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Application News

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Transportable Gas Analyzer

Evaluation of a Catalyst Used in the Production of Fuel Cell Hydrogen with CGT-7100

Steam reforming is a method used to produce hydrogen gas needed for fuel cells, a green energy technology that has attracted attention in recent years. Steam reforming introduces a high temperature catalyst to a mixture of steam and raw materials such as methane or ethanol to produce hydrogen gas. Evaluation of the catalyst used during steam reforming involves an assessment of catalytic performance and how catalyst degradation is affected by different reaction temperatures, and is achieved by monitoring changes in the concentration of product components, such as CO and CO_2. The CGT-7100 comes with the ability to detect up to two components out of CO, CO_2, and CH_4, and has built-in sample pretreatment units, which allows for direct and real-time measurement of sample gases without the need for connection of separate pretreatment systems. This article describes an example evaluation of a catalyst by CO and CO_2 measurement.

Measurement Method

Standard methane gas and steam mixed at fixed flowrates were passed through a high temperature chamber containing a catalyst. Gas discharged from the chamber was cooled to room temperature, liquid generated was drained away, and then gas was introduced to the CGT-7100, which was used to measure concentrations of CO and CO_2 in the exhaust gas sample. A single experiment was performed over a period of between 6 and 10 hours, during which time the change in CO and CO_2 concentration was monitored continuously. This experimental method is used to confirm how the state of degradation of a reforming catalyst is affected by different catalyst temperatures. It shows that increasing the temperature of the catalyst increases its reforming capacity.

Table 1 Analytical Conditions

Analyzer	: CGT-7100
Measured Components	: CO, CO_2
Measurement Range	: CO 10 vol% CO_2 15 vol%
Sample Gas Flowrate	: 100 mL/min

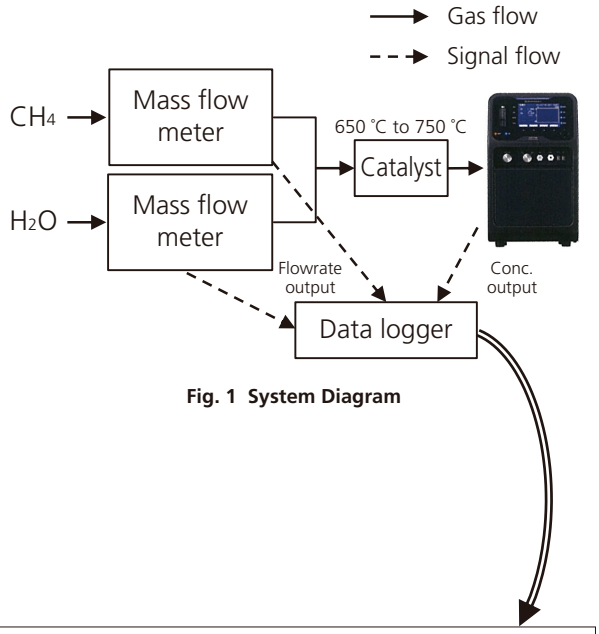

Fig. 1 System Diagram

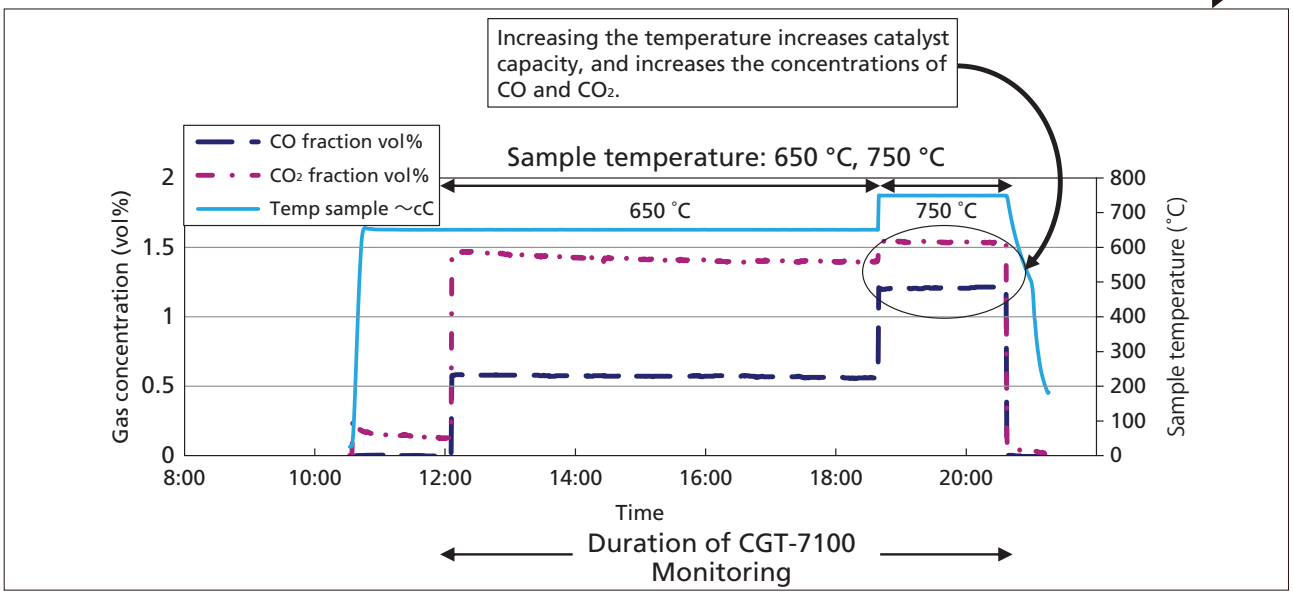

Fig. 2 Results

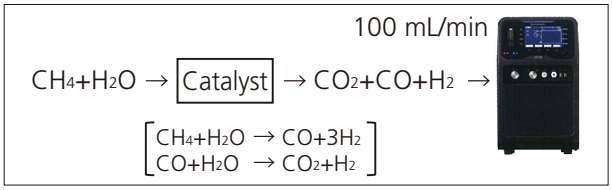

Fig. 3 Reaction Formula

The CGT-7100 can be used not only to measure combustion exhaust gases, but also for research into improving fuel cell efficiency and lifespan by monitoring the concentration of methane gas that is part of natural gas, and by measuring the concentration of the impurity carbon monoxide. Furthermore, the CGT-7100 can also be used for research into catalysts used in fuel reforming systems that produce hydrogen gas from natural gas by measuring carbon monoxide and carbon dioxide present at very low flowrates but high concentrations.

Fig. 4 CGT-7100 Main Unit

Table 2 Specifications of CGT-7100 Standard Types 1 to 3

	Type 1	Type 2	Type 3
Measured Components	CO, CO_2	CO, CH_4	CO, CO_2
Measurement Range	CO: 0 – 1000/5000 ppm CO_2: 0 – 5/15 vol%	CO: 0 – 5 vol% CH_4: 0 – 20 vol%	CO: 0 – 10/20 vol% CO_2: 0 – 10/20 vol%
Measurement Principle	CO, CO_2, CH_4: Single light source dual beam non-dispersive infrared absorption method (ratio photometry)		
Repeatability	Within ± 0.5 % of full scale		
Zero Drift	Within ± 1 % of full scale per day		
Span Drift	Within ± 1 % of full scale per day		
Linearity	Within ± 2 % of full scale	CO: Within ± 2 % of full scale CH_4: Within ± 3 % of full scale	Within ± 2 % of full scale
Response Time (Td + T90)	CO, CO_2, CH_4: Selectable from 15, 30, or 60 seconds		Less than 3 minutes (at a sample gas flowrate of 100 mL/min)
Sample Gas Collection Flowrate	Approx. 2.5 L/min (The gas flowrate for the sample cell is 1.0 L/min.)		100 to 400 mL/min (variable)
Transmission Output	0 to 1 V DC, 3-channel insulated output (non-insulated between channels)		
Wireless Signal Output	Yes		
Data Storage to External Media	Allows data in CSV format to be saved to a USB flash drive.		
Permitted Ambient Temperature	5 to 40 ˚C. Should be protected from direct sunlight and radiant heat.		
Power Requirements	100 V AC, 50/60 Hz, 130 VA		
Dimensions	W260 × D420 × H452 mm (Excluding protrusions)		
Weight (Main unit)	Approx. 16 kg		
External drain separator	Yes	No	

Please contact Shimadzu regarding analyte component combinations and measurement ranges not mentioned above.

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