Japanese Technology to upgrade low-quality CMM using filtration with activated carbon

October 30, 2007
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Objectives of Methane Concentration System

- Enhancement of recovery and utilization of low-concentration CMM currently emitted into the air
- Reduction of greenhouse gas
Outline of Methane Conc. System

Coal Mine

Off-Gas

CMM
CH$_4$: about 20%

CMM
CH$_4$: about 45%

Gas tank

Gas engine power generation

Boiler

VPSA Tower
Standard Specification of Methane Conc. System

- Inlet CMM: CH$_4$: 20% or more
  2,000 m$^3$/h/unit

- Product Gas: CH$_4$: 45% or more
  800 m$^3$/h/unit or more

- Recovery rate: 90% or more
General Flow Diagram of Methane Conc. System

Air

Off-gas (N₂ + O₂, CH₄ < 5%)

Vacuum Pump

Buffer Gas Tank

VENT

Dehydration

VENT

2,000 Nm³/h

CH₄: 20%

CMM

800 m³/h

PRODUCT GAS

CH₄: 45% or more

VPSA Tower

800 m³/h

PRODUCT GAS

CH₄: 45% or more
Bench Scale Unit of Methane Conc. System
Example of Test Results at a coal mine in Japan

- Tank Outlet Gas (Product Gas)
  - Stably concentrated
  - Small peaks were caused by detector.

- Inlet Gas
  - CMM before Concentration

- Off-Gas
Example of Test Results
Off gas methane vs. Product Gas

*Inlet CMM(20%) was produced by diluting CMM with air.
Example of Test Results
Inlet CMM vs. Product Gas

Product Gas = Inlet CMM + 25% or more

*Inlet CMM(20%) was produced by diluting CMM with air.
Application-1
For low methane CMM

Step 1 (Concentrate & Store)

Methane Conc. System

MCS

Gas Tank

Vacuum Pump

$CH_4: \geq 18-20\%$

$CH_4: \geq 30\%$

CMM

$\sim 150 Nm^3/min$

($CH_4: 18-20\%$)
Application-1
For low methane CMM

Step 2 (Recycle, Concentrate & Mix)

- CMM
- 64Nm³/min (CH₄: 18-20%)
- MCS
  - 50 Nm³/min
  - CH₄: ≥30%
- Gas Tank
  - Product Gas
  - 35Nm³/min
  - CH₄: ≥30%
- Vacuum Pump
Application-2
Conversion to CNG from CMM

2 Steps

MCS → MCS ← CMM

A

H₂O

E

Steam Reformer

B

O₂/H₂ Reactor

C

Heat Recovery

D

CNG
## Change of gas composition

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<tr>
<th>Point</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
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<td>CH$_4$ (%)</td>
<td>90.0</td>
<td>85.5</td>
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<td>87.1</td>
<td>31.5</td>
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<td>N$_2$ (%)</td>
<td>8.0</td>
<td>7.7</td>
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<td>O$_2$ (%)</td>
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<td>H$_2$ (%)</td>
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<td>H$_2$O (%)</td>
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<td>4.1</td>
<td>4.1</td>
<td>65.0</td>
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<td>Flow-rate (Nm³/h)</td>
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<td>575</td>
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<td>Temp. (°C)</td>
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<td>Heating Value (kcal/m³)</td>
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Advantage of Methane Conc. System

- Compact equipment
- Low operational cost
- Low initial cost
- High reliability
- Various applications
Master Plan for Marketing Methane Conc. System

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Pilot Plant in China (Engineering, Construction)

M2M

Partner search
Form Possible Alliances

Workout, Operation

Project Execution
Conclusion

For utilization of CMM with low-concentration methane and reduction of greenhouse gas,

We have developed a unique VPSA system for CMM enrichment with activated carbon.

We are ready to discuss business opportunity.
Thank you very much !