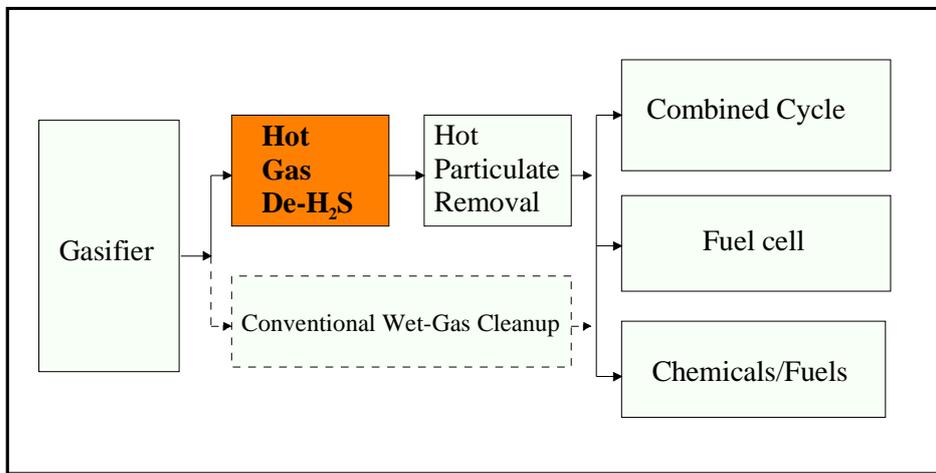




(wet type)  
 가 100 °C 가  
 가 가 가 가  
 가 가 가 가  
 IGCC IGFC 가



[ 1 ]

가 가  
 H<sub>2</sub>S COS SO<sub>2</sub>  
 /  
 가 가 가 가 가 가  
 가 H<sub>2</sub>S 가 가

SO<sub>2</sub>가

가

### 3.

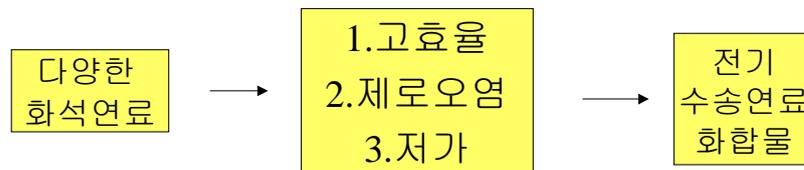
#### 3.1 Vision 21

Vision 21 21

[18]. Vision 21

(chemicals)

가



[ 1] 21

1986

(Clean Coal Technology)

[16]. (Advanced Pulverized Coal Combustion), 가 (Pressurized Fluidized Bed Combustion Combined Cycle), 가 (Integrated Gasification Combined Cycle), (Advanced Turbine System), (Fuel cells)

(deregulation)

가

. 21

, 가 가

가

Vision 21

SOx 5 ppm, NOx 10 ppm  
가

0.01 lb/MMbtu, 1/30

SOx 60 ppb, NOx 100 ppb

CO<sub>2</sub>

40 – 50 %, CO<sub>2</sub> 100%

< 1> Vision 21 Energy Plant

	60% (for HHV)	38% ( )*
	75% (for 가 LHV)	51%(가 )*
( / )	85%	
	75% (LHV)	
	Near "0"	
	SO <sub>2</sub> : 5ppm (60 ppb for chemicals)	SOx: 150 ppm (2005 70ppm)
	NOx: 10ppm (100 ppb for chemicals)	NOx: 250 ppm(2005 70ppm)
	: 5ppm	: 50 ppm (2005 20ppm)
	trace elements: 0	
	Organic compounds: HAPS 1/2	
	CO <sub>2</sub> : 40-50%	
	100% (by )	
	가	PC (1275\$/KW)*, NGCC(\$562/KW)*
	2005: (spin-off)	
	2012:	
	2015:	

\* from "Market Based Advanced Coal Power Systems [19]"

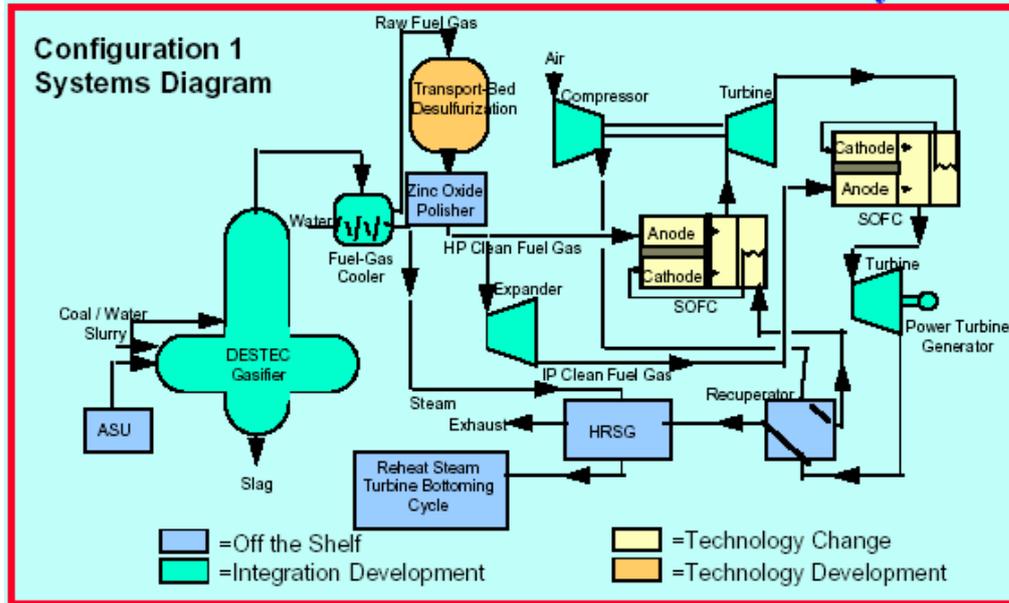
[ 2] zero-emission plant 2.5%

15 가

가 15 1000 °C ,

3 , 가 가 , 가

60% , 가 84% 가 가



[ 2] 가 / / / Vision21 [18]

3.2 (NETL)

(National Energy Technology Laboratory) Vision21

. 200 가

Gas Process Development Unit (GPDU)

. GPDU - , - , - 가  
4 가 . 가

ppb

. RVS-1  
2001 R&D 100 Award

3.3 EAGLE 가

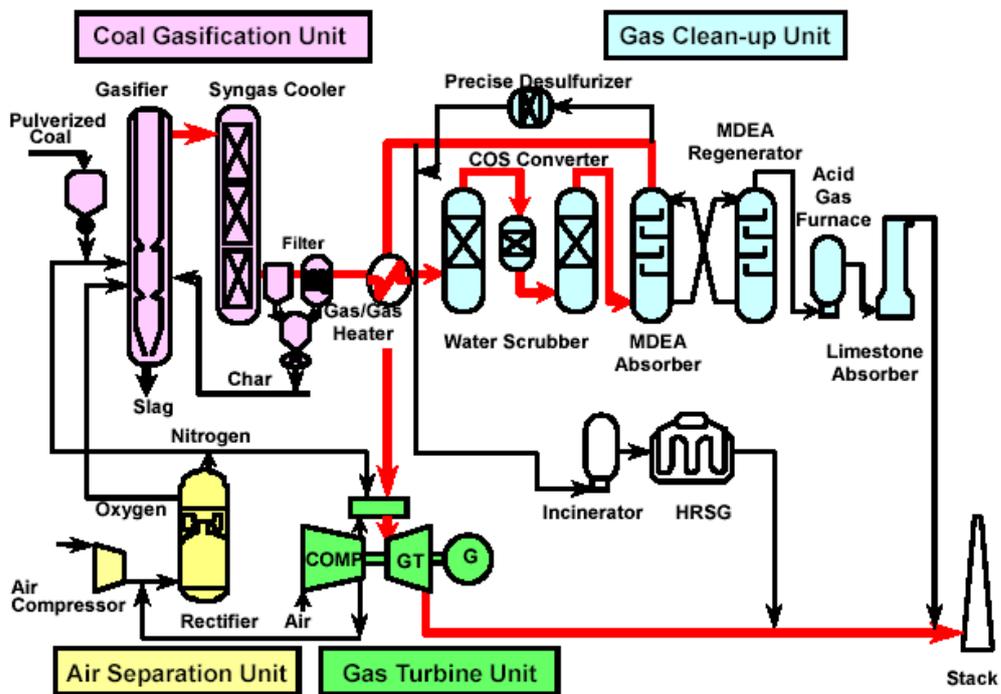
EAGLE(coal Energy Application for Gas, Liquid, and Electricity) 가

. 150 / 가 , 가 , 가 , 가

, 2001 7 .  
가 [ 3]

, COS , MDEA

(precise desulfurizer) . MDEA . < 2>  
가 가 limestone . < 2>  
EAGLE . 1 ppm ,  
1 ppm . 25 , 가  
14,600 m<sup>3</sup>N/hr, 8 MWe 가 . 1998 8 2001  
7 가 2003 . IGFC 53%  
[20].



[ 3] EAGLE

< 2> EAGLE

Coal Gasification Capability	
Carbon Conversion	> 98%
Higher Heating Value of gas	> 10,000 KJ/m <sup>3</sup> N
Gas Clean-up Capability	
Sulfur Compound	< 1 ppm
Halogen Compound	< 1 ppm
Ammonia Compound	< 1 ppm
Scrubbing Capability	1 mg/m <sup>3</sup> N
Obtaining gasification data for over 5 type of coal	
Obtaining design data 10 times that of test plant	

### 3.4 Gas Technology Institute

Vision21

GTI

가

HCl, H<sub>2</sub>S

IGCC

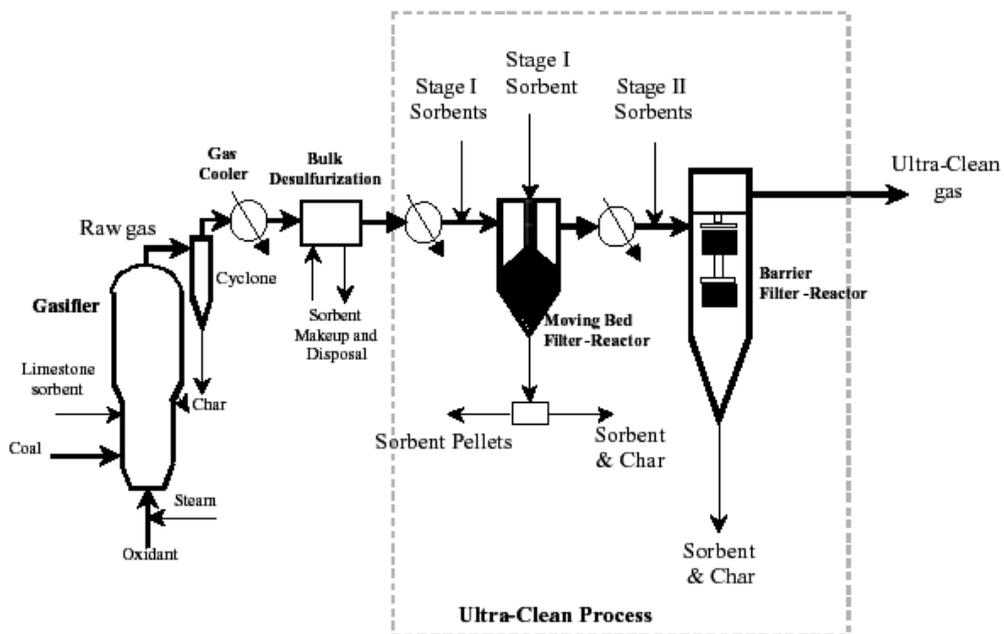
ppmw 가 . [ 4]

. H<sub>2</sub>S 60 ppbv, HCl 10 ppbv, 0.1

371-593 °C HCl

1 - 3 ppmv, 2 barrier

ppbv



[ 4] Gas Technology Institute

HCl Dionex DX320/IC20 ion chromatography

10 ppb

, H<sub>2</sub>S GC-FPD 1ppm

FPD

Supelco glass column 85 ppb

. < 3>

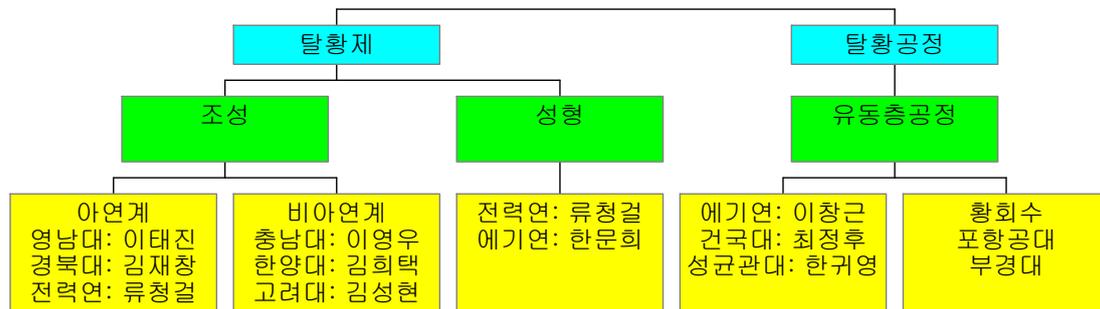
[20].

< 3> GTI 1, 2

	1	2
	499 °C	288 °C
	IGTSS-362C (Zn/Ti mole =1.5)	G-72E (70 wt% Zn)
Halide	Trona (Na <sub>2</sub> CO <sub>3</sub> NaHCO <sub>3</sub> 2H <sub>2</sub> O)	G-92C (6.4 wt% Na)
	-325 mesh, 20 μm	-325 mesh, 20 μm

4.

1994 G7  
R&D 가 , IGCC 가  
가 1999 가  
[ 5]



[ 5]

4.1

[ 6]

10cm

[ 7] KIER

(EZ4)

11000 ppm

100

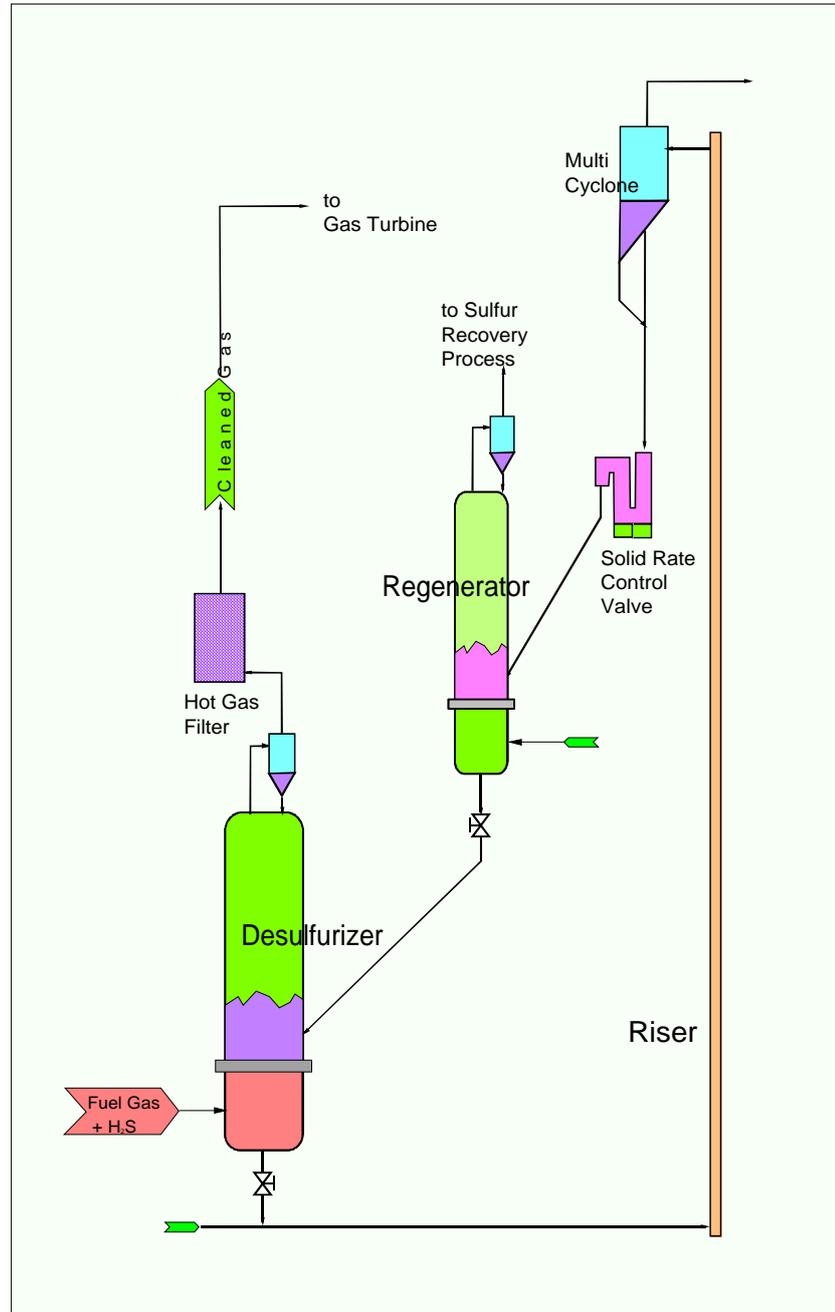
50 ppm

/

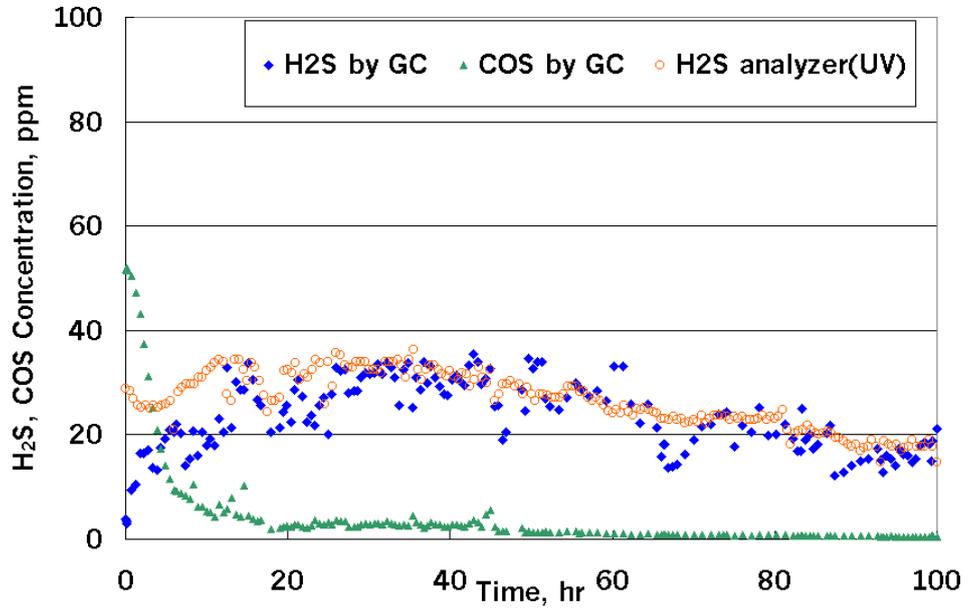
scale-up

..

가  
know-how  
가  
standpipe  
[7],  
[8],  
scale-up  
, Lehigh  
[6]가



[ 6] KIER



[ 7] 100

#### 4.2

가 . 가 .

가 .

1 1994 가

[5,11].

. Zinc ferrite zinc titanate

. 가 가 가

[9,10]. ZTE, ZTG, ZTM series multicycle microreactor , 50%

가 , 100

ZTG-40 . 2000

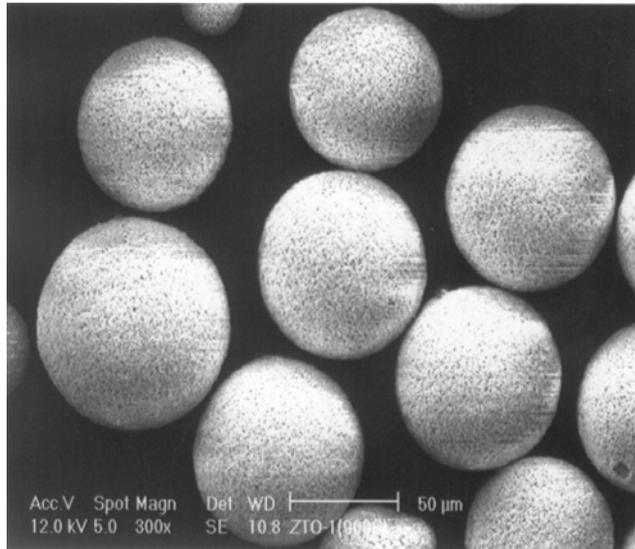
Al<sub>2</sub>O<sub>3</sub> SiO<sub>2</sub> ZA series, ZS series 가 가

[12].

[13-15]

가 , 가  
 2 가 , injectable  
 sorbent 가 가  
 가 5  
 ) ( ), ( ), ( )  
 가 CMS-6 가,  
 가 FS 가 TGA microreactor  
 . 2000 CFS series, SiC SFS series 가  
 가  
 FCC FMC 가 TGA  
 FMMC-2 COS 20 ppm  
 10 ppm 가  
 NiS (425°C) 380-400 °C ,  
 가

가



zinc titanate ASN series

ZAC series

[4].

가

100kg

100

### 5.

가

가

가

가

가

/

spin-off

### 6.

Zero emission

21

가

polygeneration

가

가 ,

가 ,

가

H<sub>2</sub>S

5-6

가

가 가

PPM

가

가

( )

( )

( )

1. , "IGCC ", , Vol. 13(5) p466-474 (1995)

2. a) , , , "IGCC (I)",

- , Vol. 16(1) p17-29 (1998).
- b) , , , "IGCC (I)",  
 , Vol. 17(1) p41-52 (1999).
3. , , , " Zinc Titanate (I) & (II),"  
 , Vol. 15(3), p237-246, Vol. 15(4), p342-352 (1997)
4. a) , , , " zinc titanate  
 " 15669 (1999).
- b) , , , , , " 가  
 " 10-2000-0022669 (2000)
5. , , , , , , " 가  
 H2S , " , Vol. 34(4), p435-442 (1996)
6. C.K. Yi, W.L. Luyben "Dynamic Model and Control Structures of a Hot-Gas Desulfurization Fluidized Process", *Industrial and Engineering Chemistry Research*, Vol. 38(11), p4290-4298 (1999)
7. J.M. Kim, G.Y. Han, C.K. Yi "The Characteristics of Particle Flow in the Overflow and Underflow Standpipe in Fluidized Beds" *Korean J. Chem. Eng.*, Vol.17(3), p273-279 (2000)
8. , , , , " "
- , Vol. 38(5), 698-705 (2000).
9. , , , , , : " Zinc  
 Titanate ", 38(1), 111(2000).
10. , , , : "A study on Regeneration of Zinc Titanate Sorbents for H2S  
 Removal", *Korean J. of Chem. Eng.*, 14(6), 513(1997).
11. , , , : " - ",  
 , 8(1), 122(1997).
12. H.K. Jun, T.J. Lee, S.O. Ryu, J.C. Kim, *Ind. Eng. Chem. Res.*, 40, 3547-3556 (2001)
13. , , , , " ",  
 , 37(5), 795-799 (1999).
14. , , , , "Reactivity of Copper Oxide-Based Sorbent in Coal Gas  
 Desulfurization", *Korean J. Chem. Eng.*, 17(6), 691-695 (2000).
15. , , , , , "  
 " , 38(1), 117 (2000)
16. Federal Energy Technology Center "Vision 21 Program Plan: Clean Energy Plants for the 21st  
 Century" FETC, Office of Fossil Energy, U.S. Department of Energy (1999)

17. National Energy Technology Laboratory "Vision 21 Technology Roadmap" NETL, U.S. Department of Energy, Pittsburgh, PA (March 2001)
18. Ruth, L.A. "Vision 21: Fossil Fuel-Based Energy for the 21<sup>st</sup> Century," Proceeding of workshop on Clean Energy Utilization Technology (Oct 2001)
19. DOE report "Market-Based Advanced Coal Power Systems," DOE/FE-0400, U.S. DOE, Office of Fossil Energy, Washington D.C. (May 1999)
20. Proceeding of 18<sup>th</sup> Pittsburgh Coal Conference, CD-Rom, Newcastle, Australia (Dec. 2001)