Transactions of the Korean Nuclear Society Autumn Meeting
Gyeongju, Korea, October 29-30, 2015

Research on How to Remove Efficiently the Condensate Water of Sampling System

SungHwan Cho [a*], MinSoo Kim [a], HoYoung Choi [a], WonHo In [a]
[a]*Korea Atomic Energy Research Institute, Daedeok-daero 989-111, Yuseong-gu, Daejeon, Republic of Korea, 305-353*
[*] *Corresponding author: shcho@kaeri.re.kr*

1. Introduction

A sampling panel for gas in the FTL (Fuel Test Loop) second equipment room has an O_2 and H_2 analyzer that measures the gas concentration in the internal system which allows maintaining its safety by purging the gas in advance.

The sampling panel was designed to measure the gas concentration inside the system. If condensate water occurs and flows into the analyzer it may cause a failure of the analyzer or indicate a wrong value.

Condensate water was flowed in the sampling panel with the gas when the gas enters the sampling panel from the disposal and degasifier tank in the FTL which is one of affiliate facilities of HANARO (High-flux Advanced Neutron Application Reactor).

As a result, corrosion was caused in the measurement chamber inside the O_2 and H_2 analyzer, and thus measuring the concentration of O_2 and H_2 was not possible.

It was confirmed that the cause of the occurrence of condensate water is due to the temperature difference caused during the process of the internal gas of the disposal and degasifier tank being brought into the analyzer.

Thus, a heating system was installed inside and outside of the sampling panel for gas to remove generated condensate water in the analyzer and pipe.

For the case where condensate water is not removed by the heating system, drain port is also installed in the sampling panel for gas to collect the condensate water of the sampling system.

2. Methods and Results

The disposal and degasifier tank is airtight and contains gas at the top and liquid at the bottom.

Internal temperature of the disposal tank is 26 ℃ under shutdown and low-temperature operating mode, but the temperature rises to 32 ℃ under high-temperature operation due to the pressurizer. The gas temperature near the analyzer inside sampling panel for gas is 27 ℃, and thus a 5 ℃ temperature difference occurs between the disposal tank and the analyzer inlet. Supposing that the humidity of the sampling gas is 100%, condensate water is produced at the amount of 16 grams per day.

Internal temperature of the degasifier tank is 26 ℃ under the shutdown state, but the temperature rises up to 50 ℃ under operation mode. The gas temperature near the analyzer inside the sampling panel for gas is 30 ℃, and thus a 20 ℃ temperature difference is occurs between the analyzer inlet and degasifier tank. Supposing that the humidity of the sampling gas is 100%, condensate water is created at 107 grams per day.

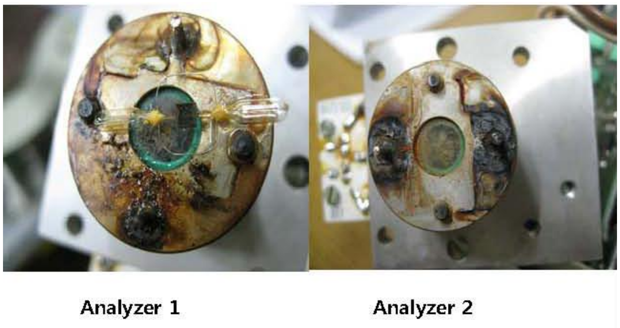

Fig. 1. Corrosion of the analyzer by condensate water inside measurement chamber

2.1 Manufactured Goods Installation

(1) Cover the pipe between the tank and panel with the heating cable.

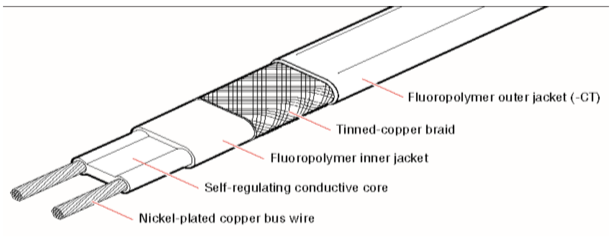

Fig. 2. Construction of heating cable

(2) Install another heating cable in the sampling panel for gas.
(3) Maximum sustainable temperature of heating cable is 110 ℃.
(4) Wrap the heating cable on the pipe with the heat insulating material.

Fig. 3. Installation of heating cable and heat insulating material

(5) Install the manufactured drain port between the front end of grap-cylinder and filter in the sampling panel for gas.

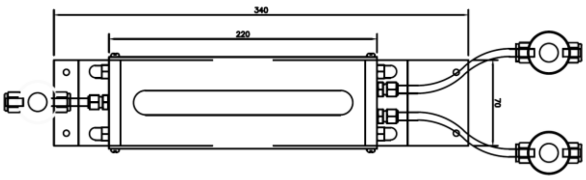

Fig. 4. Construction of drain port

(6) A part of the drain port was designed and built with acrylic to identify with the naked eye whether there is condensate water inside.

Fig. 5. Installation of drain port inside the sampling panel for gas

(7) Install the controller to control the temperature of the heating cable in the sampling panel for gas(80 to 90℃ setting).

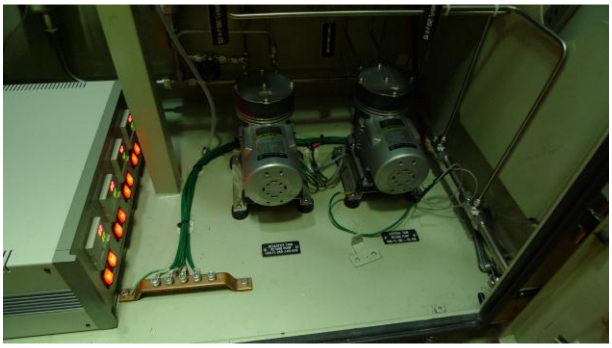

Fig. 6. Installation of temperature controller in sampling panel for gas

2.2 Analyzer Calibration and Testing Practice

(1) Make sure that zero and span gases are normally charged.
(2) The pipe from the disposal and degasifier tank to the analyzer of the sampling panel is purged for calibration and testing. In the purging process, a large volume of pre-existing condensate water was collected in the drain port and drained by opening drain valve.
(3) Due to the oscillation of gas flow rate at the front end of the analyzer, the existing PRV is replaced with a BPRV (Back Pressure Regulating Valve) to stabilize the variation of gas flow rate by controlling the pressure of the front end of the analyzer.
(4) After installing the manufactured goods and purging the pipe line, the O_2 and H_2 value were examined by the analyzer, and the result showed that the value was within the measurement ranges.

Table I: Measurement Value of Gas Concentration

Tank	Instrument No. (Gas)	Measurement Value (%)	Range (%)
Disposal	AE44(H_2)	5	0~10
	AE45(O_2)	10	0~25
Degasifier	AE46(H_2)	90	90~100
	AE47(O_2)	9	0~25

3. Conclusions

It was verified that there is a great volume of condensate water existing in the pipe line during the purging process after installing manufactured goods. The condensate water was fully removed by the installed heating cable and drain port. The heating cable was operated constantly at a temperature of 80 to 90℃, which allows the precise measurement of gas concentration and longer maintenance duration by blocking of the condensate water before being produced.

To install instruments for measuring the gas, such as an O_2 and H_2 analyzer etc., consideration regarding whether there condensate water is present due to the temperature difference between the measuring system and analyzer is required.

In the case of the disposal tank, an additional device is necessary for removing condensate water which is led by the temperature difference by the surrounding system.

REFERENCES

[1] EMR of Sampling Panel for Gas, KAERI, 2011.
[2] FTL: The High Temperature Function Test Procedures before Loading the Nuclear Fuel (Comprehensive Test Procedures of Letdown, Makeup and Purification System), Rev.1, KAERI, 2008.
[3] FTL: The Room Temperature Function Test Procedures (Sampling System Test Procedures), KAERI, 2007.
[4] HANARO SAR Chapter 11.7 FTL, KAERI/TR-3898/2009.
[5] HANARO Operating Procedures: FTL Waste Storage and Transport System, Rev.1, KAERI, 2012.
[6] HANARO Operating Procedures: FTL Letdown, Makeup and Purification System. Rev.2, KAERI, 2012.
[7] HANARO Operating Procedures: FTL Sampling System, Rev.2, KAERI, 2012.
[8] FTL P&ID HAN-FL-240-MC-H001, Rev.18, KAERI, 2009.
[9] FTL P&ID HAN-FL-250-MC-H001, Rev.9, KAERI, 2007.
[10] FTL P&ID HAN-FL-260-MC-H002, Rev.6, KAERI, 2011.