4) Introduction of Nagaoka CCU Project for effective recycling of CO2 to produce methane

19, June, 2020

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INPEX Corporation
On October 1, 2008, INPEX Holdings Inc. marked a new beginning by changing its name to INPEX CORPORATION, following completion of the business integration between INPEX CORPORATION and Teikoku Oil Co., Ltd.

INPEX is the largest oil and gas E&P company in Japan. INPEX are currently engaged in more than 64 projects spread across more than 20 countries worldwide.

INPEX’s 1 of special class share (18.94%) are held by the Minister of Economy, Trade and Industry (METI).

Please refer to our HP in detail!! https://www.inpex.co.jp/english/
Vision 2040 (established in May 2018) in INPEX

- **Sustainable Growth of Oil and Natural Gas E&P Activities**
  - A top 10 international oil company

- **Development of Global Gas Value Chain Business**
  - A key player in natural gas development and supply in Asia & Oceania

- **Reinforcement of Renewable Energy Initiatives**
  - 10% of project portfolio

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INPEX’s Strengths
Strong portfolio, partnerships with oil-producing countries, project execution capabilities, diverse human resources, financial soundness, support from the Japanese government

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Reduce carbon footprint

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Continuously and sustainably increase corporate value

INPEX has already started the projects of renewable energy such as geothermal power, PV and WT in Japan and overseas.
Conceptual illustration of the INPEX’s project

- The synthetic CH₄ as a substitute for fossil natural gas
- Reuse of CO₂ & expanding introduction of H₂ derived from RE
The first actual reservoir CO$_2$ methanation with plate reactor

Fundamental technology development phase
8 Nm$^3$-CO$_2$/h
~47 t-LNG/y

Investigation phase
~2 Nm$^3$-CO$_2$/h

Technology development phase
400 Nm$^3$-CO$_2$/h
~2.4 kt-LNG/y

Demonstration phase
10,000 Nm$^3$-CO$_2$/h
~59 kt-LNG/y

The world largest actual reservoir CO$_2$ methanation with plate reactor

Commercial phase
60,000 Nm$^3$-CO$_2$/h
~350 kt-LNG/y

Stepwise technology development is needed to complement cost reductions due to scale-up
Research teams of various organizations are conducting R&D in close cooperation for 4 objectives.
Interaction of these research team & 4 objectives

1. Scaleup of the reactor/system

- Labo-scale exam.
- Pilot scale exam.
- Demonstration plant at NAGAOKA, Niigata

2. Mechanism

- S, VOC etc.
- 4H₂+CO₂
- CH₄ + H₂O (H₂, CO, CO₂)

3. Simulation

- Investigations on:
  - Thermal degradation in hot spot region
  - Chemical degradation caused by trace elements (e.g. Sulfur, BTX,)
  - Optimization to homogenize temperature distribution

- Develop chemical reaction model for methanation over the highly active Hitz catalyst

4. Overall analysis

- Scale-up for commercialization

- Predict reaction and flow characteristics in the reactor with numerical simulation
- Simulation driven the best reactor design and acceleration of process development

0.1 Nm³.h⁻¹
1-8 Nm³.h⁻¹

Clarifications: effects of temperature, contaminations on catalytic activity

Systematic experiments in laboratory-scale facility

Interaction

Exploration of optimum operation condition for high conversion, selectivity, thermal efficiency

Develop an original in-house numerical code for simulating chemically reacting flow and heat transfer in the methanation reactor
NEDO/INPEX/Hitz started bench-scale testing at the Koshijihara Plant in the Nagaoka Gas Field of Niigata Prefecture, where INPEX produces natural gas.
System flow of the test plant

1. PEM Type Water Electrolyzer
   - Container-1 (Dehydration of reservoir CO2)
   - Reservoir CO2
   - Crude CO2
   - H2 (99.999%)
   - H2/CH4 Mix gas (H2:CO2 = 4:1)

2. High-V Power Recev. Facility

3. Plate Type Methanation Reactor
   - Container-2 (Crude CH4 purifying)
   - Crude CH4
   - Purified CH4
   - Purified CO2
   - H2/CO2 mixing, pressurizing

INPEX GTCC

Will shift from manual operation to automatic operation with a fail-safe system

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Results of the methanation by actual reservoir CO2

- Operation load: 100% (8 Nm3-CO2/h)
- Temp. of thermal jacket: 238°C
- Pressure of the reaction: 0.7 MPaG

Reach the target as >96 mol.%-CH4

After various tests operation in which temperature, pressure and operation load etc. are changed, it is planned to shift to full loaded continuous operation.
Summary

• CO2 methanation technology can reduce CO2 while utilizing existing natural gas infrastructure (page 3-4).

• Commercial scale plant of 60,000 Nm3/h at over 203X will reduce 1 million tons of CO2 annually (page 5)

• The economics of methanation mainly depend on the electricity (or Hydrogen) price of renewable energy.

• Under certain conditions, the electricity price is below 3 JPY/kWh, the IRR is roughly estimated to be 9.5%.

• Thank you for your attention!