ARO-FE ENVIRONMENTAL Bulletin

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- **Web-Page:** http://ww.arofe.army.mil/AROindex.htm ; **WEB Info:** DAndreaG@arofe.army.mil
- **Desktop News:** http://www.desktopnews.com/download/AroSetup.exe .. ***Explore / click on any of the Blue Items!***

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HYDROGEN GAS (H_2) …

… the next generation 'clean' fuel …

Hydrogen gas is an environmentally friendly fuel and it is believed to be the next generation fuel for automobiles and fuel cell batteries.
Tokyo Gas and Mitsubishi Heavy Industry have developed a Hydrogen Production System consisting of a Steam Reformer equipped with Palladium Membrane. This System uses city gas as raw material and produces pure hydrogen gas without the use of Water Gas Shift Converter and Hydrogen Purification System – needed to eliminate CO. These systems are also expensive, unstable and have low endurance. The principle of the Steam Reformer with palladium membrane is shown in Figure 1 and 2. The Reformer is 630-mm diameter x 970-mm height and houses a burner in the center. The reaction, in the catalytic layer, produces Hydrogen and CO. Hydrogen is then separated & removed by 96 palladium tubes. The off gas, CO, is recycled through the burner. The operation condition and performance data are summarized in Table 1 and 2.
These data show the Steam Reformer to have a good performance in hydrogen production (at 99.999 %), and enough endurance (30 start up tests with 1,000 hr of continuous operation).

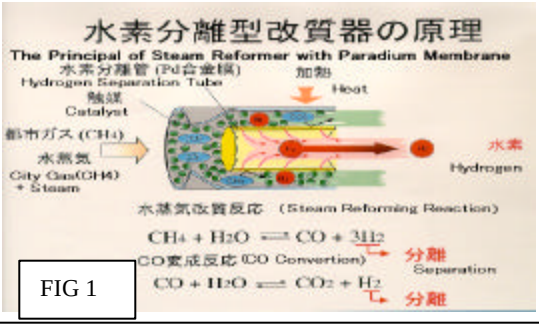

FIG 1

Table 1, Operation Conditions

City Gas Flow Rate	8.3 Nm^3/h
Fuel Gas Flow Rate	2.0 Nm^3/h
Reaction Temperature	823 K
Reaction Pressure	0.84 MPa
Pressure at permeate	0.1 MPa
S/C Ratio	3 mol/c-mol

City Gas Composition

CH4	88.5 %
C2H6	4.6 %
C3H8	5.4 %
C4 H10	1.5 %

Table 2, Performance Data

	Experiential	Calculated
H2 Production	13.8 Nm^3/h	13.8 Nm^3/h
Conversion	55.0 %	55.3 %
Reformate Gas Composition (%, dry)		
H2	37.9	38.0
CO	2.1	3.0
CO2	32.0	31.4
CH4	27.9	27.7
H2 Purity	99.999 %	99.999 %
Impurity (ppm, dry)		
CO	0.18	
CO2	0.98	
CH4	1.04	

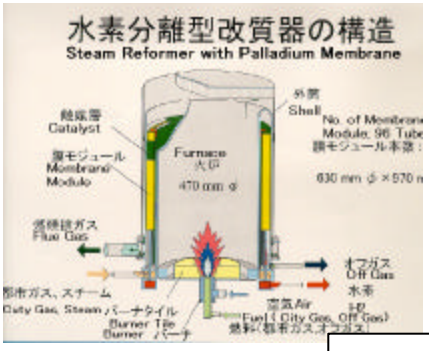

FIG 2

Mechanical & Environmental Sciences