1st Post Combustion Capture Conference
Abu Dhabi, 17th - 19th May, 2011

Development of Amine Absorbents for Post-Combustion Capture

17th, May 2011

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KEPCO Research Institute

Project overview

- ***A-COS* Project** (Development of an Advanced CO_2 Capture System)
- Project Leader: KEPCO Research Institute
- Research Periods: NOV, 2008 ~ OCT, 2014 (7 Years)
- Financially supported by the Korean government & participating companies
- Participants :

  KEPCO, KEPCO E&C, Daelim co. Posco Power and 5 Power companies

KEPCO(Korea Electric Power Company)

Major Business

Transmission & Distribution

100% market share in Korean power market

Generation

92% market share in Korean power market

Others*

(A1 / A) **Korean Government**

(51%)

(A1 / A) **KEPCO**

Assets : W99.6 Trillion
Revenues : W39.4 Trillion

(100%)	(100%)	(100%)	(100%)	(100%)	(100%)
KHNP	KOSEP	KOMIPO	WP	KOSPO	EWP
Nuclear & Hydro	Thermal & Renewable	Thermal & Renewable	Thermal & Renewable	Thermal & Renewable	Thermal & Renewable
Assets: W30,245 Bn Revenues: W5,830 Bn	Assets: W5,479 Bn Revenues: W4,228 Bn	Assets: W5,140 Bn Revenues: W4,840 Bn	Assets: W4,499 Bn Revenues: W4,767Bn	Assets: W5,010 Bn Revenues: W5,153Bn	Assets: W4,519 Bn Revenues: W4,573 Bn

GENCOs' Asset and revenues are as of Dec, 31, 2010

KEPCO E&C (77.9%) Engineering Service	KEPCO KPS (75.0%) Maintenance & Repair	LG U+ (7.5%) Mobile & Internet Service	KEPID (29.0%) Retail Metering
KEPCO NF (96.4%) Nuclear Fuel	KEPCO KDN (100%) IT Service	KOGAS (24.5%) Import & Supply of LNG	KDHC (19.6%) District Heating

* % of KEPCO's ownership, Assets and Revenues as of Dec 31, 2010

** Including only major subsidiaries and affiliates of KEPCO other than 6 GENCOs

Overall objectives

- Develop post-combustion CO_2 separation technology by alkanolamine absorbents at coal-fired power station

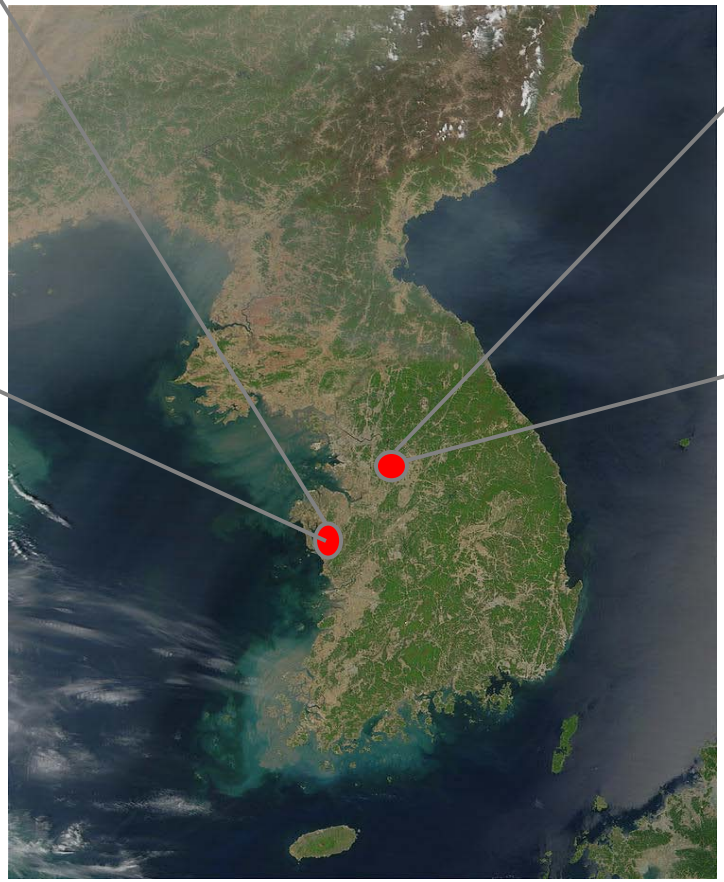
- Develop absorbents with improved regeneration energy compared to MEA (Reduce regeneration energy more than 30% than MEA)

- CO_2 capture process design and demonstration plant construction (2 TPD CO_2 capture plant (2010), 200 TPD until 2013)

Strategy

	1st Stage : `2008~11	2nd Stage : `2012~14	3rd Stage : `2015~20
Capture Energy	< 3.2 GJ/tonCO_2	2.5~3.0 GJ/tonCO_2	< 2.5 GJ/tonCO_2
STRATEGY	Test bed 2 TPD Test bed • Develop advanced absorbent • Reduce regeneration energy	Pilot Plant 200 TPD Pilot Plant • Search innovative absorbent • Process innovation	Demonstration 100~300MW
Goal	Development of an Advanced CO_2 Capture System		

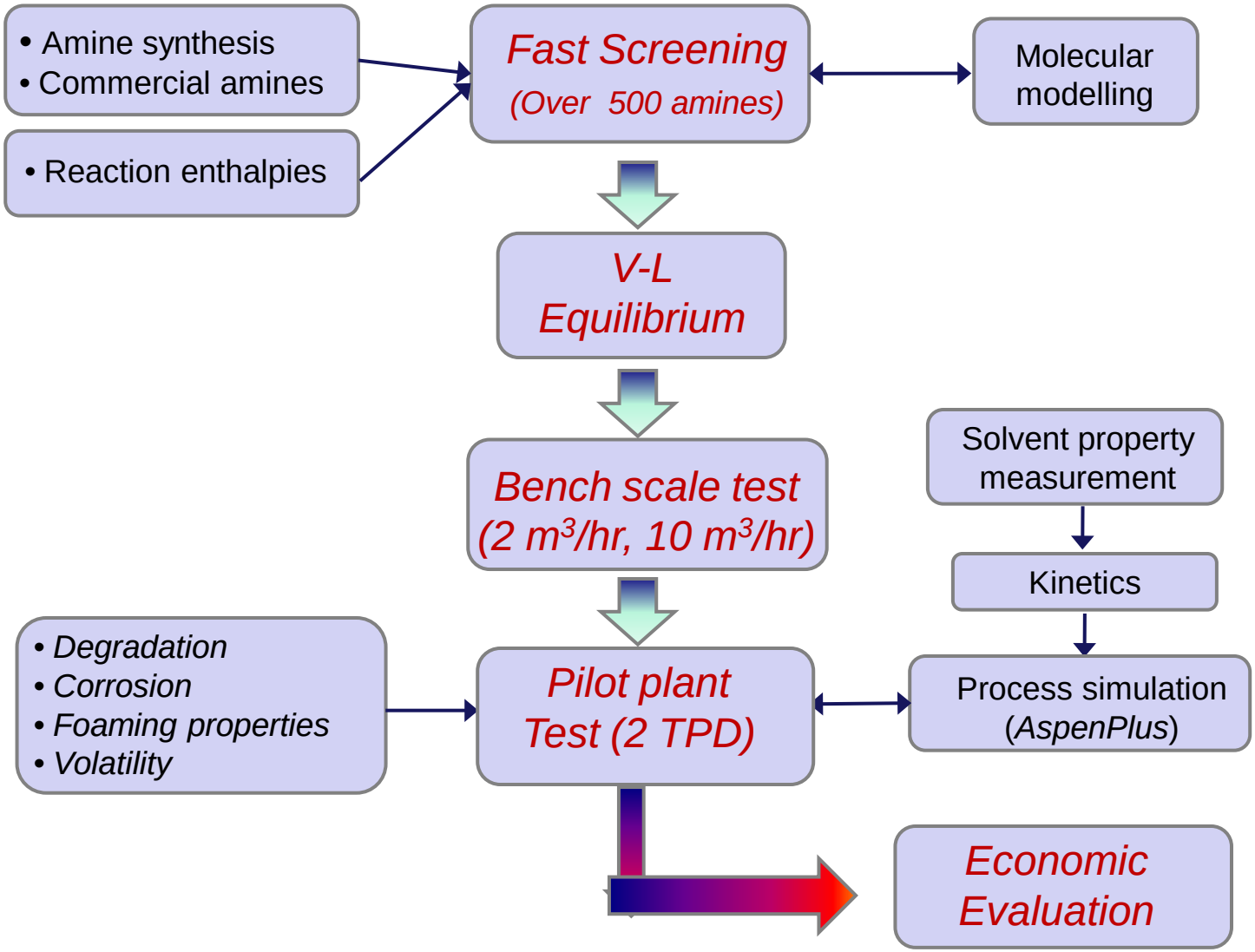
Location of test bed for CO_2 capture



- **Boryong Power Station**
  - **branch of KOMIPO**
  - **5,800 MWe(Coal)**
- **CO_2 Capture Test Bed**
  - **2TPD (2010), 200TPD (2014)**

- **Seoul Power Plant**
  - **branch of KOMIPO**
  - **387 MWe(LNG)**
- **CO_2 Capture Test Bed**
  - **2TPD (2001)**

Solvent development procedures

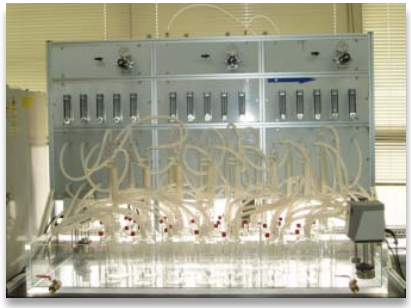


Research facilities

- *Fast Screening*

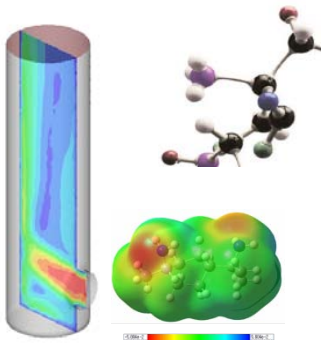
- *V-L Equilibrium*

- *Degradation*



- *Corrosion*

- *CFD & Molecular simulation*



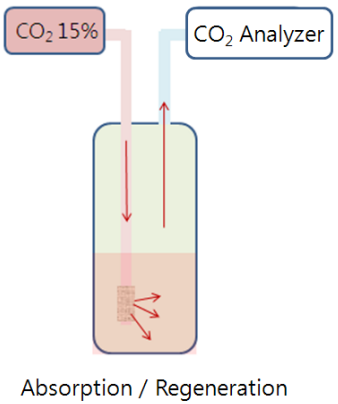
- *Bench unit*

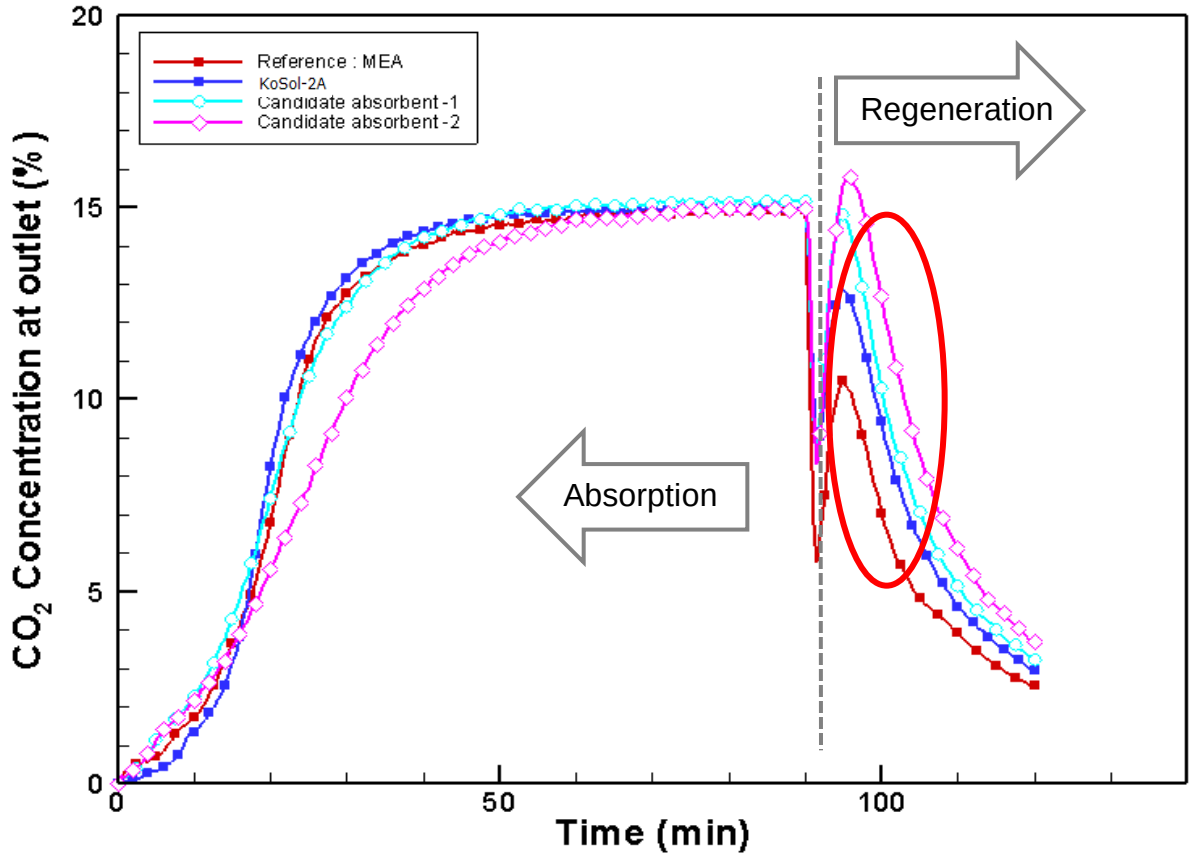
- *Pilot plant (2TPD)*

- *Economic Evaluation*

Test results : Screening test

Screening Test



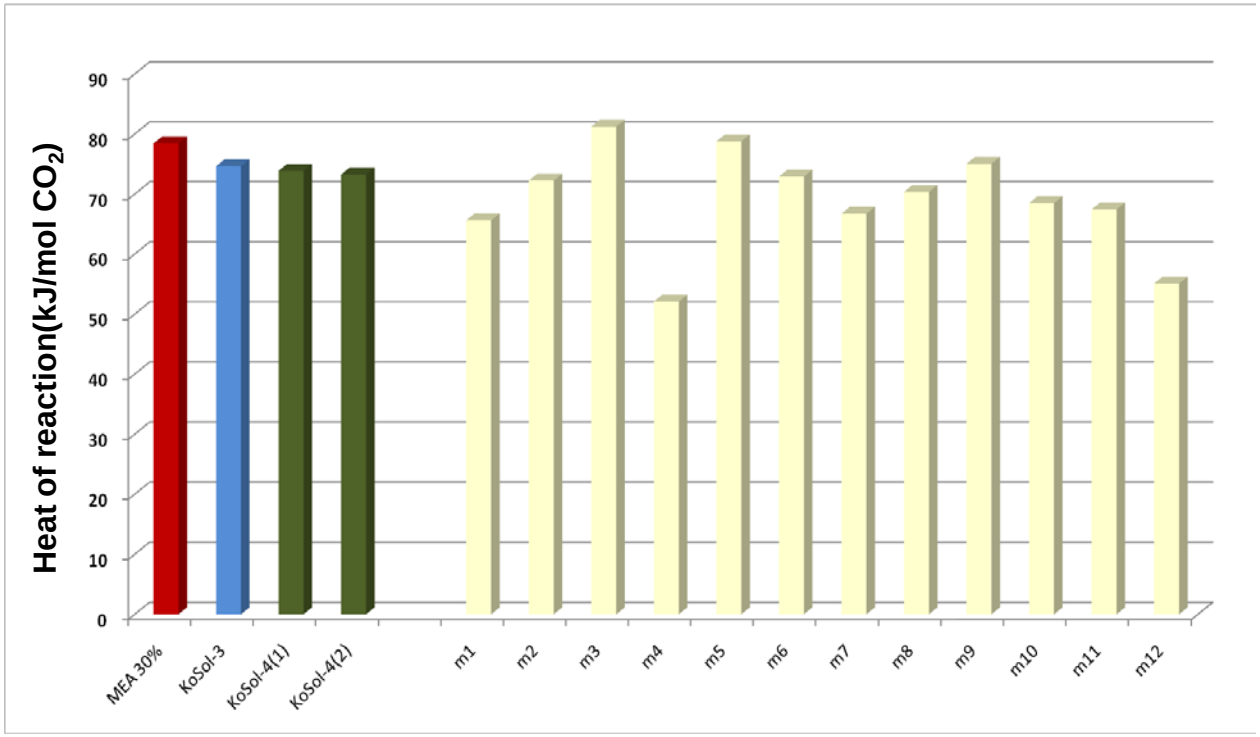


- *Quantification of an absorbent capacity*
- *Fast screening of candidate absorbents*

Test results : Heat of Reaction

- ***Heat of Reaction***

Reaction calorimetry
(Model : SIMULAR, England)



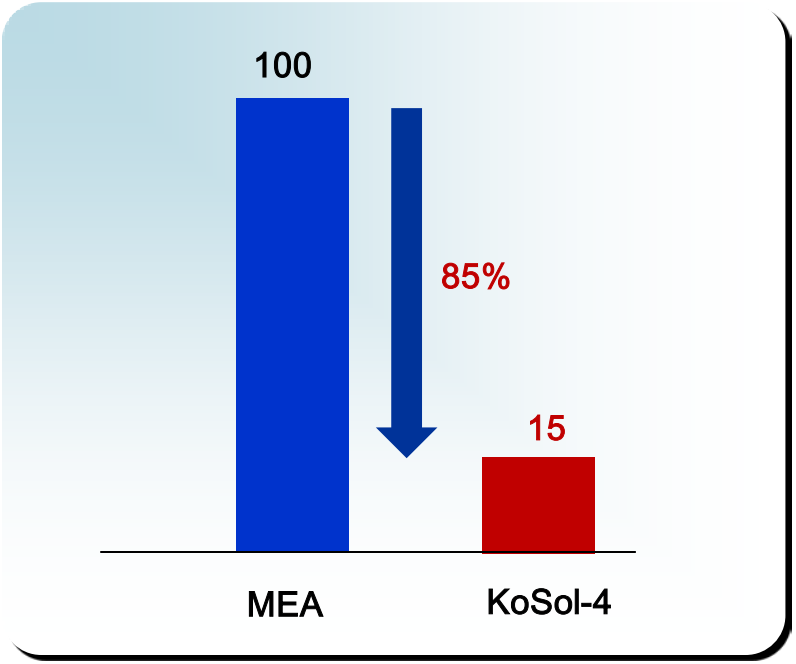
- KoSol series show lower heat of reaction than MEA

Test results : Degradation

- ***Degradation***

Oxidative degradation

Comparison of the solvent performance

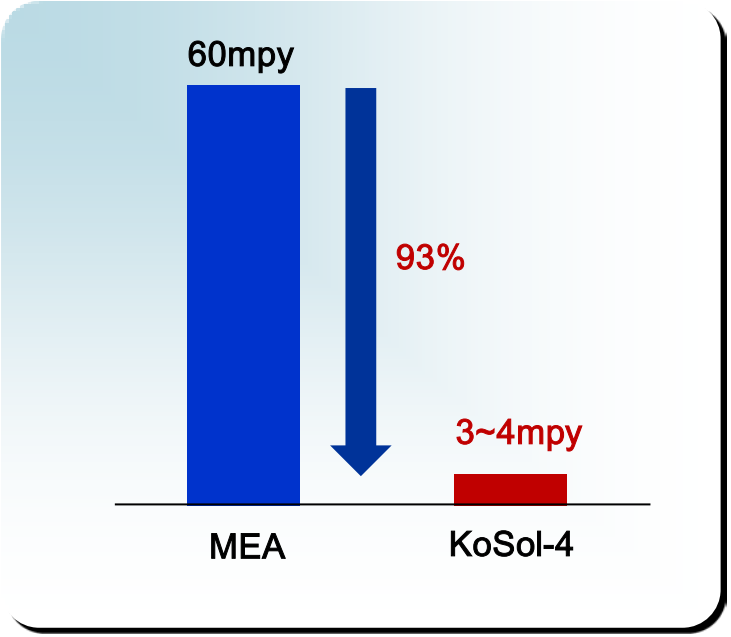


KoSol Series are less degraded than MEA

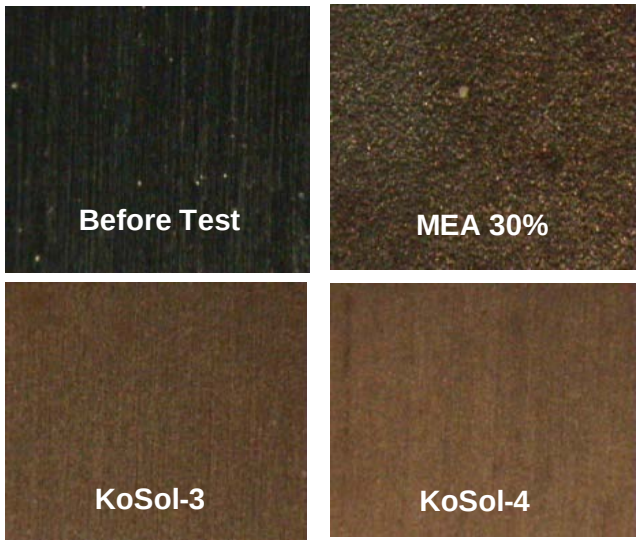
Test results : Corrosion

Corrosion

Corrosion measurement



Optical analysis of the test coupons

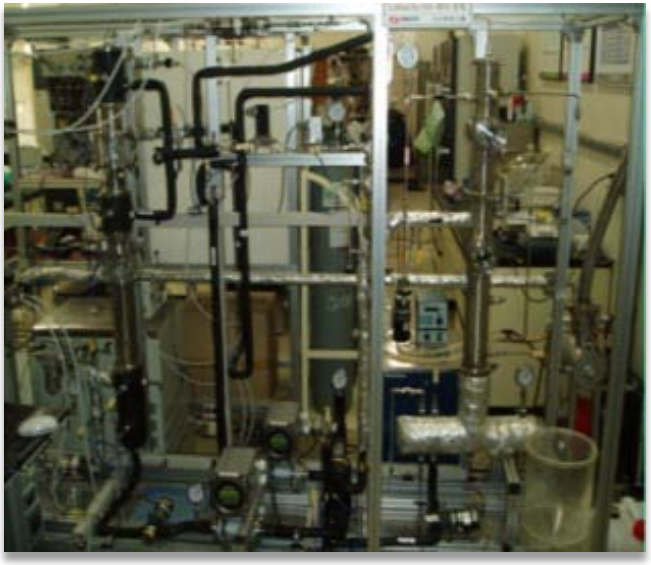


(Test coupon : carbon steel at 120℃)

KoSol Series are less corrosive than MEA

Test results : Bench–scale facility

- ***Bench scale facility***



Experimental Condition

- CO_2 concentration: 11~15%
- Gas volume: 2 m^3/h
- Reboiler: Electric heater
- Packing: Random packing

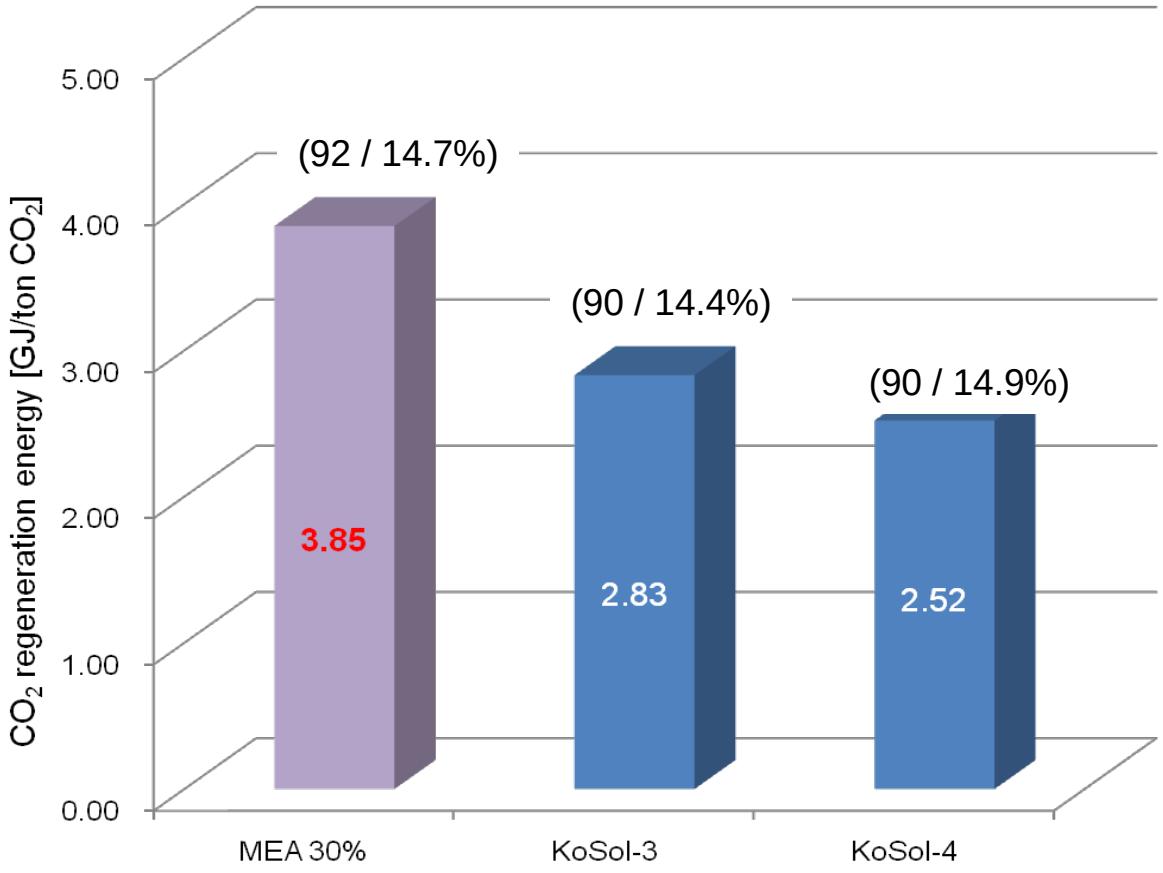
Experimental Condition

- CO_2 concentration: 11~15%
- Gas volume: 10 m^3/h
- Reboiler: Electric heater
- Packing: Random packing

Test results : Bench–scale facility

- ***CO_2 Regeneration Energy (Bench scale test)***

(CO_2 removal rate / CO_2 concentration in flue gas)



Test results : 2TPD Test bed

- ***2TPD Test bed***

Location: Boryung power Plant, Korea

Capacity: Flue gas 350 m^3/hr

CO_2 Recovery 2 Ton/day

Start Up: 2010

Packing : Random packed

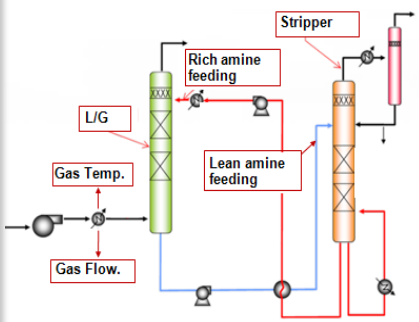
Test results : 2TPD Test bed

Test Schedule

~Jan, 23rd	**KoSol-3 campaign (1st,68days)**
Jan, 23rd~28th	washing/ solvent change
March, 1st ~ 21st	**MEA campaign (1st, 20 days)**
March, 22rd ~24th	washing/ solvent change
April,2nd ~ May,14th	**Long run operation(KoSol-3, 1,000 hours, 43 days)**

Test & Analysis

Key variable



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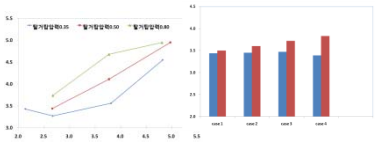
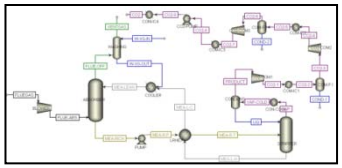
Analysis

- Statistical analysis



- Simulation

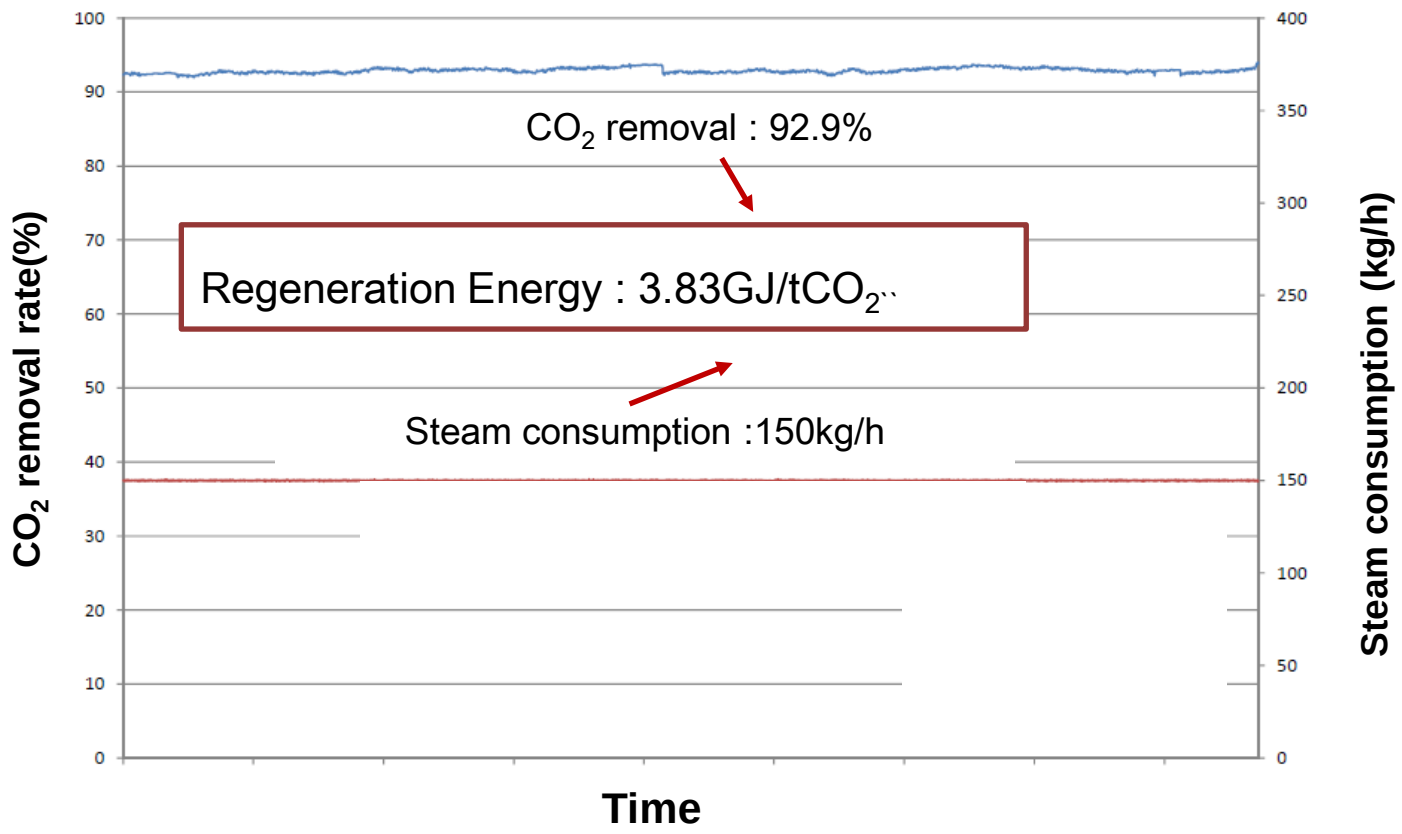


Optimal Condition

Variable	Unit	Figures
Flue gas	Sm^3/h	/
L/G	L/Sm^3	/
Stripper pressure	kg/cm^2g	/
Flue gas temp.	℃	/
Lean amine feeding	m	/
Rich amine feeding	m	/

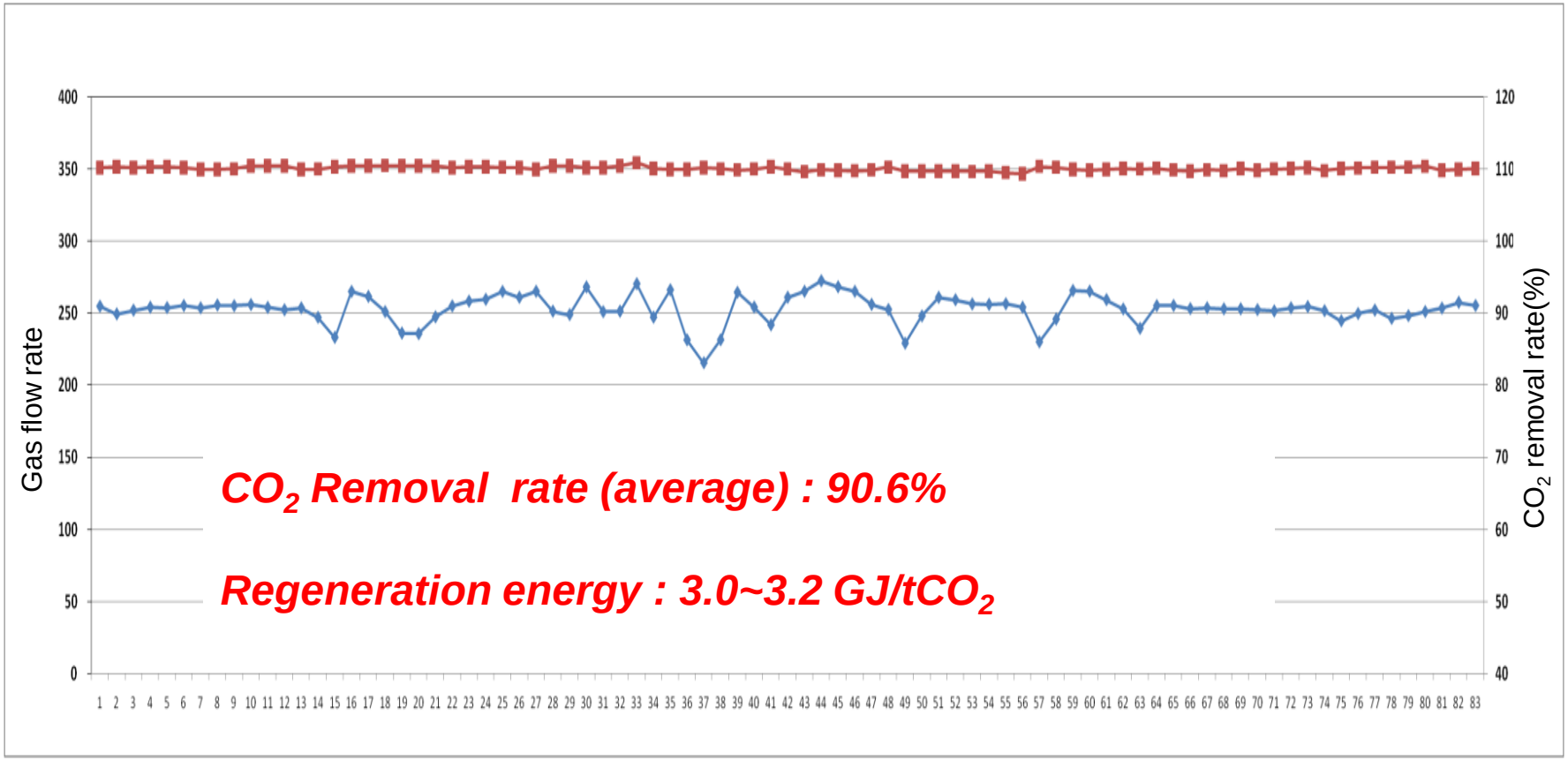
Test results : 2TPD Test bed

- **Test Results (MEA_30% Campaign)**



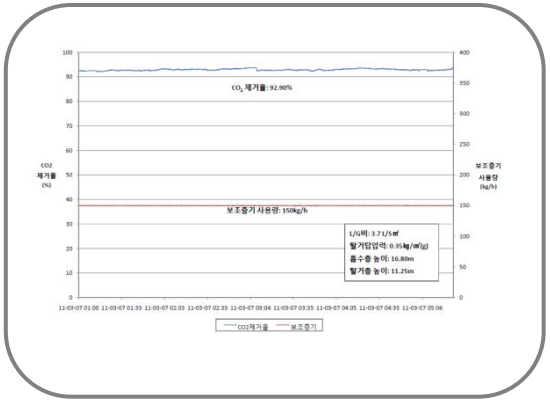
Test results : 2TPD Test bed

- **Test Results (KoSol-3 Campaign)**

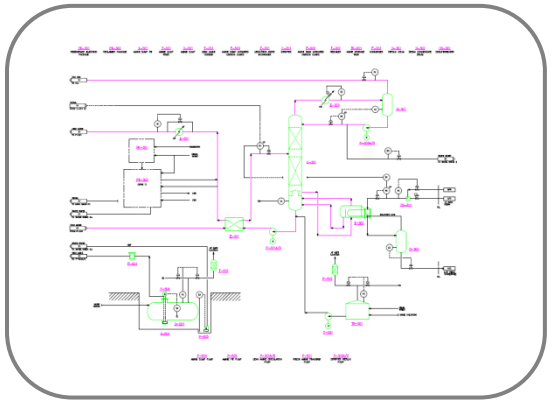


Future plan : 200TPD Pilot Plant

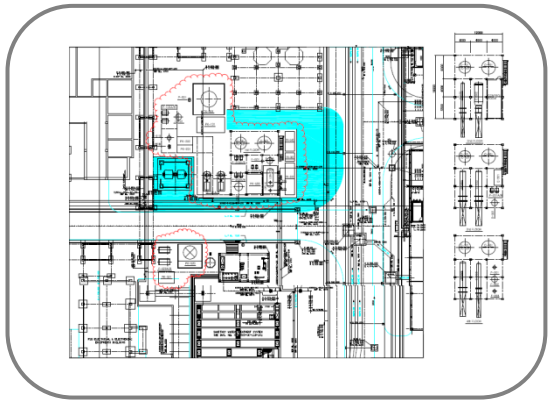
2TPD Test results



Basic Design



Layout Drawing



Economic Evaluation

200 TPD Pilot Plant Construction start at Jan, 2012

Conclusion & Future works

Conclusion

a. Development of advanced amine absorbents (KoSol-3) for CO_2 capture

- Decreased regeneration energy

  - BSU: 2.8 GJ/ton CO_2 / Test bed: 3.0~3.2 GJ/ton CO_2

- less corrosive than MEA

Future works

a. Process optimization(2TPD)

- Random to Structured packing (Absorber)
- Absorber Inter-cooling system
- etc.

b. 200TPD Pilot plant construction

THANK YOU

FOR YOUR ATTENTION

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