SOME INFORMATION ON THE HYDROGEN COMBUSTION PROCESS AND ROCKET PROPULSION SYSTEMS

Tokio Ohta
Yokohama National University, 79-1 Tokiwadai, Hodogaya-ku, Yokohama, 240-8501, JAPAN

Ikuo Komatsu
Iwatani International Corporation, 3-21-8, Nishi Shinbashi, Minato-ku , Tokyo, 105-8458, Japan

Keywords: coolant, hydrogen combustion, hydrogen fueled turbine, propellant, property of hydrogen, recuperation cycle, space rocket, supersonic transportation, thrust

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Summary

According to the combustion data and properties, hydrogen is the most efficient fuel for rockets and supersonic aircraft. In addition, hydrogen/oxygen combustion system emits no pollutant. Space rocket is the essence of space industries and the glory of nations nowadays. Conceptual designs for the supersonic (hypersonic) and the subsonic aircrafts have been studied; however the actualization is not yet, because of too large investment. The hydrogen/oxygen combustion turbine for power plant had been investigated from 1994 to 1997, and showed excellent performance.

1. Hydrogen Combustion Data

Table 1 shows the basic data of hydrogen combustion.

Auto ignition temperature:	858 K
Burning velocity in NTP air:	2.70 m/s
Density of gas at NTP:	83.764 g/m^3
Density of liquid at NBP:	0.0708 g/cm^3
Detonation velocity in air:	1.4 to 2.2 km/s
Diffusion coefficient in NTP air:	0.634 cm^2/s
Flame emissivity:	0.10
Flame temperature:	2323 K
Gas constant:	R = 4124.157 m^2/sJ
Heat of combustion (high):	141.86 KJ/g; (low): 118.93 KJ/g

Heat of fusion:	58.23 J/g
Heat of vaporization:	445.59: J/g
Limits of detonatability in air:	18.3 to 65 % (vol.)
Limits of detonatability in O_2:	15 to 90 % (vol.)
Limits of flammability in air:	4 to 75 % (vol.)
Limits of flammability in O_2:	4 to 96 % (vol.)
Limiting oxygen index:	5 % (vol.)
Minimum energy for ignition in air:	0.02 mJ
Specific heat of NTP gas:	C_p = 14.89 J/gK
Stoichiometric composition in air:	29.53 % (vol.)
Thermal conductivity of NTP gas:	1.897 mW/cm K
Thermal radiation energy from flame to surroundings:	17 to 25 % (vol.)
Volume expansivity of NBP liquid:	0.01658 K^{-1}

Notes:
1) Thermophysical properties shown above are those of Para hydrogen
2) NTP: Normal temperature and pressure; NBP: Normal boiling point

Table 1. Basic data of hydrogen combustion.

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Biographical Sketches

Tokio Ohta was born on 3 November 1925 in Japan; he has received his education from the Department of Physics, University of Kyoto with Ph.D. degree in Solid State Physics; has taught at the University of Kyoto, Portland State University of Oregon, U.S.A., and the University of Tokyo; served as the Dean of

Faculty of Engineering, Yokohama National University (1985–88), as the President of Yokohama National University (1988– 94); has been appointed to the Superintendent of the International Network University since 1999; has been appointed as the Committee Staff of Science and Technology to the Prime Minister (1974– 94); has been appointed as the Committee Staff of the Minister of International Trade send Industry (1994– 99); has published some 160 papers and 60 books on the solid state physics and the energy systems; has been elected to the Vice President of International Association for Hydrogen Energy, and he is the Founding Past President of the Hydrogen Energy Systems Society of Japan.

Ikuo Komatsu: Graduated from Faculty of Engineering, Fukui University, he obtained the position at the central research laboratory of Iwatani International Corporation (March 1967); appointed the head of the Technology Department (1994 -2000); appointed the head of the Secretary Department (2000 -).