中国大中型沼气工程发展现状及其展望

赵立欣

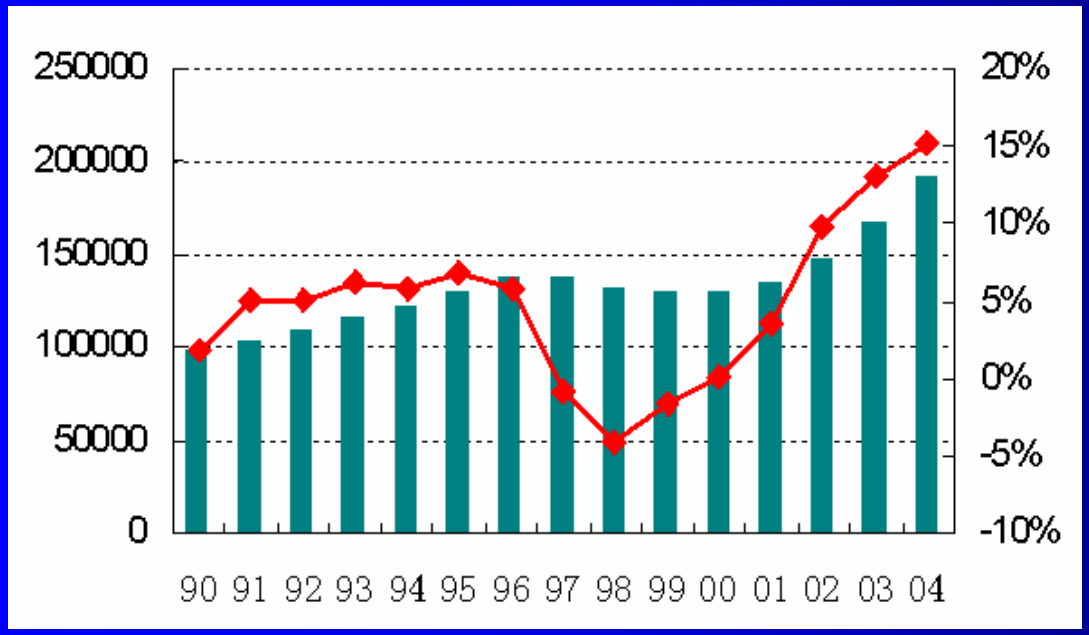
农业部能源环保技术开发中心

电话:0086,10,65925082

E-mail：zhaolixin5092@gmail.com

- China is the second largest energy consumer and producer in the world，In 2006, the total consumption of energy was 2.46 Billion TCE；
  中国是世界第二大能源生产和消费国，2006年能源总消耗量为**24.6**亿吨标煤；

- Resources per capita in shortage : 50% of world lever for coal, and far behind world lever for petroleum and natural gas.
  人均能源资源拥有量较低，煤炭人均探明储量仅占世界平均水平的50%左右，石油、天然气人均储量更是远低于世界平均水平。



Abundant resources available for biogas production
可用于沼气生产的资源丰富

1、Industrial organic waste water: discharge 2.51 billion t and 73.78 million t residue per year

工业有机废水：每年排放25亿吨，还有7378万吨残渣

includes：

- **light industry 轻工业**

alcohol, sugar, beer, rice wine, distilled spirit, starch, monosodium glutamate, beverage, pulp & paper etc

- **Non-light industry 其它工业**

pharmacy, slaughter, flour, vegetable oil, soy sauce, food can, petrochemical products, crude rubber, furfural etc

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2、Livestock waste：养殖废水废物

3 billion ton of livestock waste were produced annually from large scaled farm and household separated livestock raising. 目前中国畜禽养殖业每年产生约30亿吨粪便，主要来源于农村家庭散养和规模化养殖。

Large scaled farm raising pig, cattle and chicken reached 3.91 million, presenting 0.57 billion pigs units* on hand, resulting 1.12 billion tons livestock waste.现有猪、牛、鸡三大类畜禽规模化养殖场约391万处，存栏量约5.7亿头猪单位*，畜禽粪便资源的实物量为11.2亿吨。

***One pig unit equivalent to 30 layers, 60 broilers, 1/10 diary cattle and 1/5 beef cattle**

Resources wasn’t used efficiently-Heavy pollution
资源没有得到有效利用- 造成严重污染

2005 Status Biogas Development in China
中国沼气发展（2005年）

- **18,070,000 household biogas digesters**

  1807万口户用沼气池

- **3764 mid to large scale industrial biogas plants for industry and livestock farms**

  3764座大中型沼气工程

- **146,000 municipal waste treatment facilities**

  14.6万处城市污水处理场

- **Production of biogas from all sources is 7 billion m^3 per year，equivalent to 5 million tce.**

  年产沼气70亿方，折合500万吨标煤

Large scaled biogas plants 大型沼气工程

In China, Biogas project technology has been basically in maturity and the fermentation processes are mainly concentrated on UASB , Plug-flow , AF, USR and CSTR, etc, for varies organic waste water treatment.

中国沼气技术已基本成熟，处理工艺主要有上流式厌氧污泥床（ UASB） 、塞流式反应器（ Plug-flow） 、厌氧滤器（ AF）、 升流式固体反应器（ USR） 和全混厌氧反应器 CSTR 等。

- Entire design for different materials.根据各种不同原料的差异，进行包括预处理、厌氧、沼气输配、制肥、消化液后处理的全部设计。
- Series of equipment products for different processes.制罐、自动控制、脱硫脱水、固液分离等装置已形成系列化成熟产品 。
- But the overall development of equipments are still far behind international advanced level.但工程装备的整体水平远远低于国际先进水平 。

Challenge

- **No enough land resource** to take in the high concentrated effluent from digester, and cause secondary pollution.
- 厌氧废水浓度低、量大，没有足够土地销纳，造成二次污染；
- **Low efficiency** of anaerobic treatment and gas production.
- 厌氧发酵效率低，产气率低；
- **Energy consumption** for aerobic process.
- 好氧阶段的能量消耗问题；

Dry fermentation technology turned out to be the optimum solution to challenges above.

干发酵技术是解决上述问题的最优方案

- **Garage-type Dry Fermenters from BIOFERM and BEKON are in use already.**德国BIOFERM公司、BEKON公司等厂家生产的车库型工业级装备已投入实际运行

But with the problems of:

- Complicated structure 结构复杂
- Expensive 投资高
- High quality sensors
- 存在安全隐患，需要高灵敏度的有毒气体检测仪器
- High operation cost 运行成本高
- Inconvenient operation 操作不方便

- Garage-type Dry Fermenter is not fit Chinese situation.不适合在中国发展

Development of dry fermentation technology in China
中国厌氧干发酵技术进展

CAAE developed a new “Film-Covered Dry Fermenter”.

农业部规划设计研究院开发了“覆膜开敞槽干法厌氧发酵技术与装备”

- No energy input 无外加热源
- Moderate temperature anaerobic digestion at 38℃.
  达到中温厌氧发酵温度
- High gas yield 高容积产气率:

  average 1.09L/L·d in 1 month,

  maximum of 2.09L/L·d.
- Raw material: cattle dung/corn straw = 2/1

A pilot plant of 180m^3 (2 units) is established in Daxing district, Beijing.

北京市大兴区庞各庄镇薛营村建设的180m3中试工程基本完成。

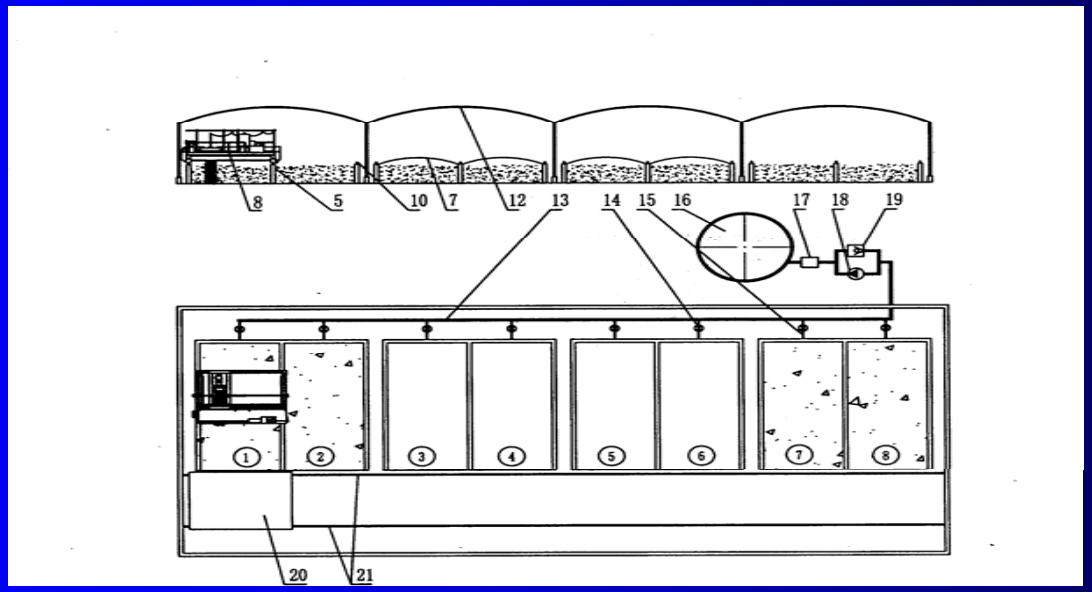
Average of gas yield is more than L/L·d, with 60.7% (v/v) methane.

平均容积产气率超过1L/L·d， 甲烷浓度60.7%。

Characteristics 特点

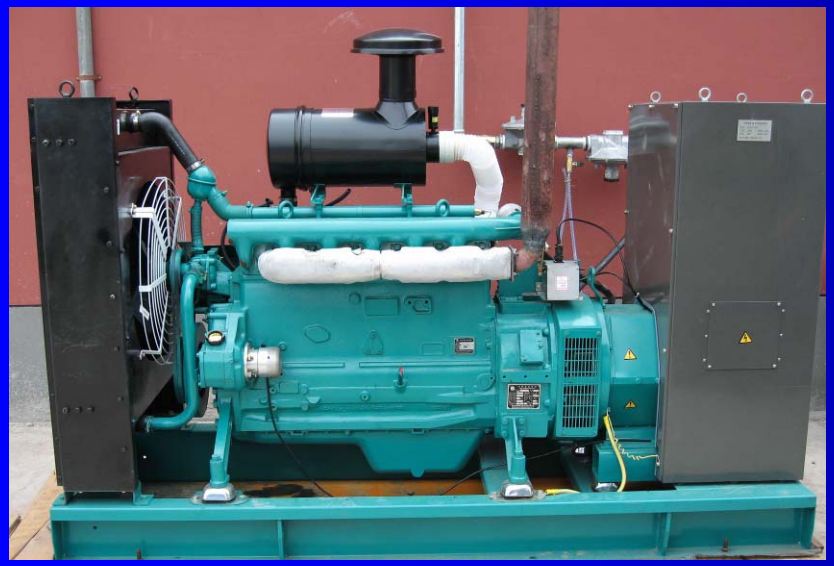
- No wastewater 无污水排放；
- No solid waste（the residues discharged are high quality fertilizer) 无固体废弃物（发酵剩余物为固体有机肥料）
- No energy input 无外加热源（利用生物能和太阳能使料温达到38℃左右的中温厌氧发酵温度
- No waste heat 无废热排出
- High gas yield, low energy consumption (even in winter heating cost only 15% of produced biogas) 容积产气率高，自身能耗低（冬季辅助加温耗自产沼气的15％左右）
- Mechanical Feed-in and out, feasible for large scale production.用装载机进出料，适合规模化生产

- Visible detect of gas empty， easily avoid accident caused by residual biogas 可直观判断发酵槽中的沼气是否排空，避免残留沼气造成的安全事故
- Unit system. Suit for different demands, seasons and scale 采用单元化设计，通过启动厌氧发酵单元的数量调节不同季节用气量和满足不同规模用户的要求
- Wide applicability for animal manures, crop residues and living waste.对畜禽粪便、作物秸秆、生活垃圾等有广泛的适应性。



Industrialized utilization of biogas
沼气的工业化利用

- Biogas combustion generator has been developed in China.
  我国已成功研制了纯燃沼气发电机组
- Wide application of centralized gas supply system has been achieved. 沼气集中供气已有较广泛地应用



Under Research 研究方向

沼气的高附加值开发利用

Treatment: purification，compression 沼气净化、压缩

Utilization : biofuel for transportation and living， uel cell，

作为运输燃料或装罐用于民用燃料；开发燃料电池

The development goal according to <Renewable energy Law>
发展目标

		2004	2010	2020
Biogas power generation 沼气发电	10,000kW 万千瓦	2	80	300
	Million kWh 百万千瓦时	0.1	4	15
	10,000 tce 万吨标煤	3.6	136	495
Gas supply 供气	Number 数量	1400	6300	16900
	Billion m^3 10亿立方米	1.46	3.9	13.5
	10,000 tce 万吨标煤	104	279	964

Exploring Collaboration 合作

- High efficiency anaerobic fermentation technology
  高效厌氧发酵技术
- Biogas Generator Equipment
  combined heat and power (CHP) equipment
  沼气发电设备（热电联供）
- Biogas purification, compression and canning
  沼气净化、压缩、装罐技术
- Methane fuel cell 沼气燃料电池技术
- Clean Development Mechanism (CDM)
  - Already applied to landfill gas projects
  - Now being applied to biogas projects
  清洁发展机制在沼气工程中的应用

We are looking forward to collaborating with you

谢谢！

Thank you!