ETHYLENE OXIDE AS A MONOPROPELLANT[1]

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Thermodynamic calculations to determine the theoretical performance of ethylene oxide as a monopropellant have been carried out for various possible decomposition reactions. The performance calculations were carried out, by using standard evaluation procedures (1), for two possible exothermic decomposition reactions, one of which leads to the formation of CO and CH_4, whereas the other leads to the production of CO, C, and H_2. For the process leading to carbon formation, two limiting cases were considered, viz., (a) no slippage between the carbon particles and the gases during expansion with thermodynamic equilibrium being maintained at all times, and (b) complete deposition of carbon in the combustion chamber. The results of calculations, for a chamber to exit pressure ratio of 20.42:1 and injection of the liquid monopropellant at its normal boiling point of 10.7°C, are summarized in Table I, where T_c and T_e denote the adiabatic flame temperature and the nozzle exhaust temperature, respectively, c* is the characteristic gas velocity, C_f represents the nozzle thrust coefficient, and Isp denotes the specific impulse.

The factors leading to carbon formation in combustion are not

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(1) "Quantitative Evaluation of Rocket Propellants", by S. S. Penner, American Journal of Physics, vol. 20, 1952, pp. 26-31.

Table I. Summary of Performance Calculations for C_2H_4O Monopropellant

Decomposition Reaction	T_c (°K)	T_e (°K)	c*(m/sec)	C_f	I_{sp}(sec)
$C_2H_4O = CO + CH_4$	1430	908	1230	1.295	162.2
$C_2H_4O = CO + 2H_2 + C$ (carbon in equilibrium with gas)	638	304	891	1.400	127.6
$C_2H_4O = CO + 2H_2 + C$ (carbon deposited in rocket chamber)	638	270	1025	1.385	105.4

clearly understood although a considerable amount of work has been done on this subject in recent years. An extensive literature survey on the kinetics of ethylene oxide decomposition has been carried out. The results of this study are summarized in the thesis from which this letter is abstracted.