Joint Project on the Removal of Mercury from Natural Gas (Oman)

Natural gas is a fuel that releases less carbon dioxide per unit energy consumption compared to oil and coal, and is imported in the form of liquefied natural gas (LNG). As it is not as widely distributed as oil, it is an important source of energy to a country like Japan that is dependent on foreign imports to satisfy most of its energy needs. Moreover, it poses minimum risk in terms of geopolitics, and is also important from the perspective of diversifying energy sources.

However, natural gas contains large amounts of mercury, which must be removed to prevent corrosion of natural gas facilities. Mercury must also be removed from natural gas as it is a metal that has been restricted in recent years due to its strong toxicity to living organisms. Today, LNG production plants in operation around the world are equipped with mercury removal units, which use mercury removing agents made of expensive zeolite materials that have short lifecycles. For this reason, LNG production plants are strongly seeking the development of low-cost, long-life mercury removing agents.

Taking this situation into consideration, JCCP launched the "Joint Project on the Removal of Mercury from Natural Gas (Oman)" as a FY2013 project, as outlined below.

1) Period of implementation: April 2013 – March 2014
2) Overseas counterpart: Sultan Qaboos University (SQU)
3) Participating companies: Cosmo Engineering Co., Ltd.; Hagio High Pressure Containers Co., Ltd.
4) FY2013 project activities
   (1) Removal of impurities from natural gas
   (2) Manufacture of a laboratory testing apparatus
   (3) Performance evaluation of adsorbents using the laboratory testing apparatus

JCCP and SQU also held a Memorandum of Agreement (MOA) signing ceremony for implementation of the joint JCCP-SQU project in fiscal 2013.

The signing ceremony took place in the main building of SQU on November 3, 2013. On the Japanese side, members of JCCP were joined by the Japanese Ambassador to Oman and executive officers from Cosmo Engineering Co., Ltd. and Hagio High Pressure Containers Co., Ltd. The Omani side included executive officers of SQU and members of the royal family. Local newspapers in Oman printed an article on the ceremony, and contributed to spreading information and increasing public recognition of JCCP activities in Oman.

The following achievements were made in fiscal 2013.

(1) Removal of impurities from natural gas

An examination was made into the composition of natural gas mined and refined at Petroleum Development Oman (PDO)'s Saih Nihayda Gas Plant. The plant operates a mercury removal unit (MRU), which was confirmed to reduce mercury concentration from 15 – 60 μg/Nm^3 at the inlet to 20 – 100 ng/Nm^3 at the outlet. PDO's standard for mercury concentration at the outlet of the mercury removal unit is 5,500 ng/Nm^3.

(2) Performance evaluation of adsorbents using a laboratory testing apparatus

The performance of adsorbents was tested using nitrogen gas or methane impregnated with mercury as model gas. Three types of activated carbon (HG-1, HG-2, HG-S) and activated carbon HG-W were examined as adsorbents for removing impurities from natural gas.

As a result of the above examination, two tests were implemented: one using an adsorbent containing HG-S only, and the other using an adsorbent containing HG-W and HG-S at a 1:1 volume ratio.

Since the gases used in the laboratory test contain mercury, there was concern that it would adhere to the inner walls of the gas cylinder. Thus, the impact of mercury adhesion to the inner walls of the gas cylinder was examine and assessed. As a result, traces of mercury were found adhered to the walls of the gas cylinder, but since the amount was extremely small, the impact of any adhesion of the mercury content in the natural gas in the cylinder was judged to be negligible.

(3) Manufacturing of the laboratory testing apparatus

A laboratory testing apparatus was manufactured with reference to the gas throughput and operational pressure

of the mercury removal unit in operation at PDO. With consideration given to safety, the conditions for the laboratory test were set at a pressure of 0.1 MPa and a per-column flow rate of 2.0 NL/min. After transporting natural gas obtained from the Saih Nihayda Gas Plant to SQU, it was fed into a column filled with mercury adsorbent, and the concentration of mercury content in the gas was measured both at the inlet and outlet to confirm the ability of the adsorbent to adsorb mercury.

The laboratory testing will be continued until the beginning of fiscal 2014, to evaluate the ongoing performance of the adsorbents that were introduced, and to assess and examine breakthrough time. Based on the results of the above, the volume of adsorbent to be introduced to the actual mercury removal unit will be decided. Furthermore in fiscal 2014, a pilot unit will be designed and manufactured, and during fiscal 2015, the pilot unit will be installed in a gas field in Oman to evaluate its adsorbent performance using actual gas.

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