

February 7, 2024

**Study of a Model for the Use of Synthetic Methane as Fuel for Natural Gas Vehicles
and Introduction into Waste to Energy Plants
under a Project Commissioned by the Ministry of the Environment of Japan.**

Hitachi Zosen Corporation, in cooperation with Isuzu Motors Limited (Yokohama, Kanagawa Prefecture; President and COO: Shinsuke Minami), has been studying the use of synthetic methane which is produced by a methanation reaction using CO₂ emitted from a waste to energy (WtE) plant, as a fuel for natural gas vehicles. We are pleased to inform you that this synthetic methane can be a substitute for conventional natural gas fuels.

This study was conducted under the Ministry of the Environment's "Commissioned Project to Promote the Creation of Circular Carbon Society Model through CO₂ Recycling (Demonstration project to establish a carbon cycle model through recycling of carbon dioxide collected from WtE Plants)." This project has been in the works since 2018 with EX Research Institute Limited (Representative Director Masato Ono, Toshima-ku, Tokyo) as a co-implementer and ended at the end of December 2023.

Under the commissioned project, we have conducted a demonstration test^{*1} to produce 125 Nm³/h of synthetic methane using CO₂ emitted from a WtE plant (Odawara City, Kanagawa Pref.) by fiscal 2022. This is the world's first initiative to produce synthetic methane from a WtE plant that is in operation.

In fiscal 2023, we used CO₂ conversion rate and methane concentration data obtained from the demonstration tests to examine and test the exhaust gas components, engine power, fuel efficiency, etc. when used as fuel for natural gas vehicles. We also studied models for introduction to WtE plants.

Test^{*2} to examine exhaust gas components, engine power, fuel economy, etc., were conducted using Isuzu Motor's gas engine "6UV1-TCN" and with gas simulating synthetic methane supplied and operated in the engine. As a result, it was confirmed that methane concentrations of about 96% or more in synthetic methane can be used as fuel for conventional domestic natural gas vehicles. In addition, it was confirmed that if the methane concentration is 82% or higher, it can be used by using an engine control method that has been used in vehicles for overseas markets where the fuel properties are unstable. The methane concentration of 82% is the design value for the demonstration test in fiscal 2022, and we confirmed that it can actually be generated.

In the study of the model for introduction into a waste treatment plant, we assumed a waste incineration plant with a 300ton/day of WtE plant (150ton/ date × 2 furnaces) and studied how to capture CO₂ emitted and conduct a methanation reaction. The volume of methane production depends on the CO₂ capture method and the amount of hydrogen supplied, but results have been obtained, including the possibility of producing up to about 41 million Nm³/year of synthetic methane (of about 145 million km/year in terms of driving distance for natural gas vehicles).

Through this commissioned project, we were able to confirm that synthetic methane obtained by installing

a methanation facility in a waste treatment plant can be a substitute fuel for natural gas vehicles, and to study an introduction model.

Item	Expected Conditions and Results
WtE Plant (Condition)	300 ton/day (=150ton/day × 2 lines)
Operating days (Condition)	24 hour × 304 days/year
CO ₂ Collection Methods (Requirements)	Chemical absorption
CO ₂ captured (Result)	Approx. 80,800 ton-CO ₂ /year
Production of synthetic methane (Result)	Approx. 41,000,000 Nm ³ /year
Distance traveled (Result)	About 145,000,000 km/year

[Estimates and results of CO₂ recovery facilities and methanation facilities]

In 1965, Hitachi Zosen was the first in Japan to deliver an waste incineration plant with power generation to Osaka City, a pioneer in the field of WtE plants. In the methanation sector, we have been conducting R&D since the 1990s, and we have supplied a large number of demonstration facilities.

Hitachi Zosen will actively contribute to the reduction of greenhouse gas emissions, which is a global issue, by integrating our expertise in both technologies and building a new carbon circular model for cleaning plants.

※1 Press Release: Started demonstration operation of methanation facilities, the largest in the country.

(20220616.pdf (hitachizosen.co.jp))

※2 The following four tests were performed.

①JE05 mode testing: An official test method for evaluating the emission regulation compliance of natural gas vehicles. A transient test simulating vehicle running (a test conducted under continuous operation with engine speed and load following target values), with the main purpose of evaluating the impacts on emission components.

②Full-load test: A steady-state test (a test in which the engine speed and load are measured under stable conditions), with the main purpose of evaluating the impact on engine output at the full opening of the accelerator.

③Mapping test: A steady-state test in which the load is adjusted according to the accelerator opening, with the main purpose of evaluating the impact on the fuel consumption rate.

④Heavy vehicle fuel consumption tests: Fuel consumption rate is obtained by simulating vehicle driving using data generated from mapping test results and typical vehicle specifications of the vehicle in which the test engine is installed.

The outline of the project is as follows.

1.Project name: Commissioned Project to Promote the Creation of Circular Carbon Society Model through CO2 Recycling (Demonstration project to establish a carbon cycle model through recycling of carbon dioxide collected from WtE Plants).

2.Project period: August 2018 to end of December 2023

3.Major roles of the companies in this study work in 2023 and the implementation structure:

- Study of the use of synthetic methane as fuel for natural gas vehicles: Hitachi Zosen and Isuzu Motors
- Study of models for introduction to waste treatment plants: Hitachi Zosen and EX City Research Institute

[Implementation Structure]

