14 July, 2020

University of Toyama
Chiyoda Corporation
Nippon Steel Engineering Co., Ltd.
Nippon Steel Corporation
HighChem Company Limited
Mitsubishi Corporation

Initiation of "Technology Development for Para-xylene Production from CO_2"

We, University of Toyama, Chiyoda Corporation, Nippon Steel Engineering Co., Ltd., Nippon Steel Corporation, HighChem Company Limited, and Mitsubishi Corporation (hereinafter collectively referred to as the "Group") are pleased to announce that the Group has jointly applied for and been selected by NEDO[*1] for "Development of Technologies for Carbon Recycling and Next-Generation Thermal Power Generation / Development of Technologies for CO_2 Reduction and Utilization / Development of Technologies for CO_2 Utilization for Chemicals".

1. Summary

In order to cope with global climate change, it is necessary to address the issue of CO_2 emissions from factories, power plants, and various emission sources while pursuing all possible technological options including carbon recycling technologies. "Roadmap for Carbon Recycling Technologies" formulated by METI[*2] in June 2019 sets forth guidelines for utilization of carbon recycling technologies for separating and collecting CO_2 as resources and reusing it in the form of diverse carbon compounds for chemical materials or fuels.

Against this backdrop, NEDO has launched a development project for the world's most advanced technology for industrial para-xylene[*3] production from CO_2 to substitute existing fossil fuel-derived chemicals, and the Group has been selected as contractors for this commissioned project. Para-xylene is a particularly important basic compound in the production of PTA[*4] which is a feedstock material for polyesters such as polyester fibers and plastic bottles. Due to its composition, it can be produced with a relatively small amount of hydrogen while fixing a large amount of CO_2, compared to other compounds from carbon recycling. This is a theme with great potential from both economic and environmental

perspectives.

Global demand for para-xylene is approximately 49 million tons per year. Assuming that the feedstock for para-xylene of the current demand level is entirely converted from fossil fuels to CO_2, theoretically 160 million tons of CO_2 could be fixed in the para-xylene per year.

In this project, the Group will improve the innovative catalyst for the production of para-xylene from CO_2, develop a way to mass-produce the catalyst, and develop the process while studying its feasibility including its overall economic efficiency and CO_2 reduction effect in order to pave the way to the demonstration stage.

2. Description of the Project

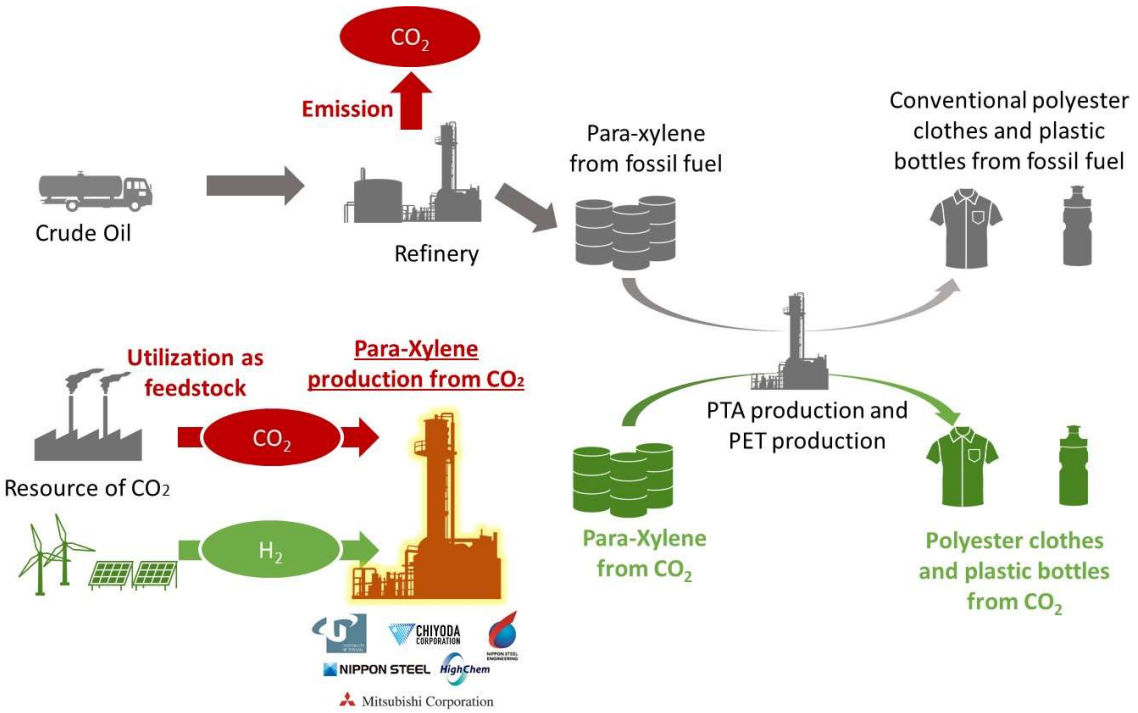
Project Name: Technology Development for Para-xylene Production from CO_2

Scope: 1) Improvement of performance of the catalyst and extension of its lifetime.
2) Development of a mass production method for the catalyst
3) Development of the process and design
4) Feasibility study including economic evaluation, amount of CO_2 reduction, and market research

Contractors: University of Toyama (for Scope-1)
Chiyoda Corporation (for Scope-3)
Nippon Steel Engineering Co., Ltd. (for Scope-3)
Nippon Steel Corporation (for Scope-1 and Scope-3)
HighChem Company Limited (for Scope-1 and Scope-2)
Mitsubishi Corporation (for Scope-4)

Duration: Fiscal year 2020 to 2023

Contract Price: 1.99 Billion JPY



*1 NEDO: the New Energy and Industrial Technology Development Organization

*2 METI: Ministry of Economy, Trade and Industry

*3 Para-xylene: An aromatic hydrocarbon, one of three isomers of dimethyl-benzene known as xylenes, having the same chemical formula C8H10. Para-xylene is used to produce PET(polyethylene terephthalate) and polyester.

*4 PTA: Pure Terephthalic Acid (C8H6O4), produced by catalytic oxidization of para-xylene, known as one of the raw materials for PET (polyethylene terephthalate) and polyester.

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