ON THE DEPENDENCE OF SURFACE TEMPERATURE ON THE BURNING RATE OF HMX

V. N. Marshakov and G. V. Melik-Gaikazov

N. N. Semenov Federal Research Center for Chemical Physics of the Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation

Abstract: The paper presents the results of processing the experimental data available in the literature on the surface temperature and burning rate of double-base propellants, RDX and HMX. The interrelation between the burning rate and surface temperature for them is represented in the form of a single, unambiguous, and unified correlation independent of the initial temperature of the sample. For HMX, such a correlation takes a form $\ln U = 4.8 - 2550 T_s^{-1}$ (SD = 0.06) or $U = 124 \exp(-2550/T_s)$ where $[U]$ = cm/s and $[T_s]$ = °C and, conversely, $T_s = 516 + 72 \ln U$ (SD = 7.2) valid for the ranges of burning rates $0.05 < U < 1.0$ cm/s and surface temperatures $360 < T_s < 515$ °C. The derived correlations $U(T_s)$ allow estimation of the temperature at individual points on the front of the transverse wave based on the local values of the burning rate in these points.

Keywords: HMX; inhomogeneous combustion front; burning rate; transverse wave; local burning rate; surface temperature; activation energy

DOI: 10.30826/CE24170309 **EDN:** EKTWDS

Figure Captions

Figure 1 Burning rate vs. surface temperature for the double-base propellants: *1* — experimental data for propellant N; *2* — experimental data for propellant NB; *3* — experimental data for propellant N+; *4* — correlation 4 (see Table 1) for a set of data for propellants N, NB, and N+; and *5* — correlation 5 (see Table 1) for a set of data for propellants N, NB, and N+ from [7]

Figure 2 Burning rate vs. surface temperature in semilogarithmic coordinates: signs — experiments; curves — calculations; *1–4* — [10]; *5* — [9]; *6* — [11]; *7* — correlations (1) and (3) [12–14]; *8* — correlation (2) [12, 13]; and *9* — correlation (4) [14]

Figure 3 Burning rate U vs. surface temperature T_s in semilogarithmic coordinates for the initial temperatures of samples $T_0 = 20$, 100, and −170 °C: *1* — data and correlation $\ln U(1000/T_s)$ from [10]; and *2* — data and correlation $\ln U(1000/T_s)$ from [11]

Figure 4 Surface temperature T_s vs. burning rate U at the initial temperatures of the samples $T_0 = 20$, 100, and −170 °C: *1* — data from [10]; and *2* — data from [11]

Table Captions

Table 1 Burning rate dependences on the surface temperature for double-base propellants

Table 2 Parameters of combustion waves at pressures 0.5–5 atm

Table 3 Parameters of combustion waves at pressures 5–60 atm

Table 4 Parameters of combustion waves at pressures 100–500 atm

Acknowledgments

The work was carried out within the framework of Fundamental Scientific Research Program of the Russian Federation “Combustion and Explosion Processes” (registration No. 122040500073-4).

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Received July 7, 2023

Contributors

Marshakov Vladimir N. (b. 1935) — Doctor of Science in physics and mathematics, chief research scientist, N. N. Semenov Federal Research Center for Chemical Physics of the Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; marsh_35@mail.ru

Melik-Gaikazov Georgy V. (b. 1958) — Candidate of Science in physics and mathematics, engineer, N. N. Semenov Federal Research Center for Chemical Physics of the Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; marsh@chph.ras.ru