Richard Nakka's *Experimental Rocketry* Web Site

Potassium Nitrate-Sucrose (KNSU) Propellant Chemistry and Performance Characteristics

Standard Composition (65/35 O/F)

For KNSU propellant, with an oxidizer-fuel (O/F) ratio of 65/35, the theoretical combustion equation is as follows:

$$C_{12}H_{22}O_{11} + 6.288\ KNO_3 \rightarrow 3.796\ CO_2 + 5.205\ CO + 7.794\ H_2O + 3.065\ H_2 + 3.143\ N_2 + 2.998\ K_2CO_3 + 0.274\ KOH$$

at a pressure of 68 atmospheres (1000 psi), and where the following compounds are symbolized as:

sucrose	solid	$C_{12}H_{22}O_{11}$
potassium nitrate	solid	KNO_3
carbon dioxide	gas	CO_2
carbon monoxide	gas	CO
steam	gas	H_2O
hydrogen	gas	H_2
nitrogen	gas	N_2
potassium carbonate	liquid	K_2CO_3
potassium hydroxide	gas	KOH

The mole numbers for each of the products shown above were determined from PROPEP (Propellant Evaluation Program).

Characteristics of KNSU Propellant (65/35 ratio)

	Parameter		Units	Note
	Process method	Cast		
Isp	Specific Impulse, ideal	153.5	sec.	[1]
Isp	Specific Impulse, delivered (typical)	125-130	sec.	[2]
C*	Characteristic exhaust velocity, theoretical	3013	ft/s	
To	Combustion temperature, theoretical @1000 psia	1447 (1720)	deg Celsius (K)	[3]
To	Combustion temperature, measured@1000 psia	1350	deg Celsius	[4]
	Density, ideal	1.89	gram/cu.cm.	
	Density, as cast (typical)	1.80	gram/cu.cm.	[5]
X	Mass fraction of condensed-phase products	0.424	-	
k	Ratio of specific heats, mixture	1.133	-	[6]

M	Effective molecular wt. of exhaust products	42.02	g/mole	[7]
	Burn rate behaviour	de St.Robert		
n	Burn rate pressure exponent, strand	0.319		
n	Burn rate pressure exponent, erosive	0.323		
a	Burnrate constant	0.0665		[8]
ro	Burn rate @ 1 atm.	0.156	in/sec	
r	Burn rate @ 1000 psia	0.602	in/sec	
Tcr	Auto-ignition temperature	> 300	deg. C.	

[1] At 1000 psi pressure; exit pressure one atmosphere
[2] Static tests AST-17, AST-18
[3] PROPEP combustion results
[4] Measured with type k thermocouple, static test AST-16
[5] Measured, typical grain
[6] Mixture(2-phase), at chamber conditions
[7] System mass divided by number of gas moles
[8] Use with pressure units of *psi*. Resulting burn rate is *inches per second*

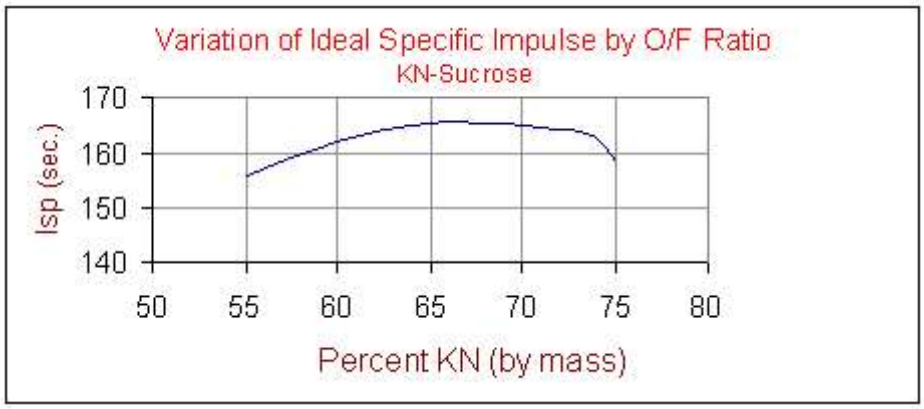

Figure 1 -- This chart shows the variation of theoretical specific impulse with O/F (oxidizer/fuel) ratio.

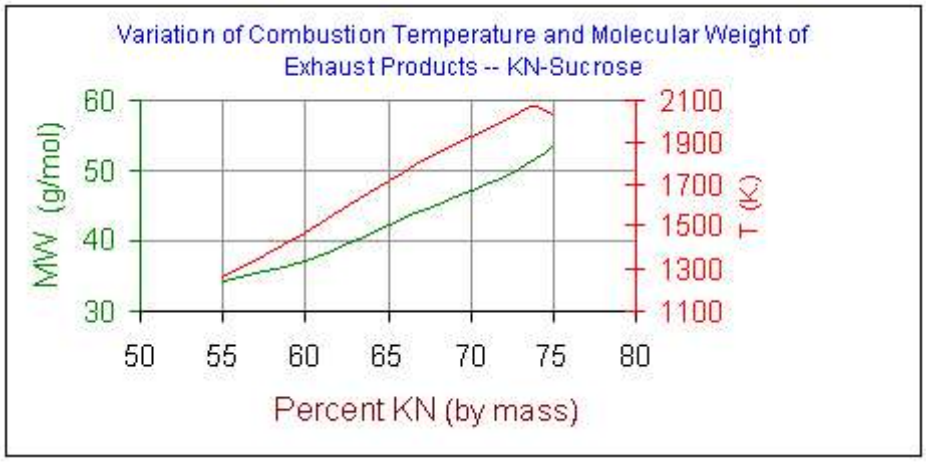

Figure 2 -- This chart shows the variation of combustion temperature and molecular weight of exhaust products with O/F ratio.

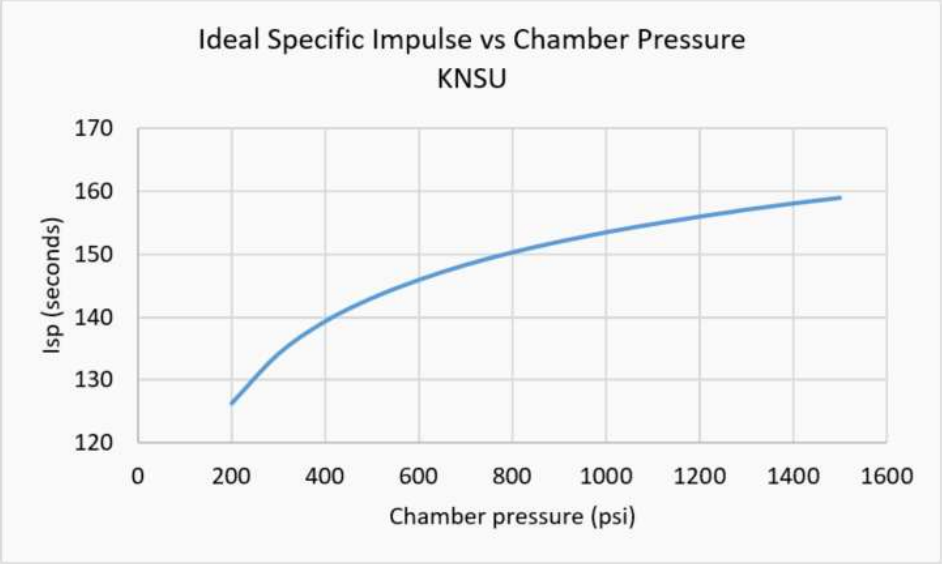

Figure3 -- This chart shows the variation of theoretical specific impulse with chamber pressure.

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