Development of CO2 Capture Technology with Solid Sorbent Utilizing Low-Temperature Steam: Progress in Bench-Scale Demonstration

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Kawasaki’s products (Year ended March 31, 2019)

- Motorcycle & Engine: 22.4%
- Energy System & Plant Engineering: 15.9%
- Aerospace: 29.1%
- Rolling Stock: 7.8%
- Ship & Offshore Structure: 5.0%
- Others: 6.0%

Total: 1,594.7 billion
1. NEDO project
2. Kawasaki CO2 Capture System
3. Bench-Scale test
4. Conclusions
1. NEDO Project

R&D project for practical utilization of advanced CO2-capture solid sorbent
Supported by METI(~FY2017) and NEDO(FY2018~)
Target: Coal-fired power plant

Sponsor

Project management
Solid sorbent development

Capture process development
Process simulation

Kawasaki

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Project objective

- We evaluate the CO2 capture energy at the KCC moving-bed system containing the solid sorbent developed by RITE.
- We establish the design methodology for large-scale plants.

KCC Moving-bed System development

Solid sorbent development

NEDO Project

Apply

KHI Bench-scale Test Plant (5t/day)

Scale-up design

Large-scale Plant at power plant (30~40 t/day)
2. Kawasaki CO2 Capture System (KCC)

- Contains amine in porous support
- Selectively adsorbs CO2
- Desorbs CO2 by introducing low-temp. steam (60 °C), which can be generated by low-temp. waste heat

**Absorption**
- Exhaust gas
- Solid sorbent

**Desorption**
- CO2
- Solid sorbent
- Low-temperature Steam (60°C)
- Solid Sorbent

**Amine**
KCC Moving-bed System

The solid sorbent is circulated around the plant

<Concept of the KCC moving-bed system>
Bench-Scale Demonstration

Located at Akashi works, KHI-constructed next to coal-fired facility

coal-fired facility

KCC moving-bed test plant
Moving-bed Test Plant: facility appearance

Designed Capture amount 5 ton/d scale (20m tall)
RITE’s Solid Sorbent

High-performance amine developed by RITE

1.47 GJ/t-CO₂ with 93% recovery + 98% purity is achieved.
3. **Bench-scale test (CO2 Capture energy saving)**

The CO2 capture energy calculated from the amount of steam introduced was 1.7 GJ/t-CO2.
Bench-scale test (Amount of Captured CO2)

- To increase amount of captured CO2, we adjust the amount of introduced steam and circulation rate of solid sorbent.

- Amount of captured CO2 approximately 6.6 t/day

※The CO2 capture energy calculated from the amount of steam introduced was 2.9 GJ/t-CO2.
Future Development roadmap

**Fundamental res. phase**
2010~2014

**Practical system develop. phase**
2015~2019

- Apply RITE’s sorbent

**Commercialization phase**
2020~

- Moving Bed System at power plant (30~40 t/day)

**2030~**

- CCS

**KHI in-house**

- RITE Lab evaluation (~3kg/day)

- KHI Moving-bed test plant (5t/day)

- Coal-firing boiler (3,000 t/day)
5. Conclusions

- We confirmed that RITE solid sorbent can be applied to KCC moving-bed system.

- CO2 capture energy calculated from the amount of steam introduced was 1.7GJ/t-CO2.

- Captured CO2 from gas containing 13% was 6.6t-CO2/d.

- Design methodology for large-scale plants was established.
Acknowledgment

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New Energy and Industrial Technology Development Organization

PCCC5 Site tour on Sept. 20th

Bench-scale Test Plant 6 ton/d scale (20m tall)

- Adsorption Reactor
- Desorption Reactor
- Sorbent Dryer