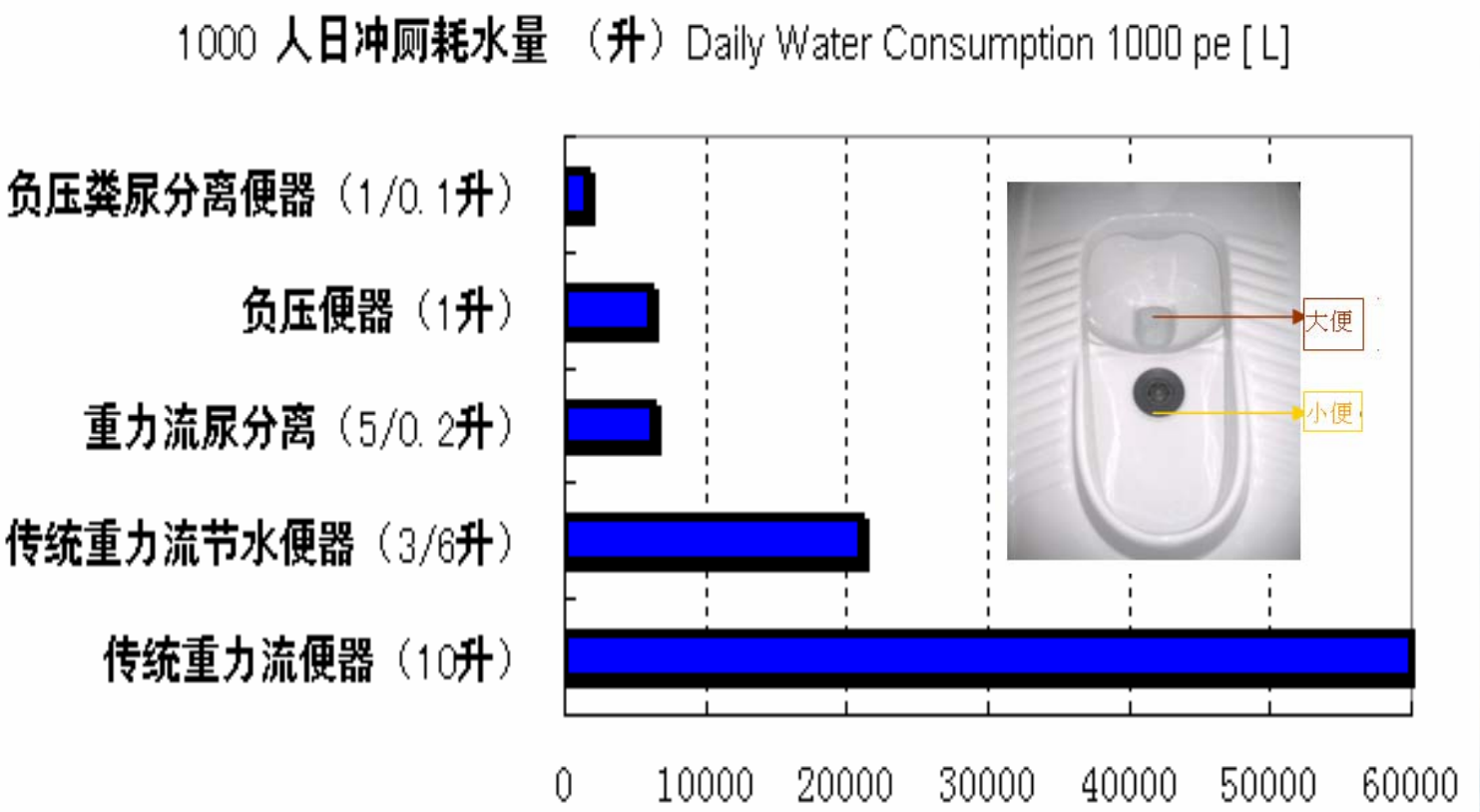
从现有技术看可行性The feasibility based on the available tools

源分离方案 Source Separation Concepts

		国外 International Examples	国内 China
方案1	不冲水的堆肥干厕 + 尿液分离 Urine Separation Dry Toilet	北欧国家的低密度乡村和私宅得到较多应用。除了生态原因外，乡村水污染控制要求也是一个重要原因（参见张健（2006）：乡村排水系统的分析）	在农村有示范应用,在内蒙东胜中瑞典合作项目在多层建筑进行示范
方案2	冲水厕具+尿液分离 Flushing Toilet with Urine Separation	在欧洲乡村和城乡结合部已经取得较多示范。	万若环境重力流粪尿分离便器应用项目在实施中。
方案3	极少量冲水的负压（真空）厕具 Vacuum Toilet	德国进行了成功的示范，是城镇污水源分离的一个经典。	万若环境真空便器在多个项目得到应用
方案4	极少量冲水的负压（真空）厕具+尿液分离 Vacuum Toilet with Urine Separation	国外有极小规模的试验。	万若环境真空粪尿分离便器在多个实际项目得到应用。

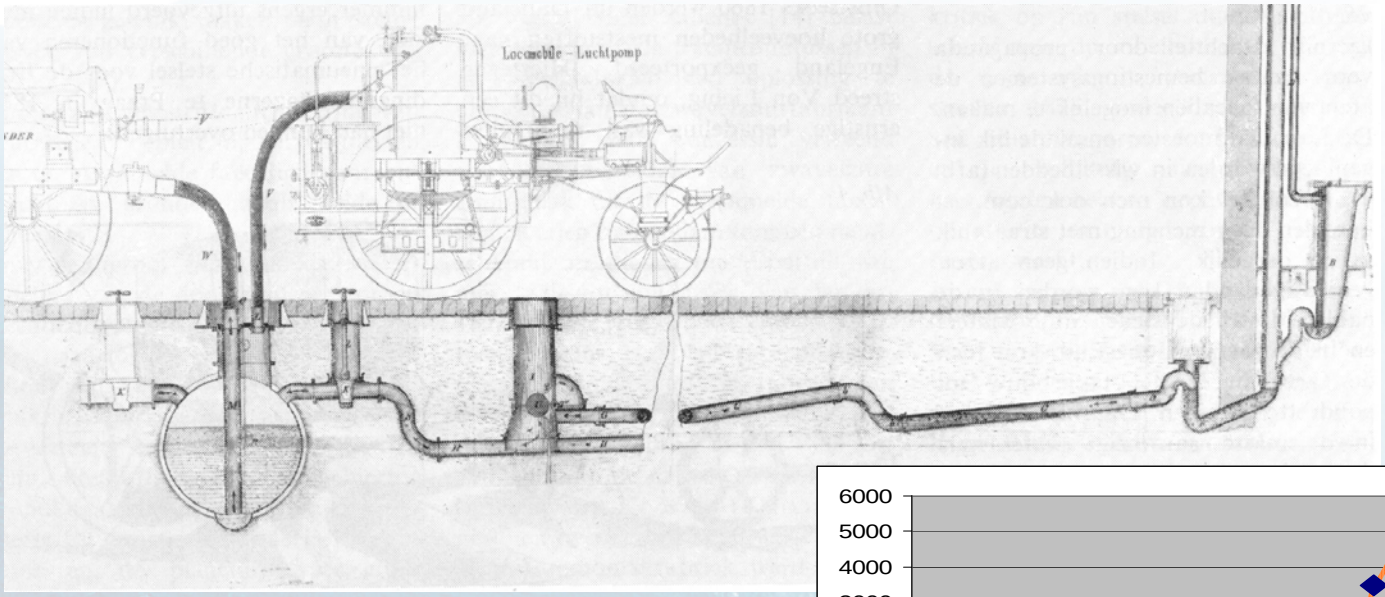
从现有技术看可行性The feasibility based on the available tools

节水的源分离便器 modified water saving flushing toilets

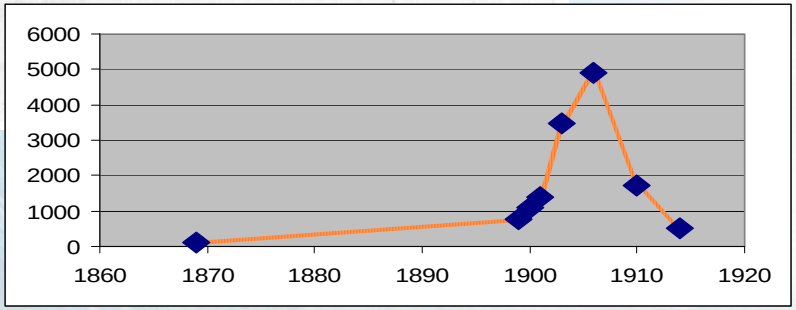


从现有技术看可行性The feasibility based on the available tools

城市区域的粪尿收集 Collection in densely urban areas



1869 Liernur 负压收集厕所废水系统



阿姆斯特丹服务人口
（Lange&Otterpohl）

从现有技术看可行性The feasibility based on the available tools

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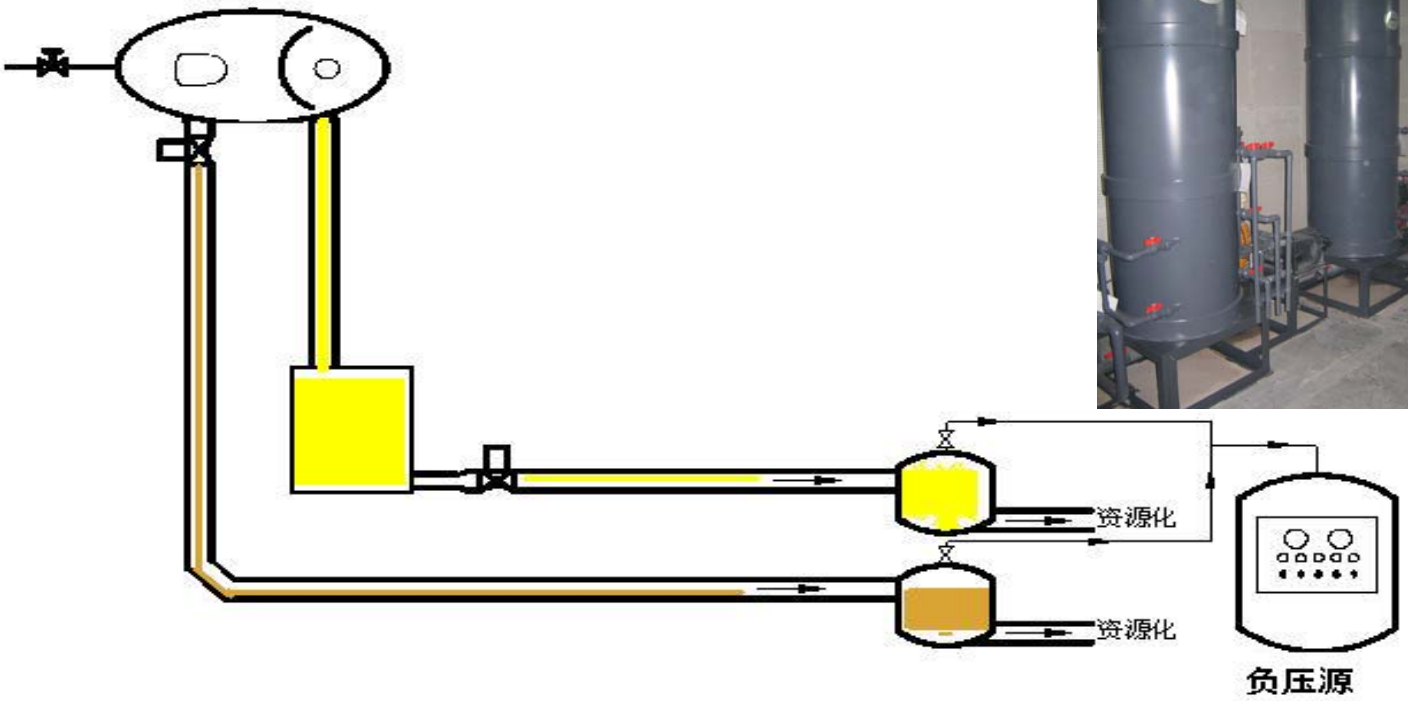


从现有技术看可行性The feasibility based on the available tools

粪尿收集的技术可靠性 Technical reliability of the collection system

Water supply

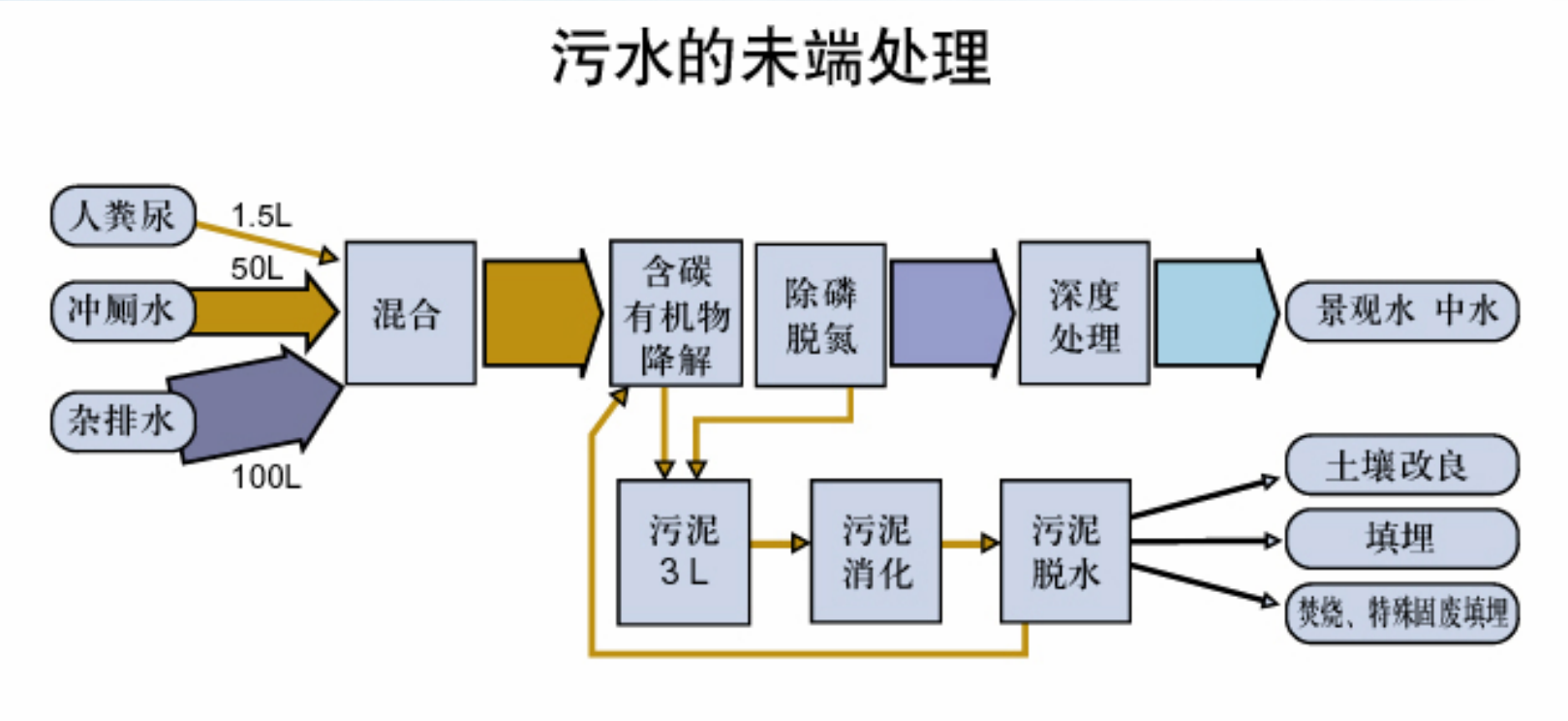
Vacuum drainage

真 空 收 集 系 統

从现有技术看可行性The feasibility based on the available tools

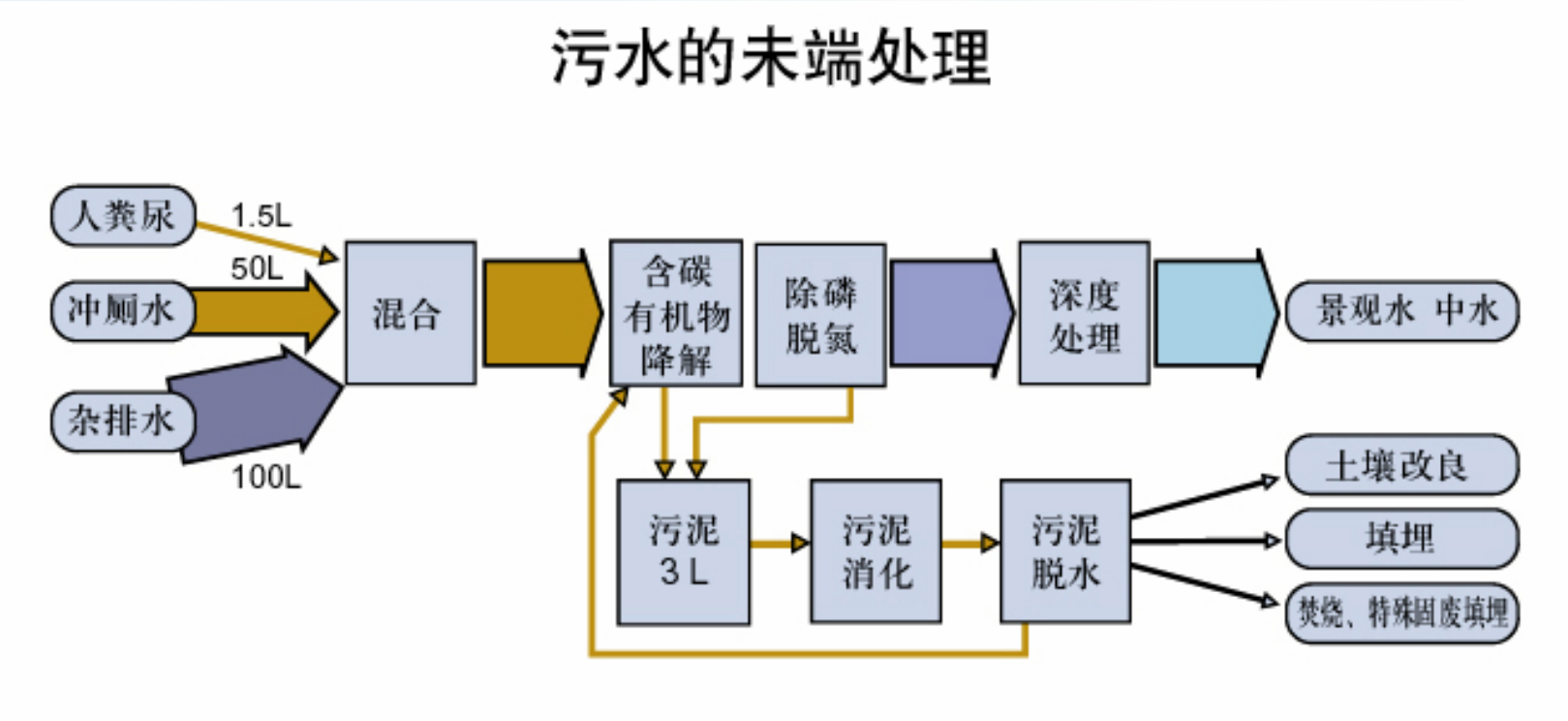
处理技术的合理性与经济性 Technically and economically more feasible

漫长的末端治理之路 where we are on the way of - end of the pipe ?

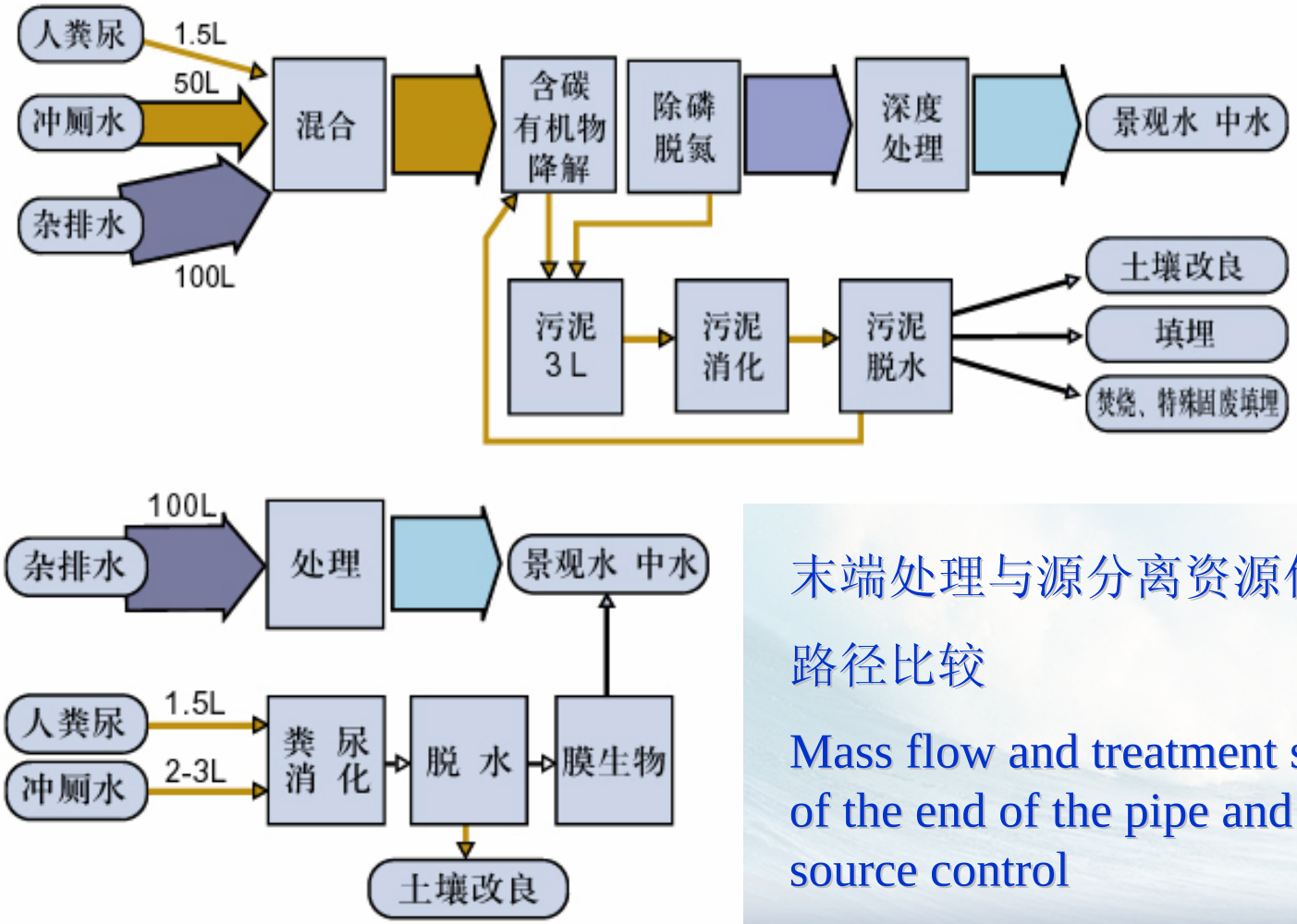


从现有技术看可行性The feasibility based on the available tools

处理技术的合理性与经济性 Technical and economically more feasible



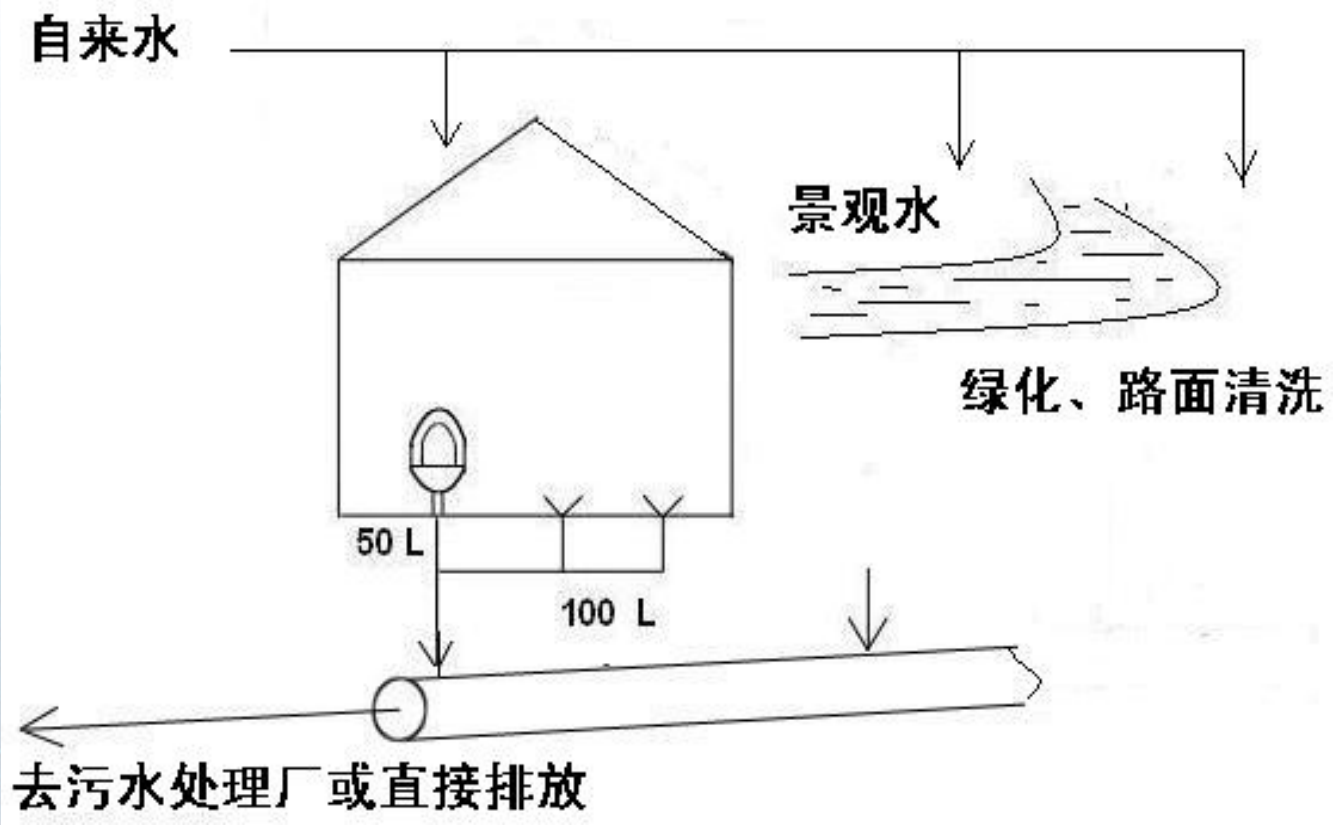
污水的末端处理



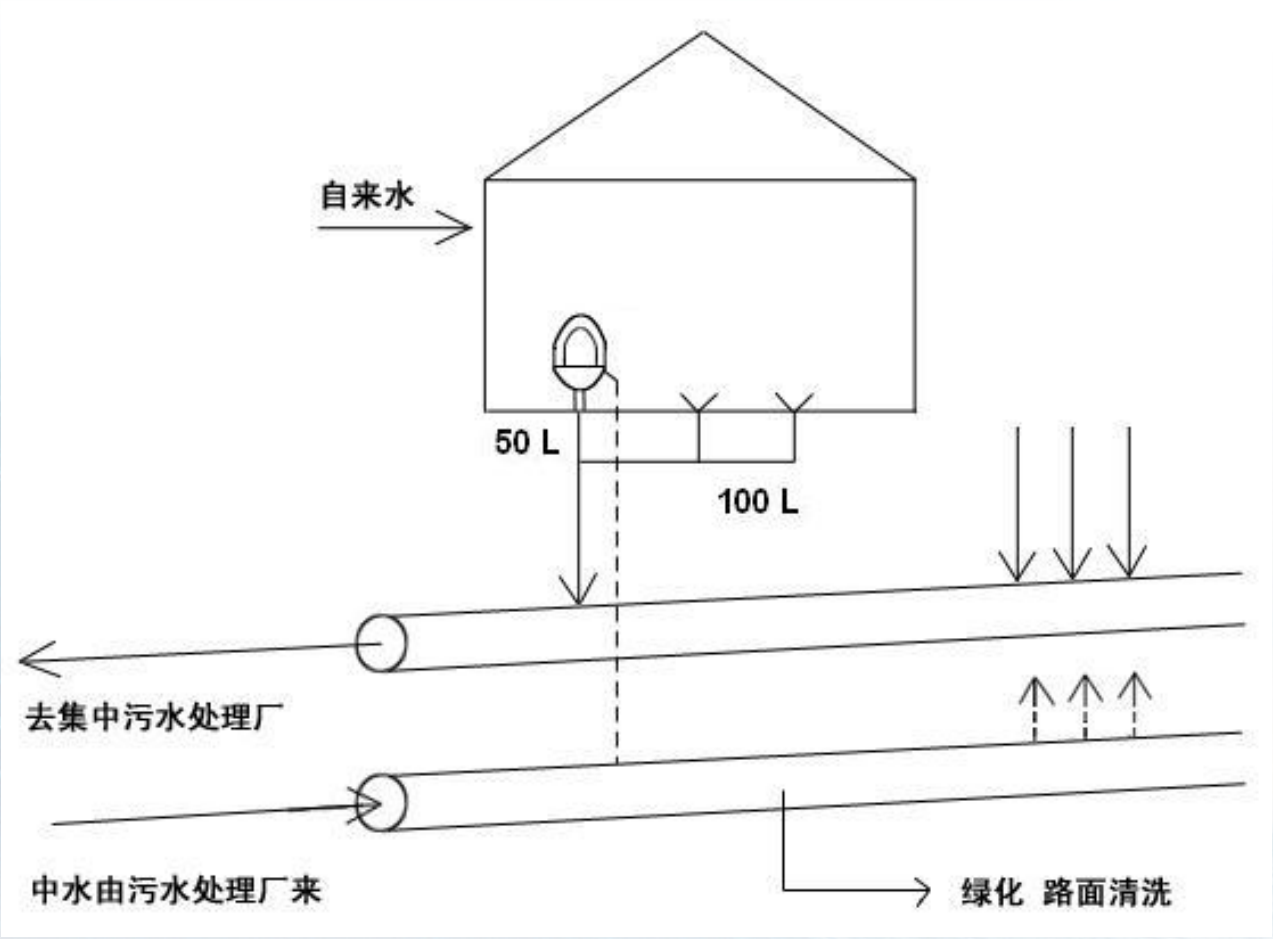
末端处理与源分离资源化路径比较

Mass flow and treatment steps of the end of the pipe and source control

传统模式 Conventional

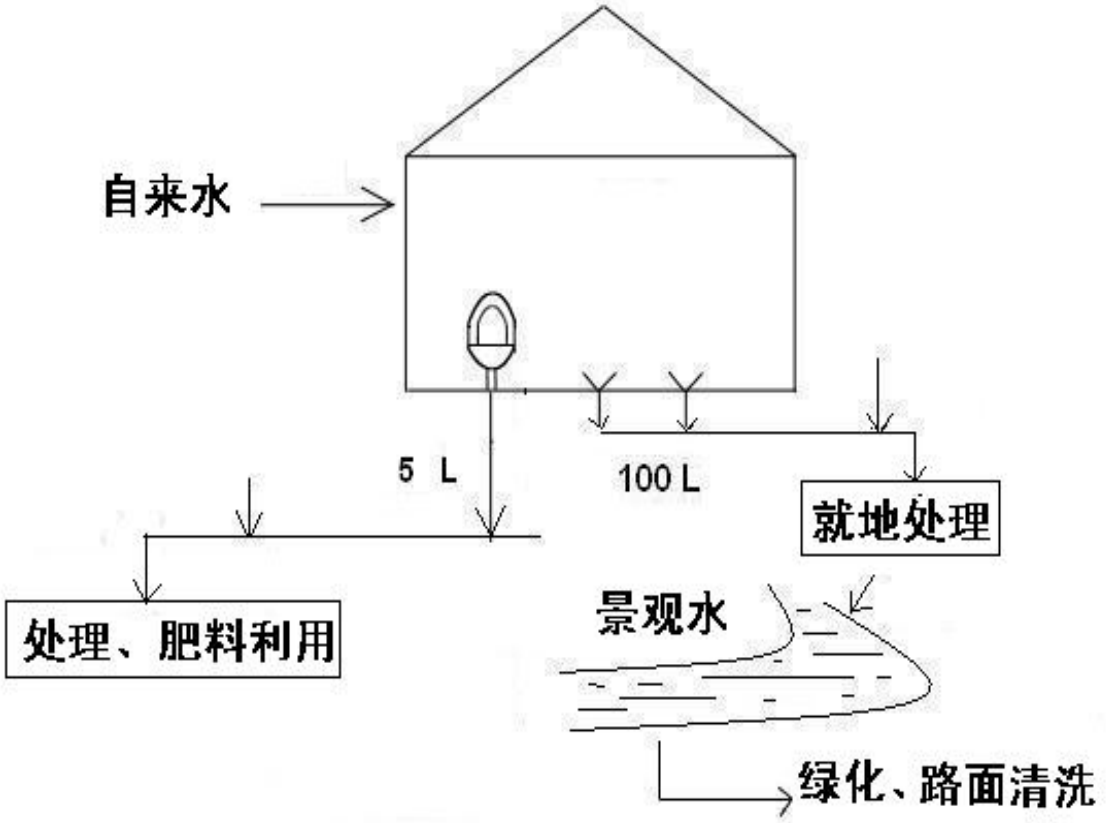


传统模式加中水回用 conventional + wastewater reuse



源分离模式 water saving, source control

最大节水加粪尿资源化 resource recovery



生态排水

外来水源

厨　房

淋　浴

洗　衣

厕　所

雨　水

集中处理

地　表　水

生 态 排 水

洗浴

厨房

洗 衣

尿　大便

雨水

厨房垃圾

食品

净化处理

给水处理

生态良性循环

有机肥

农 业

地表水(蓄水)

绿化

地下水再生