



Seoul National University Seminar

Gasification Technology of Solid wastes

November 11. 2014

KOLON GLOBAL Corp., R&D department

KWAK YEON HO

1. Introduction of KOLONGLOBAL



[Overview]



[Gwacheon]



[Songdo]

▶ KOLON GLOBAL CORPORATION

▶ Address

- KOLON TOWER (Main building) 11 kolon-ro
Gwacheon-si, Gyeonggi-do, Korea

- Song-Do Technopark IT Center 32 Song-Do science-ro
YeonSu-Gu, Incheon, Korea

▶ Employee : 2,500 people

▶ Revenue : 3 Billion Dollars (2013)

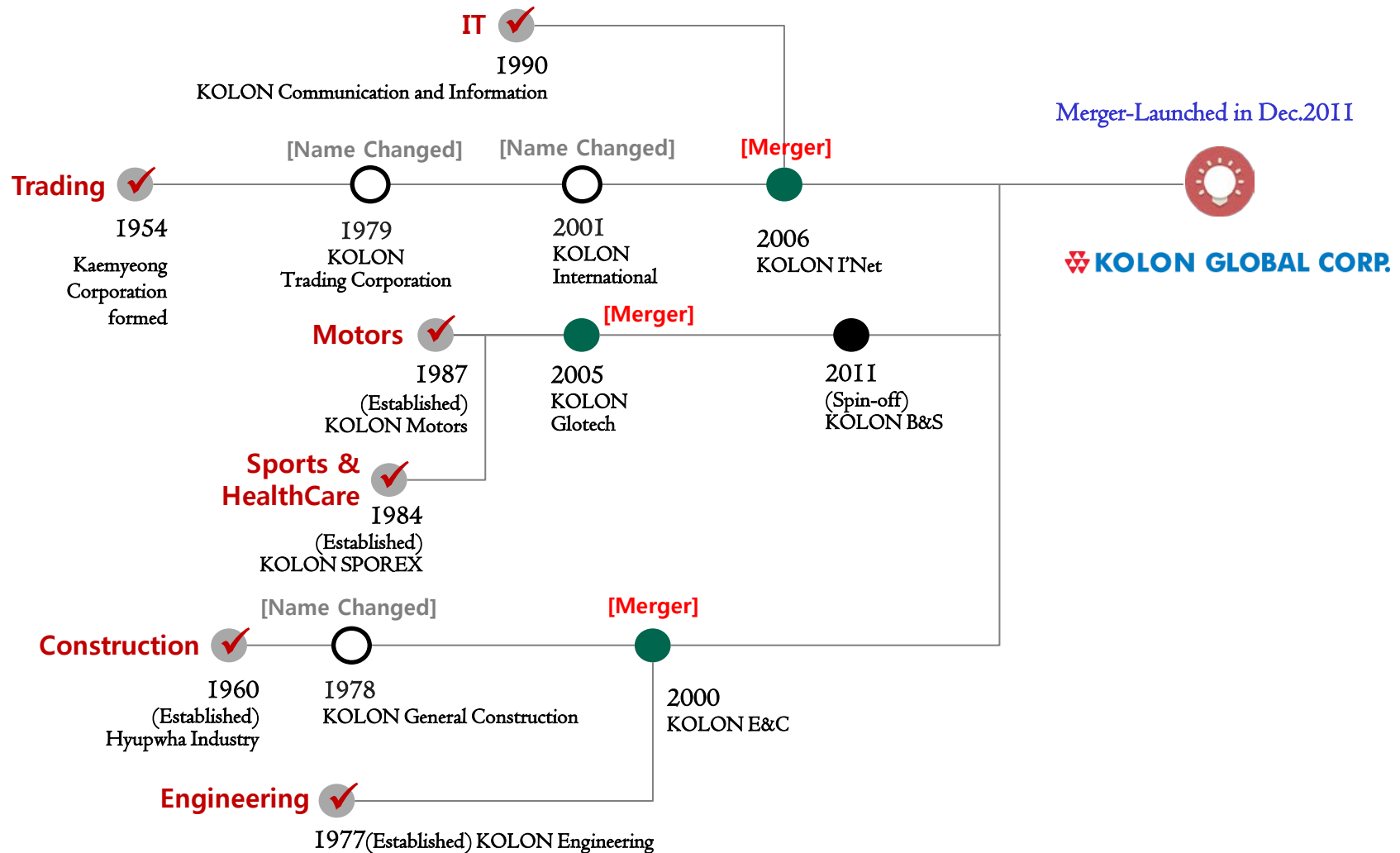
KOLON GROUP

- Established in 1954
- Over 12,000 employees with 36 Subsidiaries
- Sales Revenue US\$ 11 Billion (2013)

1. Introduction of KOLONGLOBAL



[History of Company]



1. Introduction of KOLONGLOBAL



[Business Area]

Construction



- Construction, Development, EPC & O&M
- Power plant, Environmental plant
- New regeneration energy
- Overseas

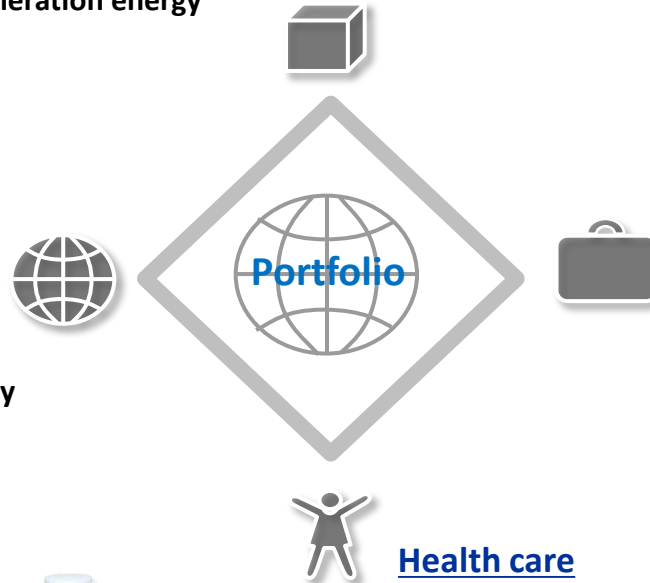


Auto distribution

- BMW Dealing (No.1 in domestic)
- A/S Factory
- BMW Rental, Lease
- BPS service
- MINI, R/R, BMW Motorrad

Trading Service

- Steel
- Energy, Heavy chemistry
- Fashion, Leisure, Fiber
- General products



Health care

- Sport center (KOLON Sporex)
- Lifestyle Business (Bang&Olufsen)



1. Introduction of KOLONGLOBAL



[Environment Business Area]

Future Environmental Technology for Human

Base on environment friendly technologies and abilities, KGC provides total solution for all environmental facilities from EPC to O&M.

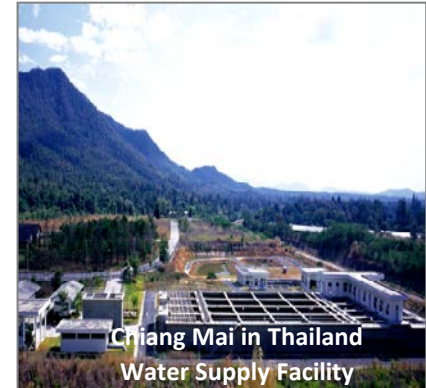
Our sewage water treatment technology is selected as new environmental technology and we're endeavoring to improve high water treatment facilities business.

Business Brief

- Water treatment
- Waste treatment(Incineration, Sanitary landfill)
- Waste to Energy
- Recovery works, etc.



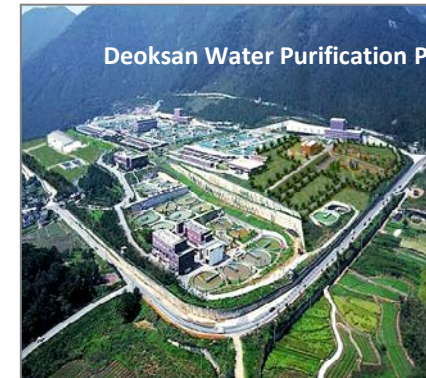
Namyang-Ju Incinerators



Chiang Mai in Thailand
Water Supply Facility



Daejeon Sewage Treatment Plant



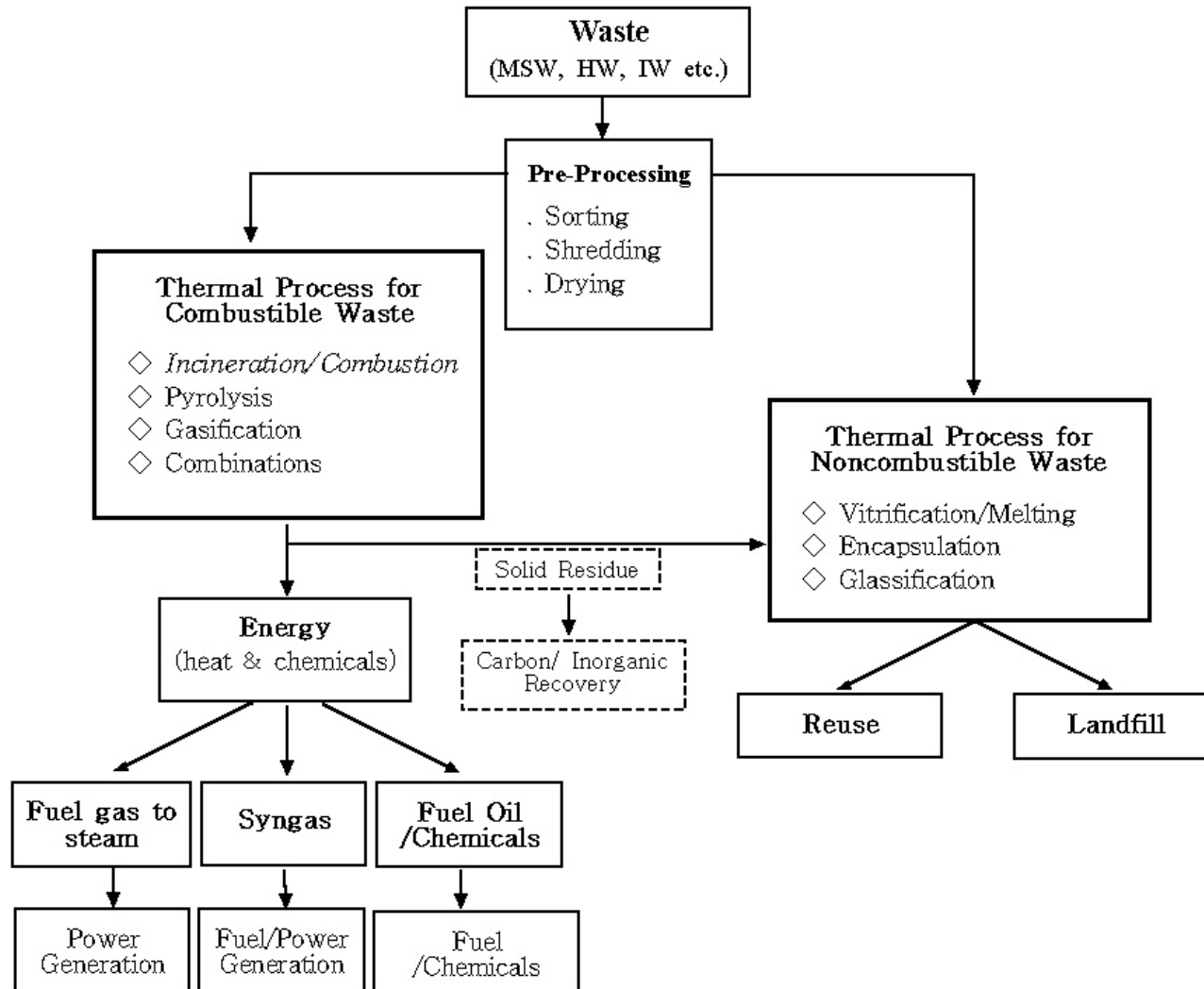
Deoksan Water Purification P

Green technology for the future

2. What is Gasification?



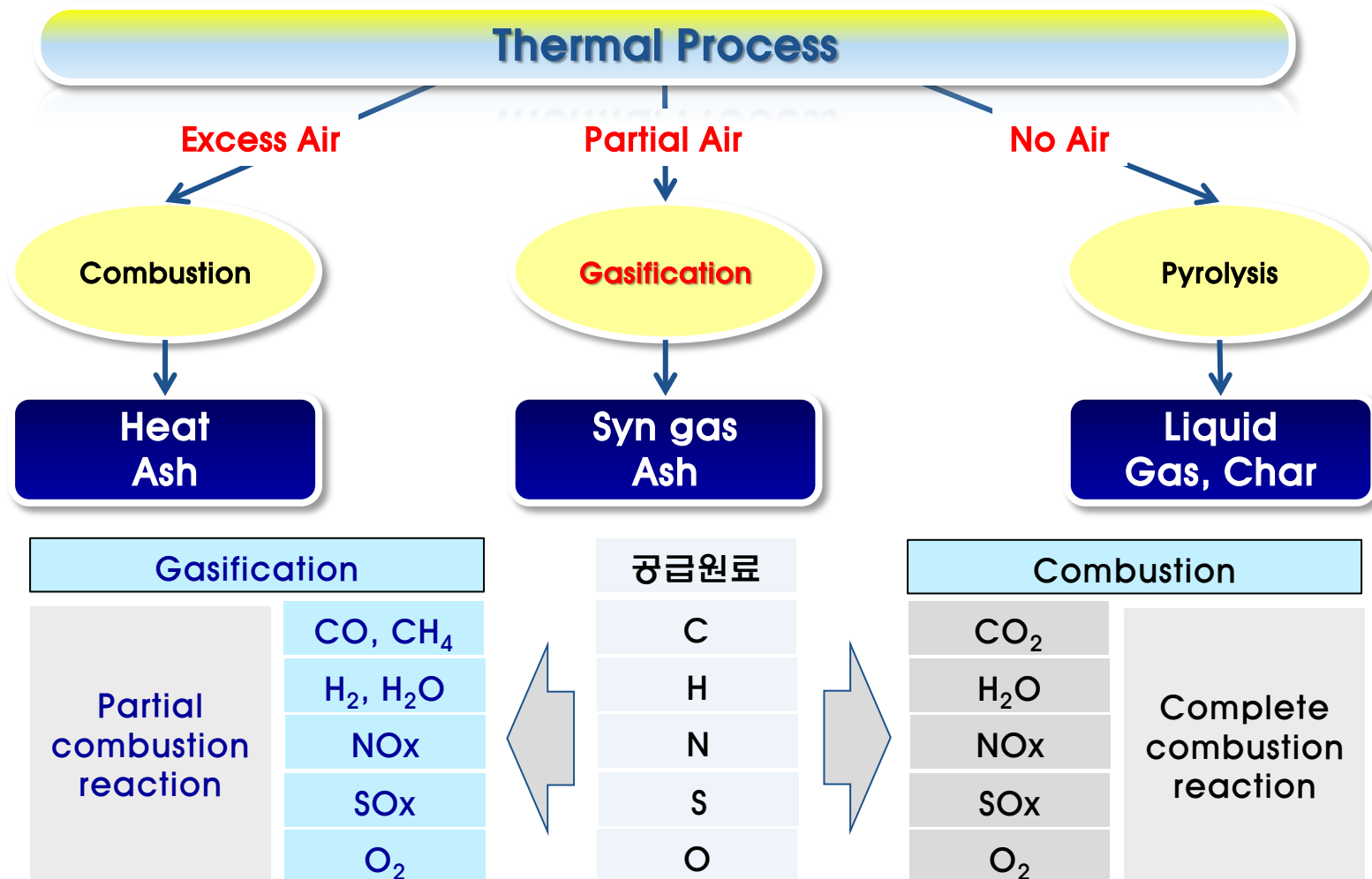
Thermal treatment technology of wastes



2. What is Gasification?



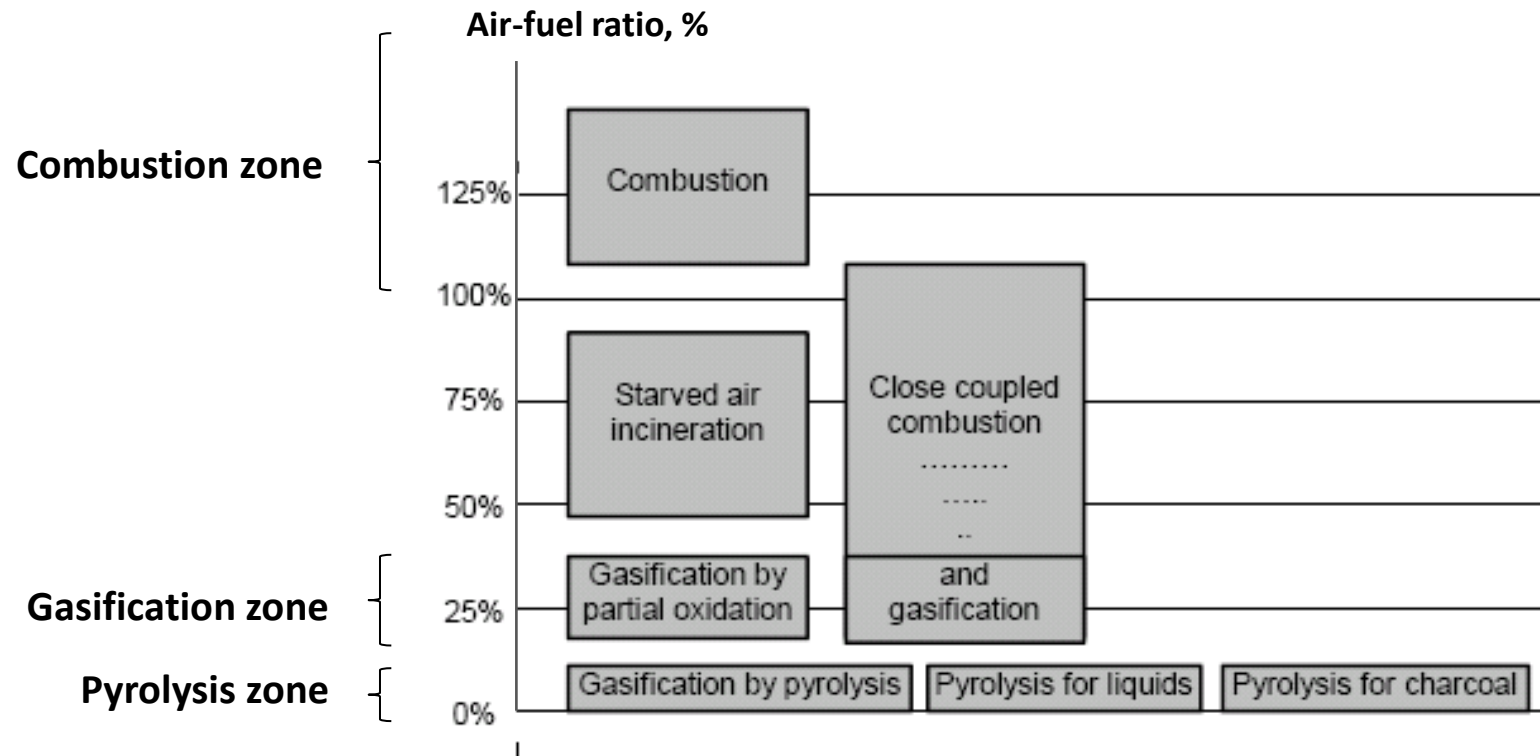
- Thermal Conversion Processes : Combustion, Gasification, Pyrolysis



2. What is Gasification?



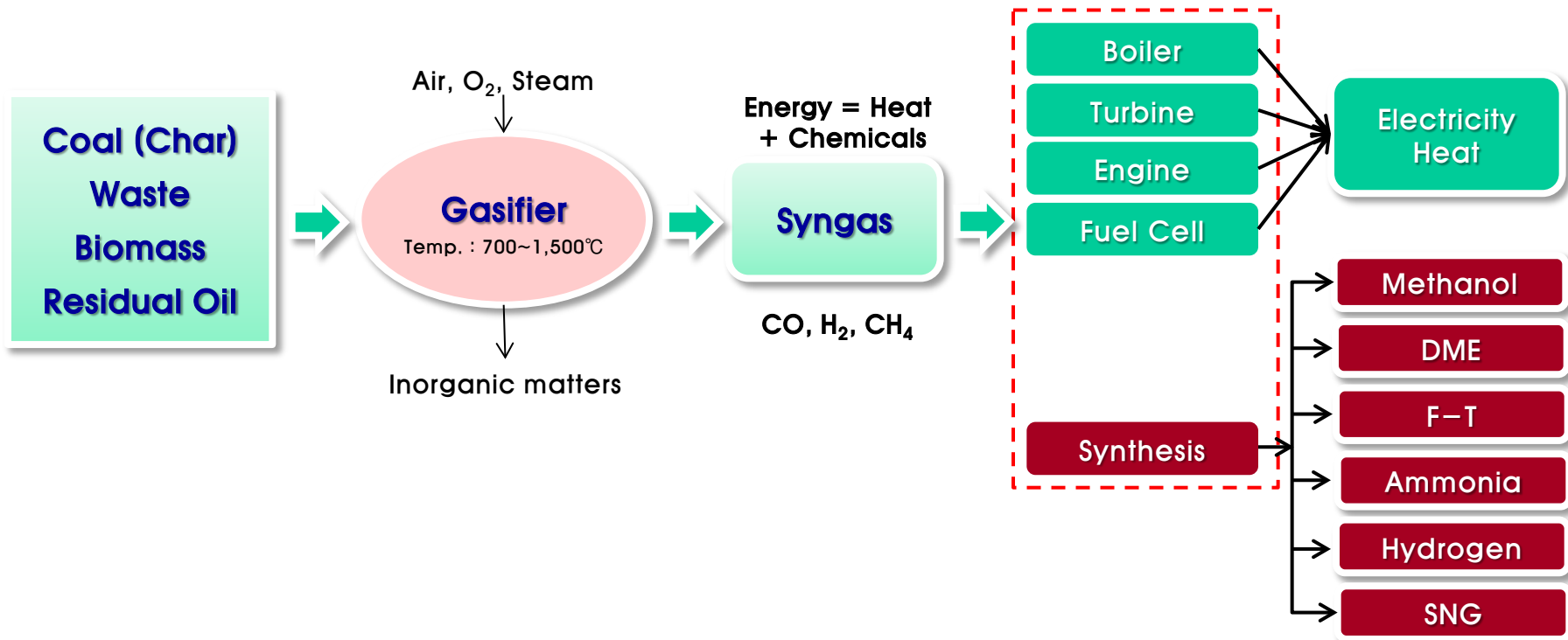
- Thermal Conversion Processes : Combustion, Gasification, Pyrolysis



2. What is Gasification?



- Purpose : To convert wastes or low-value fuels to higher value energies

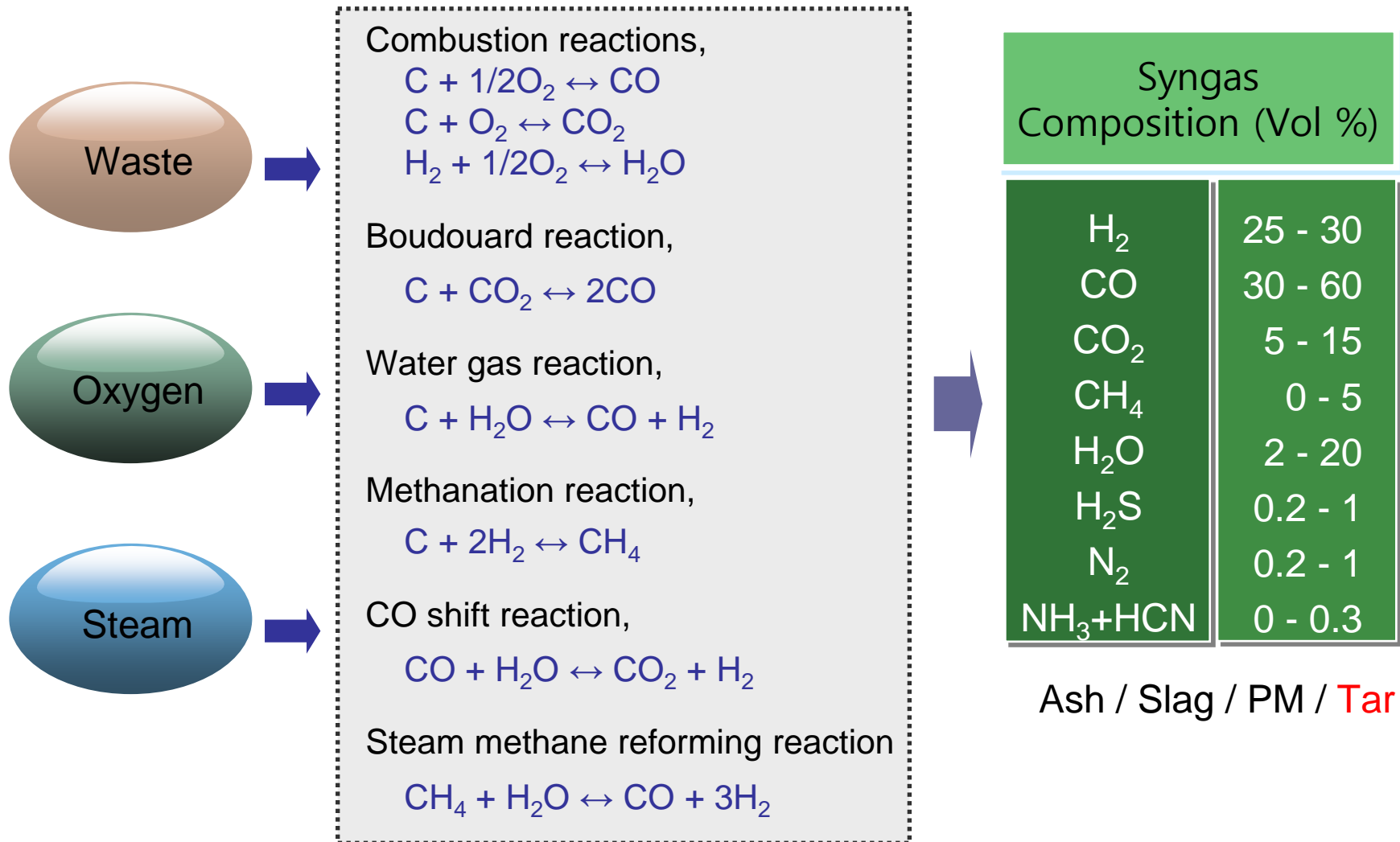


- The feedstock is prepared and fed into a gasifier with the reactants
- Combustible gas called syngas is produced
- These gases are available to produce the electricity or heat after gas cleaning
- They can also be used for the production of chemicals

2. What is Gasification?



o Main gasification reaction and gas composition



3. Why is Gasification?



- **Advantages of Gasification in compare to incineration**
 - **Environmental standpoint**
 - low SO_x / NO_x emissions(reducing atmosphere)
 - Dioxin compounds are not formed during gasification
 - Reduction of CO₂ emissions
(Exhaust gas is much less than its of combustion)
 - **Energy standpoint**
 - Possible to a various applications(Power/Heat/Chemicals/Oil)
 - Power efficiency is high
 - **By-product utilization standpoint**
 - Reuse of slag as construction materials

3. Why is Gasification?



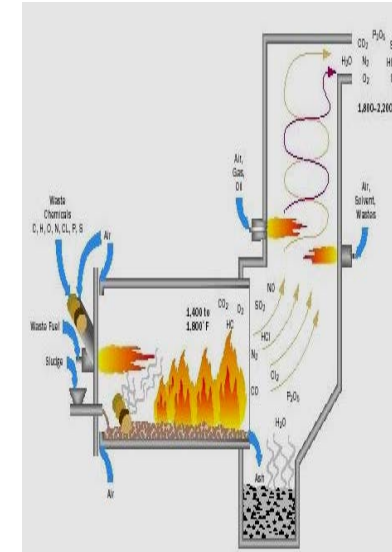
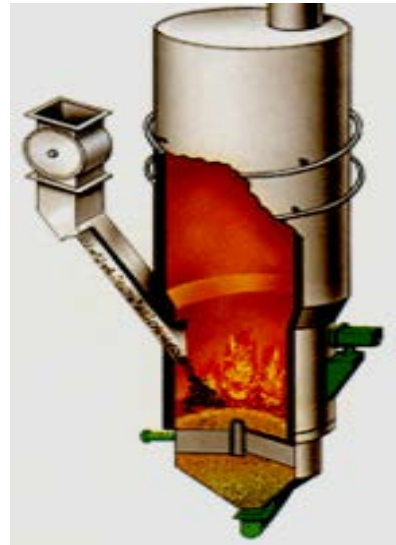
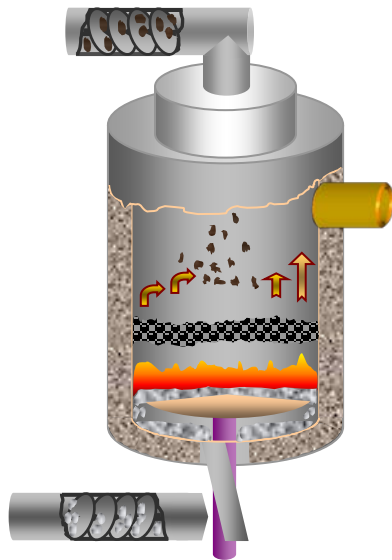
- Reduction effect of greenhouse gas according to waste to energy types

Classification	Reduction of greenhouse gas (TC/ton)	Reduction of others (TC/ton)	Total (TC/ton)
Incineration (No heat recovery)	0	-	0
Incineration (With Heat recovery)	0.19	-	0.19
SRF (Solid refused fuel)	0.21	-	0.21
Gasification	0.27	0.4	0.67

4. What do we develop?



Development of gasifier



type	Fixed bed	Fluid bed	Rotary kiln
Advantage	Simple of gasifier	High heat transfer Large scale upgrading	High syngas quality (indirect heating)
Disadvantage	Limited capacity	Low syngas quality (high air injection)	Low heat transfer

4. What do you develop?



Development of gas cleanup system

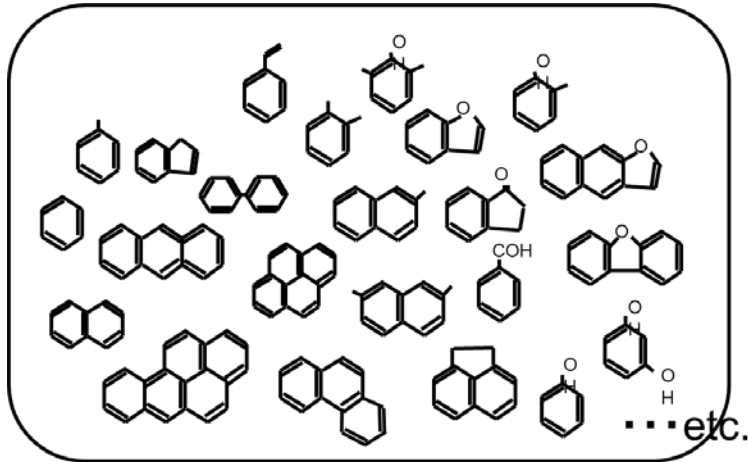
Contaminant	Examples	Problems	Cleanup method
Particles	Ash, char, fluid bed material	Erosion	Filtration, scrubbing
Alkali Metals	Sodium and potassium compounds	Hot corrosion	Cooling, condensation, filtration, adsorption
Fuel nitrogen	Mainly NH ₃ and HCN	NO _x formation	Scrubbing, SCR
Tars	Refractory aromatics	Clog filters, difficult to burn, deposit internally	Tar cracking, Tar removal
Sulfur, Chlorine	H ₂ S, HCl	Corrosion, emissions	Lime or dolomite scrubbing or absorption

4. What do you develop?



Development of gas cleanup system

Structure of tar



- As complex aromatic compounds are connected with many benzene rings, tar is very difficult to remove completely.
- The tar is present in the gaseous state at a high temperature.
- However, tar is changed in a limy liquid when cooled.
- This can cause the damage to the engine or turbine equipment

4. What do you develop?



- Development of gas cleanup system

Tar removal method

Physical removal method

To directly remove the tar

Filter
Scrubber
Adsorption

Low cost
Low removal efficiency
Reduction of syngas heating value

Steam reforming method

Tar was converted into syngas by a thermochemical conversion

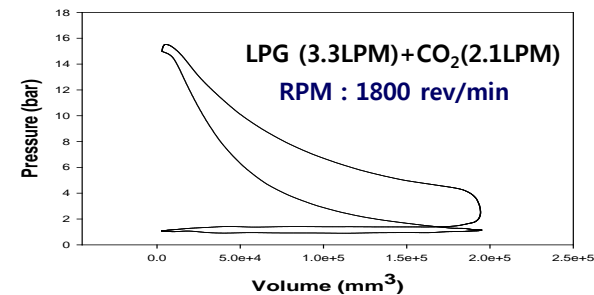
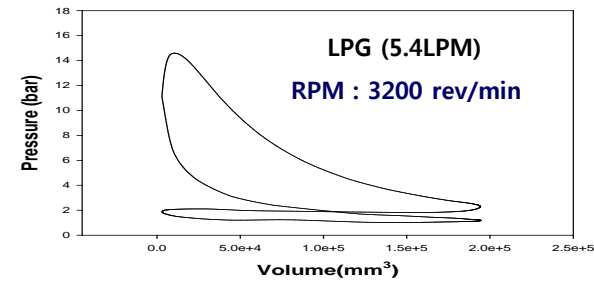
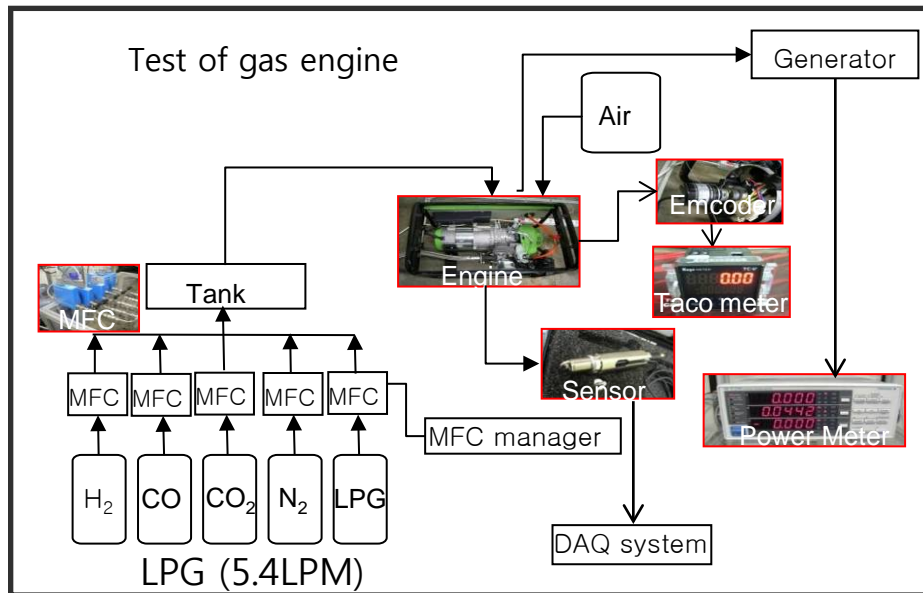
Steam of a high temperature

High value syngas
High removal efficiency
High cost

4. What do you develop?



Development of gas engine



- the gas engine for LNG was generally developed
- Heating value of syngas is very lower than its of LNG (1,500kcal/Nm³)
- When heating value of syngas is low, techniques for controlling the mechanical characteristics of engine is needed.

5. Our research



Research Project

Project Title	Eco-STAR Project : Center for Waste Eco-Energy and non-CO₂ Green House Grasses
Research Title	Development of energy conversion technology from waste through application of pre-treatment & gasification
Total Research Period	2008. 2.1~2012. 12.31 (4 year 10 month)
Total Research fund	8.2 billion won
Major Research Institute	KOLON E&C
Participating firm	KOLON E&C, EFMC, KOREA DISTRICT HEATING CORP, SUDOKWON Landfill Site Management Corp., SEOHUNG EN-TECH LTD., U SENTECH
Consignment research institution	Korea Testing Laboratory, THE UNIVERSITY OF SEOUL



Objectives

Concept : E³ TECHNOLOGY

Eco – friendly : Developing technologies to minimize contaminants

Energy efficient : Maximizing recovery of energy by increasing gasification conversion rate

Economic : Saving cost of facilities and operation by integration and localization

Application in
full-scale plant

**Developing energy conversion system from waste by
pretreatment / gasification / energy recovery technologies**

5. Our research



Research history

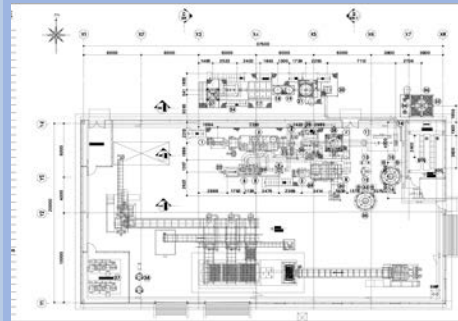
2008

Research project launched(2008)

2009



Prototype manufacture and test(20kg/hr) (2009)



Plant design(5t/d)(2010)

2010



Construction of building (2010)

2011



Operating and test(~2012)



Manufacture of gasification facility(2011. 05)

2012



Manufacture of pre-treatment facility(2010)

5. Our research



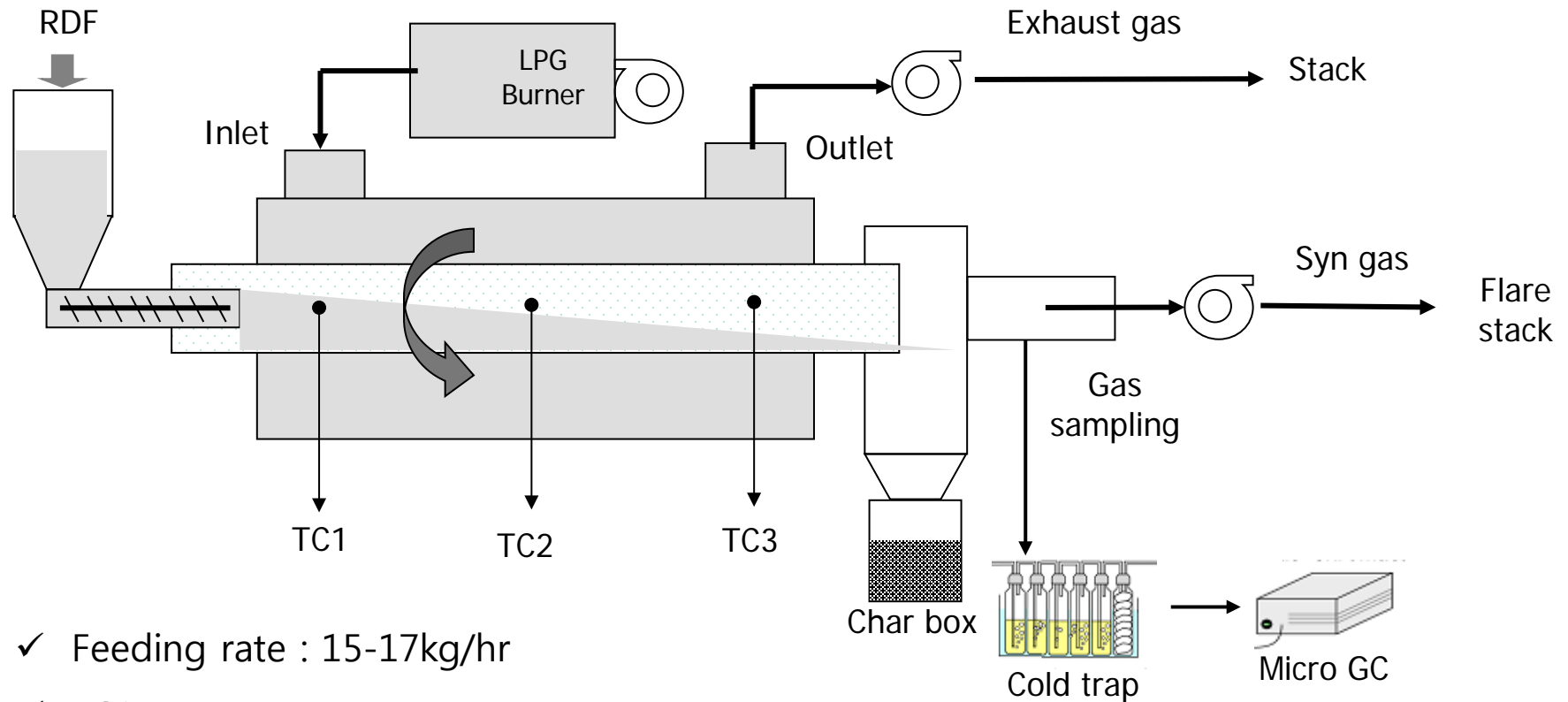
Prototype rotary kiln gasifier(20kg/hr)



5. Our research



Testing procedure in a rotary kiln gasifier



- ✓ Feeding rate : 15-17kg/hr
- ✓ TC1 temperature : 630 – 790 C
- ✓ Air ratio : 0.05 – 0.15

5. Our research



Sample used in this Test



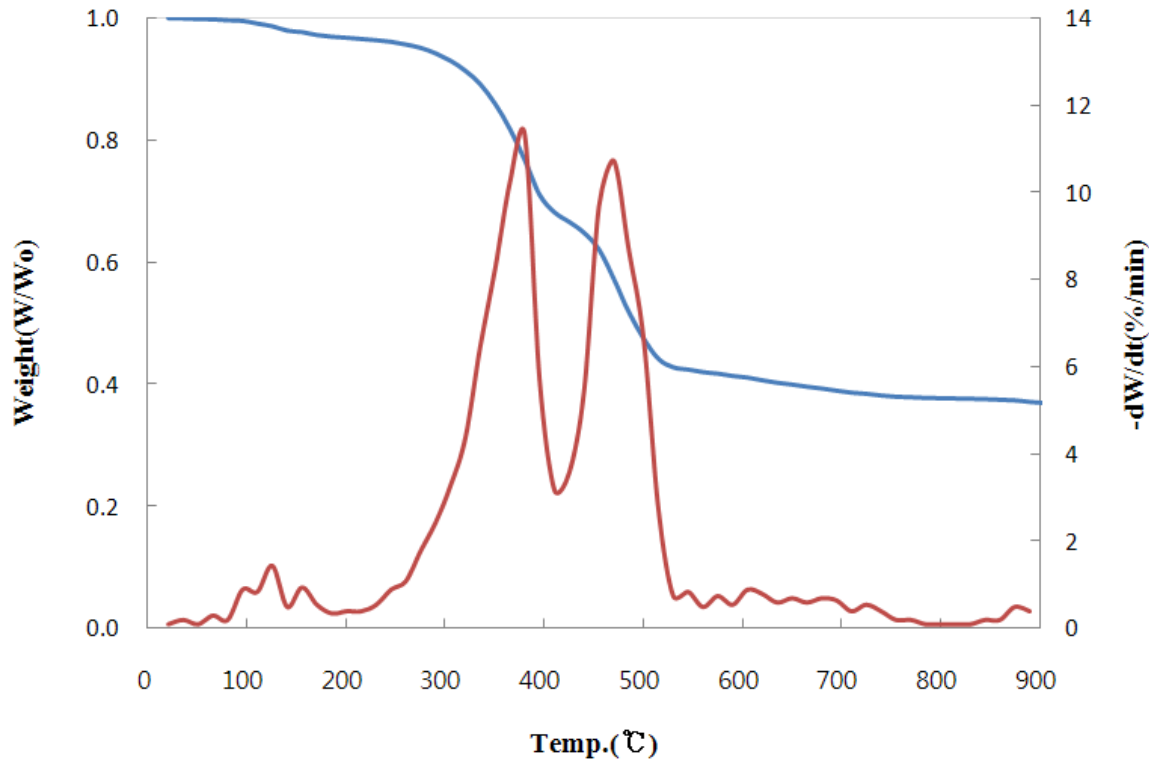
Pelletized RDF

Proximate analysis (wt%)		Ultimate analysis (wt%)	
Moisture	9.0	C	40.63
Volatile matter	53.0	H	5.74
Fixed carbon	11.5	O	23.97
Ash	25.8	N	1.33
High Heating value	3,850	S	0.01
(kcal/kg)		* Dry basis, **Wet basis	

5. Our research



TG and DTG curves of Sample



- ✓ Feedstock : RDF(dried and crushed)
- ✓ Sample weight : 10 mg
- ✓ Setting temperature : 30C/min to 900°C
- ✓ Carrier gas : N2



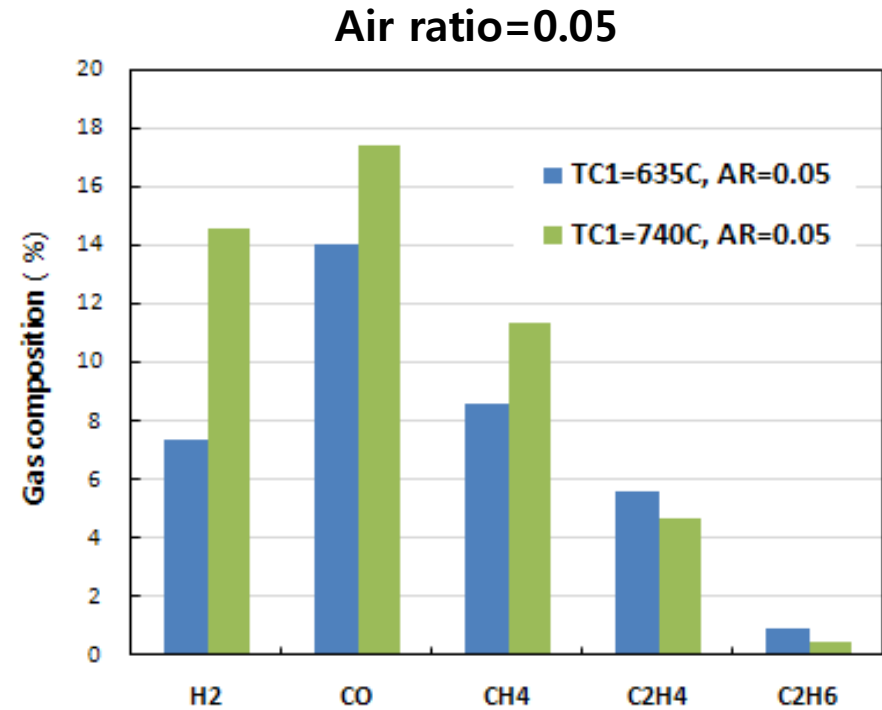
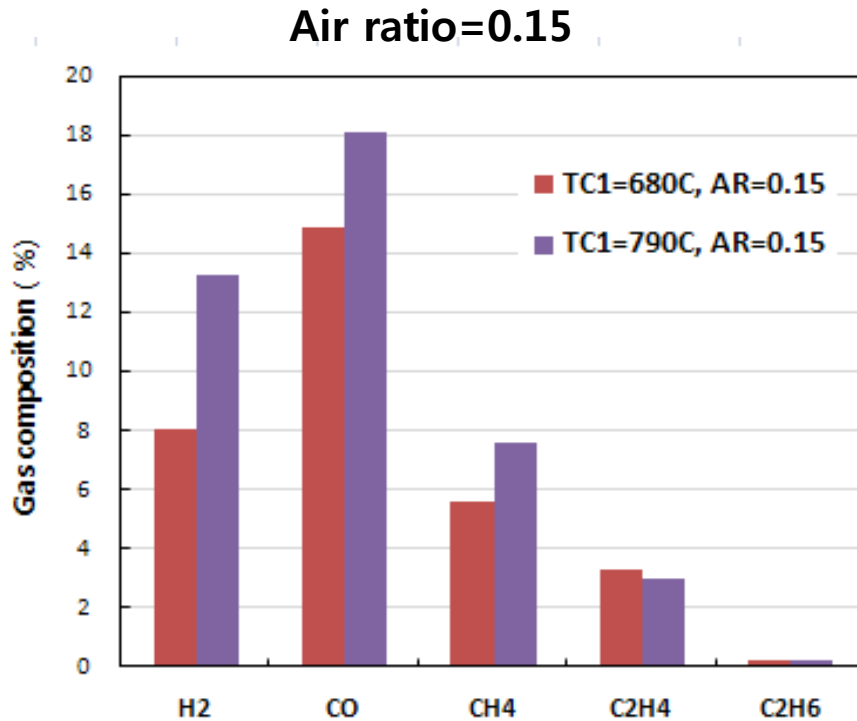
2nd stage pyrolysis

- 1st(300-410°C) : Paper, Wood, Food waste, Textile
- 2nd(420-510°C) : Rubber, Plastics

5. Our research



Result of gasification experiment - gas composition

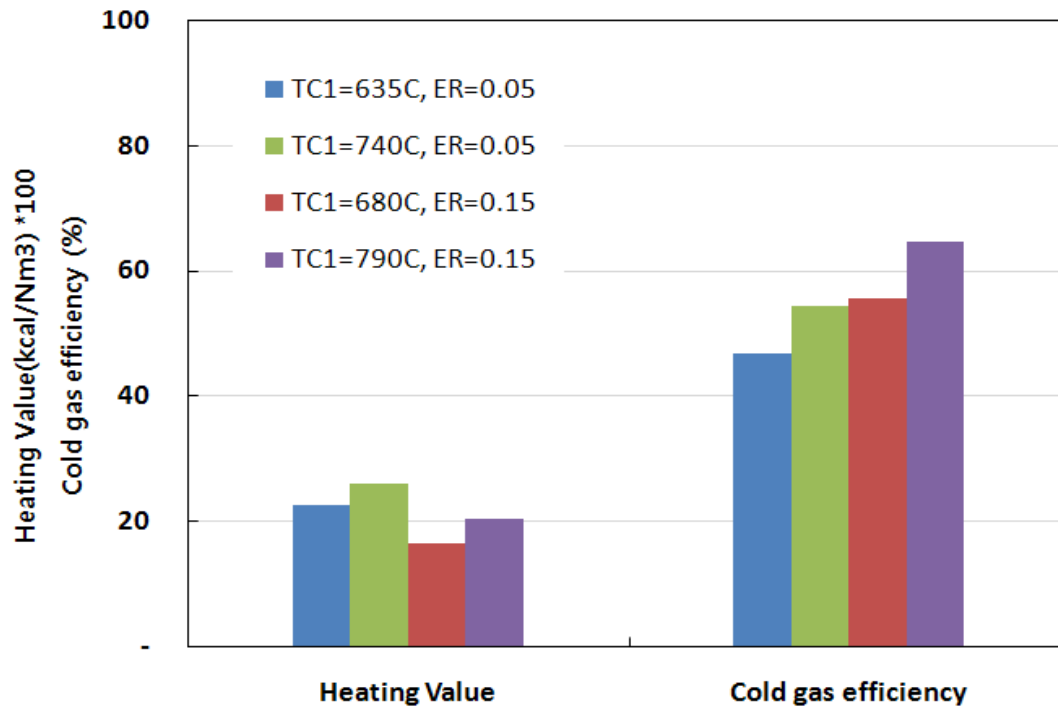


Hydrocarbons were converted into CO or CO₂ by oxidation reaction as AR increased

5. Our research



Result of gasification experiment - Heating value & Cold gas efficiency



➤ Heating value(kcal/Nm3)
=Σ(Heating value of each gas * content)

➤ Cold gas efficiency(%)
$$\frac{\text{Heating value in product gas[kcal/hr]}}{\text{Heating value in RDF[kcal/hr]}}$$

➤ Minimum heating value for the energy from gas engine
: 1300-1,500kcal/Nm3

➤ Cold gas efficiency at high temperature
: 60-70%

An efficient energy generation appears to be possible through results obtained in this experiment

5. Our research



Pilot plant

K-MeGa system (Kolon Mechanical & Gasification system)

생활폐기물 에너지화 통합공정 (K-MeGa System)



- Waste : Municipal Solid Wastes
- Facilities : Pre-treatment + gasification
- Capacity : 5 ton/day
- Construction costs : 2.1 billion won



Pre-treatment system



Gasification system

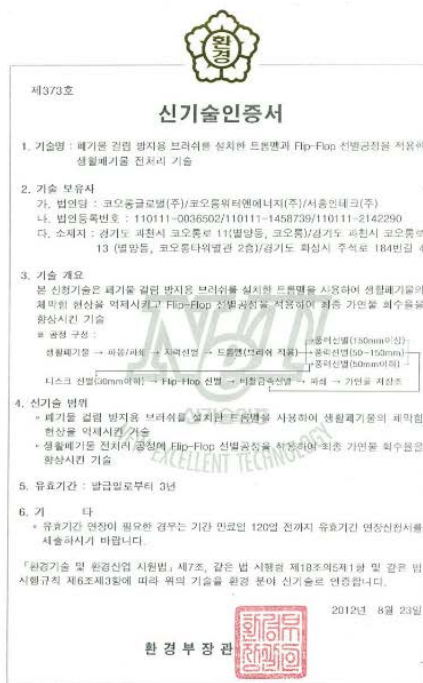


The video to explain K-MeGa system



Research result

전처리 환경신기술 인증 제 373호



Certification on environment new technology

5. Our research



Research result

가스화 환경신기술 인증(제364호)

제364호

신기술인증서

1. 기술명 : 직간접 동시 가열 기술을 이용한 로타리킬른식 폐기물 가스화 기술

2. 기술 보유자
가. 법인명 : 코오롱글로벌(주)/코오롱위더엔에너지(주)
나. 법인등록번호 : 110111-0036502/110111-1458739
다. 소재지 : 경기도 과천시 별양길2로 42(별양동)/경기도 과천시 별양상가2로 42(별양동, 코오롱타워 6층)

3. 기술 개요
기연성 폐기물을 직간접 동시 가열하는 구조를 가진 로타리킬른 가스화기로 가스화하는데, 가스화 과정에서 생성된 char 및 합성가스 연소열을 이용하여 간접가열하고 동시에 열교환된 공기를 로타리킬른 내부로 직접 공급하여 보조열원을 최소화한 기술

4. 신기술 범위
○ 폐기물을 직간접 동시 가열하는 구조를 가진 로타리킬른 가스화 장치
○ Char 및 합성가스 연소열을 이용하여 간접가열하고 동시에 열교환된 공기를 로타리킬른 내부로 직접 공급하여 보조열원을 최소화한 가스화 기술

5. 유효기간 : 발급일로부터 3년

6. 기 타
* 유효기간 연장이 필요한 경우는 기간 만료일 120일 전까지 유효기간 연장신청서를 제출하시기 바랍니다.

「환경기술 및 환경산업 지원법」 제7조, 같은 법 시행령 제18조의5제1항 및 같은 법 시행규칙 제6조제3항에 따라 위의 기술을 환경 분야 신기술로 인증합니다.

2012년 5월 9일

환경부장관

아시아경제

이투데이

WOW한국경제TV

최신뉴스

코오롱글로벌 '폐기물 가스화 기술' 친환경 인증 획득

이 기술은 기존 폐기물을 분해한 연소시켜 기존 합성가스를 제조하는 기술은 기존 폐기물 소각과 가스화 기술보다 대기오염물질, 다량유기염류 발생량이 적고, 수거·처리 용이하다.

가스화 환경신기술 검증(제155호)

제155호

기술검증서

기술검증보고서

직·간접 동시 가열 기술을 이용한 로타리킬른식 폐기물 가스화 기술

2013. 3

NTI

KEINT

환경부장관

Certification on environment new technology

5. Our research



Research result



Patent application : 36, Patent registration : 12

6. Our further research _ commercial plant development PJT

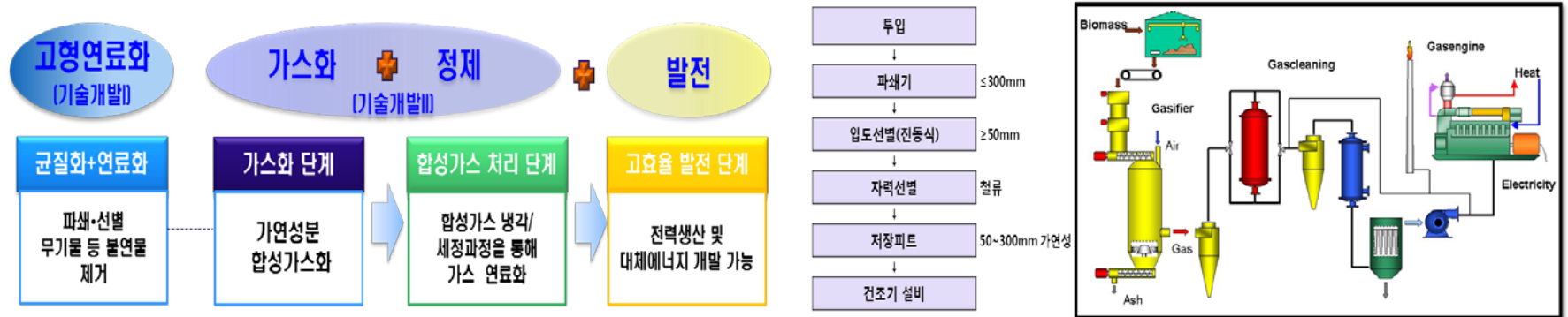


Overview

- Research period : 2013 ~2019(during 9 years)
- Research fund : 68 billion won
- PJT Scale : SRF 120ton/day, gasification & power 80ton/day
- Gasifier type : Fixed bed
- Site : Yeosu city
- Research institute : Samho, Kolon, Advanced tech. Institute

Meaning

- The first full scale commercial plant in Korea
- The next-generation technology alternating incineration





**Thank you for
your attention**