

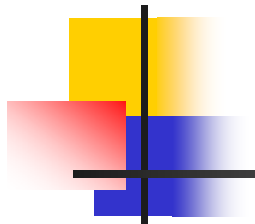
Coal Gasification Technology in China: Application and Development

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1. Application of Coal Gasification Technology

2. Coal Gasification Technology

- **Introduced technology**
- **Development of coal gasification technology**

3. Coal Gasification Technology R&D in the East China University of Science and Technology(ECUST)

1. Application of Coal Gasification Technology

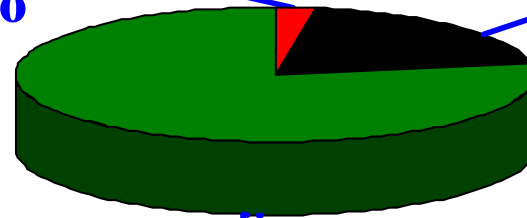
➤ Proportion of coal consumption in different type

Gasification(synthetic chemicals)

5.0%

Coking

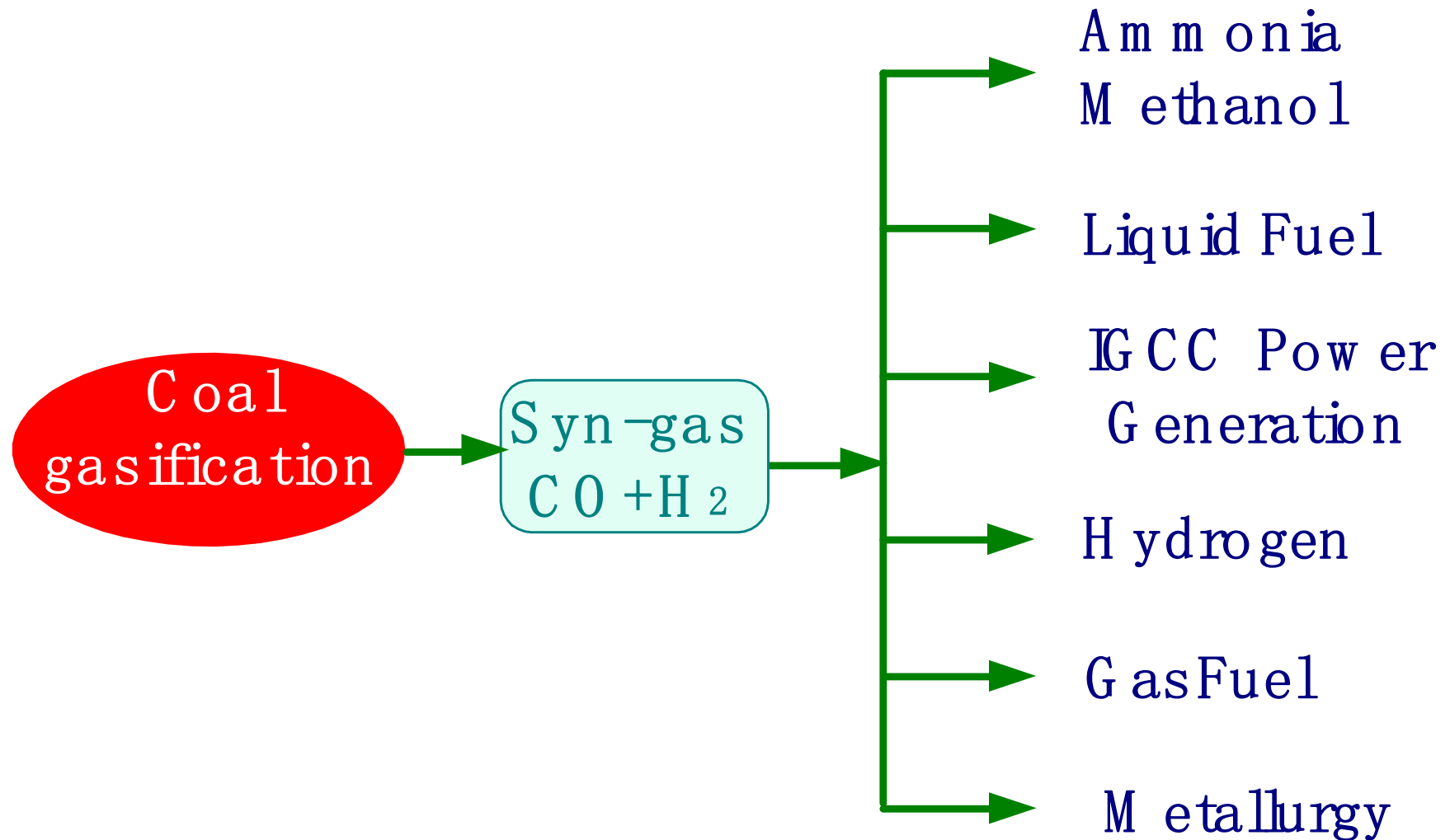
20.0%



Combustion(power generation, industry fuel, domestic fuel etc.)

75.0%

1. Application of Coal Gasification Technology





1. Application of Coal Gasification Technology

➤ Synthetic ammonia

- **1930s** first ammonia plant built up
- early **1950s** production capacity was less than **6kt/a**
- **2003** **30** sets of large-scale production installations(**300kt/a per set**)
55 sets of medium sized production installations(\leq **100kt/a per set**)
700 sets of small sized production installations(\leq **40kt/a per set**)



1. Application of Coal Gasification Technology

- **2003 ammonia total capacity 41.60 Mt/a**
- **Coal-based synthetic ammonia accounts for about 65% of total output**
- **40Mt/a feedstock coal**
- **over 4000 coal gasifier**
 - 11 Texaco entrained CWS gasifier**
 - 4 Lurgi fixed bed gasifier**
 - 3985 UGI fixed bed gasifier**



1. Application of Coal Gasification Technology

➤ Synthetic methanol

- **1960s** first methanol plant built up
- **2003** more than **200** enterprises produce methanol
 - 1** enterprises with capacity **200kt/a**
 - 18** enterprises with capacity **100kt/a**
 - 6** enterprises with capacity **80kt/a**
 - others** enterprises with small capacity



1. Application of Coal Gasification Technology

- **2003** methanol total capacity over **4.0 Mt/a**
- Coal-based synthetic ammonia accounts for about **75%** of total output
 - 4.8Mt/a** feedstock coal
 - 4** Texaco entrained CWS gasifier
 - others** UGI fixed bed gasifier
- **2004** methanol capacity will be **5.0 Mt/a**
- **2005** methanol capacity will be **6.0 Mt/a**



1. Application of Coal Gasification Technology

- Downstream products from methanol
 - acetic acid
 - formic acid
 - ethers and esters
 - ethane and propylene
 - fuels : gasoline and dimethyl ether(DME)
- **2002 DME capacity 20kt/a**
- **2003 DME capacity 50kt/a**
- **2004 DME capacity 120kt/a**



1. Application of Coal Gasification Technology

➤ IGCC power generation (future)

1995 begun to discuss first IGCC power plant

1999 Yantai IGCC power plant project
authorized, capacity 300MW



1. Application of Coal Gasification Technology

- **Indirect coal liquefaction (future)**
 - **Indirect coal liquefaction R&D for over 20 years**
 - **2002 set up 1000t/a equipment (Shanxi)**
 - **2003 set up 10kt/a equipment and put into operation in 2004 (Yankuang Group)**
 - **Planning Project**
 - 3 mt/a (Yulin City, Shanxi Province)**
 - 3 mt/a (Ninxia Hui autonomous region)**



2. Coal Gasification Technology

- Imported technology
 - Before **1980's** coal gasifiers applied in China are behindhand UGI gasifier
 - **1984** Lurgi pressured fixed bed coal gasifier was imported firstly, **1987** began to operate
 - 7** Lurgi coal gasifiers are operating now



3. Coal Gasification Technology

- **1987** Texaco entrained coal gasifier was imported in Lunan Fertilizer Plant , 1992 began to operate
about **21** Texaco entrained coal gasifier are operating and will operate at present (table 2)



2. Coal Gasification Technology

table 2 Texaco coal gasifier operating and will operate in China

Location	Gasifiers	Capacity coal/d	Pres. Mpa	Products	start ope.
Lunan	2	400	~3.0	NH₃	1987
Wujing	4	1500	4.0	CH₃OH	1995
Weihe	3	1500	6.5	NH₃	1996
Huainan	3	1000	4.0	NH₃	2000
Haolinghe	3	1000	4.0	NH₃	2004
Jinling	3	2000	4.0	NH₃, H₂	2005
Yulin	3	1500	4.0	CH₃OH	2006



2. Coal Gasification Technology

- **2000** Shell entrained coal gasifier was imported

Table 3 Shell coal gasifier Construct and Planning

Location	Gasifier	Capacity t/d	Pres. Mpa	Products	State
Yingcheng	1	1000	3.0	NH₃	1995
Yueyang	1	2000	3.0	NH₃	Constuct
Liuzhou	1	1500	3.0	NH₃	Constuct
Anqing	1	2000	3.0	NH₃	Constuct
Zhijiang	1	2000	3.0	NH₃	Constuct
Shenghua	-	2000	3.0	Fuel	Planning
Dalian	1	1500	3.0	CH₃OH	Planning



2. Coal Gasification Technology

- Investigation on coal gasification technology in China start in early **1960's**
- **1966-1976** all study works were interrupted
- Early **1980's** pilot gasifier(Texaco CWS entrained gasifier) built up in Lintong Fertilizer Research Institute
- **1990's** pilot fluidized bed gasifier built up in Institute of Coal Chemistry, Chinese Academy of Sciences
- 2001** commercial fluidized bed gasifier began to operate, capacity **200t coal/d**



3. Coal Gasification Tech. R&D in ECUST

In early **1990's** Research Institute of CCT , ECUST, started to study CWS gasification technology

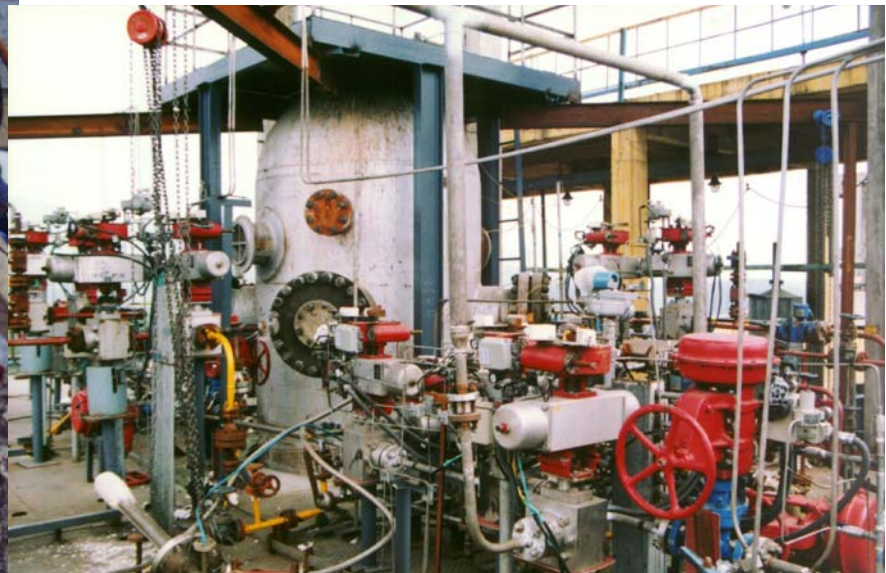
- **2000** pilot gasifier(multi-nozzle opposed entrained gasifier) had run successfully capacity **22t/d**
- A commercial gasifier (**750t/d, 6.5MPa**) has run firstly in Dezhou on **Nov. 30,2004**
- A commercial gasifier (**1150t/d, 4.0Pa**) has run at Lunan(Guotai Co. Ltd. , Yankuang Group) in **2005, July 21**

CWS gasification



Shanghai Jan, 2005

**Pilot plant had run
successfully in the July
of 2000**



CWS pilot plant gasification results

Plant		Capacity t coal/dunit	CO+H ₂ %	Oxygen consumption $\frac{\text{Nm}^3\text{O}_2}{1000\text{Nm}^3(\text{CO}+\text{H}_2)}$	Coal consumption $\frac{\text{kg coal}}{1000\text{Nm}^3(\text{CO}+\text{H}_2)}$	Carbon conversion %	Remarks
This technology (CWS pilot plant)		~22	~83	~380	~550	>98	Mixed bituminous coal in Luoling, Beisu, Jingting and Jisuo and CWS concentration ~61%
Lunan Fertilizer Plant	Imported pilot-scale installation	~15	80~81	~410	~600	~95	The same coal and CWS concentration as the above
	Industrial installation	~400	81.4	-	-	-	The same coal as the above and CWS concentration 61.6~63.6% at 0~4 am on Oct. 12, 2000
	Industrial installation	~400	~83	~410	~590	~95	The same coal as the above and CWS concentration ~65%
Shanghai Coking Limited Company		~500	~80	~410	~640	~95	Shengfu bituminous coal and CWS concentration ~60%
Weihe Fertilizer Plant		~800	~80	~410	~630	~95	Huating bituminous coal and CWS concentration ~62%

Dezhou commercial gasification system





Dezhou commercial gasification system

- **The Gasifier in the Shandong hualuhengsheng Chemical Co. Ltd.’s project of “Nitrogen Fertilizer” has run continually over 700 hours in the end of July.**
- **During the period of running the gasifier, the gasifier was stopped and checked according to our plan. Results showed that the firebricks in the burner chamber and gasifier, the burners, quenching rings were all in good condition.**



Dezhou commercial gasification system

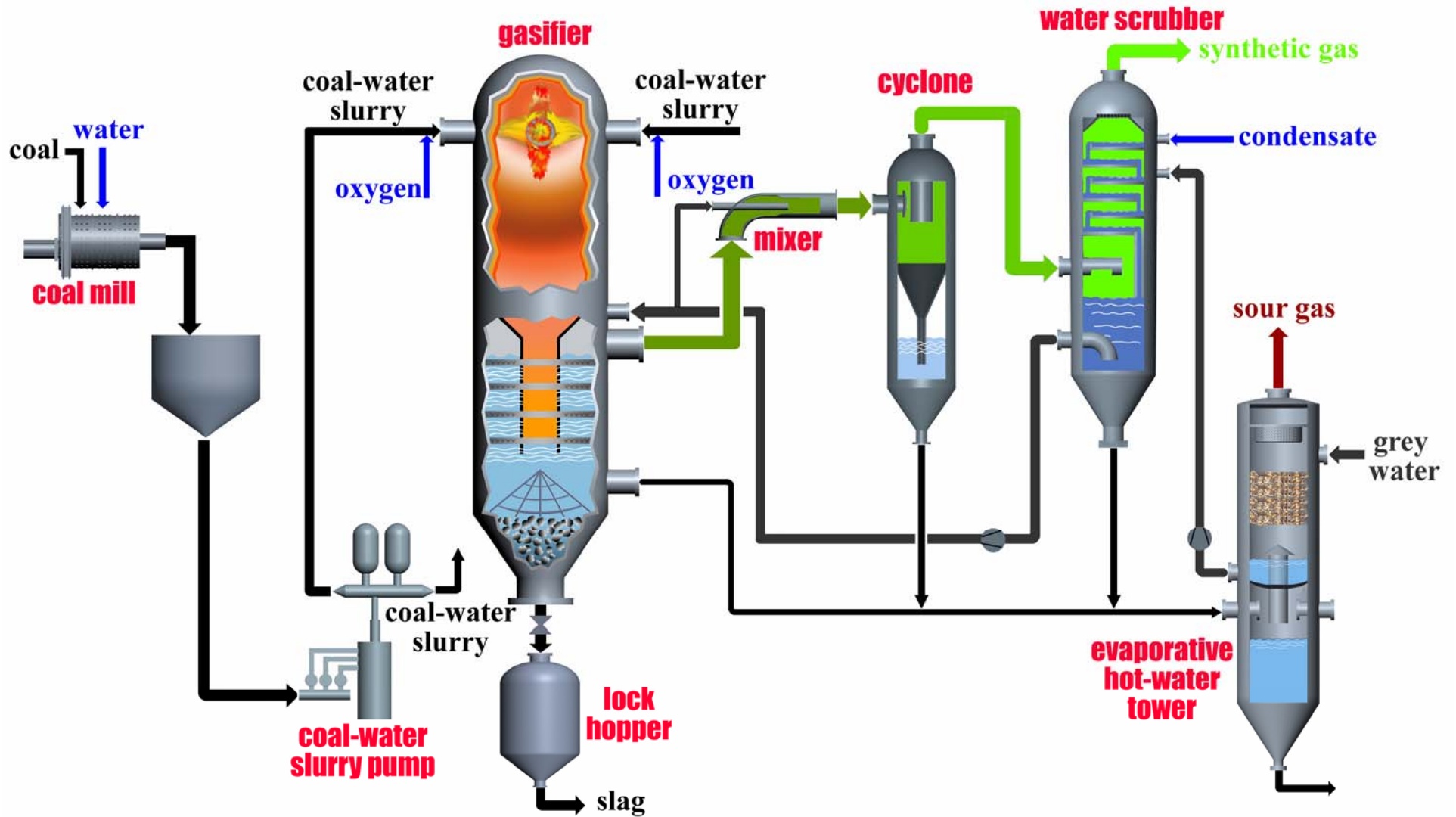
- **The process results was very good , the gas yield was about 9% higher than the GE(Texaco) gasifier, and the oxygen consumption was about same, the carbon conversion yield was 98%.**

Guotai commercial gasification system

**The gasifier has run successfully
in the end of July 2005**



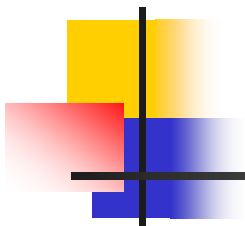
Guotai commercial gasification system



Pulverized coal pressurized-gasification

**Pilot plant had run
successfully in the end
of 2004**





Gasifier	Feed system	(CO+H ₂) %	Carbon conversion %	Oxygen consumption	Coal consumption	Coal type
				$\frac{\text{Nm}^3\text{O}_2}{1000\text{Nm}^3(\text{CO}+\text{H}_2)}$	$\frac{\text{kg coal}}{1000\text{Nm}^3(\text{CO}+\text{H}_2)}$	
New type gasifier (Pilot trial)	pulverized coal	89~93	98~99	300~320	530~540	Present coal type for Lunan gasifier (Ash: 9.14%)
	coal water slurry	83	>98	380	550	Former coal type for Lunan gasifier (Ash: 7.67%)
Shell (Shell China Limited)	pulverized coal	90	>99	340	590	Ash: 18%
Texaco (Lunan fertilizer plant)	coal water slurry	~83 (Oct, 2004)		~399 (Jun~Dec,2003)	~644 (Jun~Dec,2003)	Present coal type for Lunan gasifier (Ash: 9.14%)



Pulverized coal pressurized-gasification

Pilot plant operation of pulverized coal pressurized-gasification technology by using CO₂ as transfer medium succeeded satisfactorily.

- The commissioning test run was started on June 15th, 2005 and sustained for 48 hours.
- The gasification pressure in the pilot plant was up to 3.0Mpa, the temperature was 1350°C and the nitrogen content in the synthesis gas decreased to below 1%, and the content of the effective gas increased to 90~95% as compared with conveying pulverized coal use nitrogen flow.



Pulverized coal pressurized-gasification

- So far, there are no relevant data concerning pulverized coal pressurized-gasification, which used CO_2 as conveying medium, being reported in other countries.
- This significant research progress means importance for widening the application area of pulverized coal pressurized-gasification technology (i.e. for producing methanol, dimethyl ether, acetic acid, alkene and Fisher-Tropsch synthesis).



Future works in ECUST

- pulverized coal pressurized-gasification is planning to set up an commercial gasifier , capacity is about 1200 t coal/day.

The project will be invested by Tengzhou Lunhua Phoenix Fertilizer Company Ltd., final product is fertilizer, The project has been listed in the **Important Projects** of Shandong province,

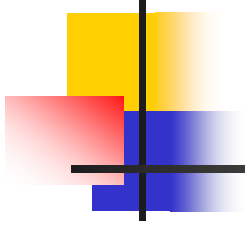


Future works in ECUST

- **A new pilot plant gasifier with Water-Wall lining will be going to build (capacity about 30-40 ton coal/day) in Yankuang Lunnan Chemical Fertilizer Plant.**

The final object is to research and develop Water-Wall lining gasifier technology which can be industrialized as quickly as possible.

It has be planned to process and modify the setting frame at Sep. or Oct. this year and start operation at the first quarter, 2006.



Thanks for You Attention