MASTER

STABILIZATION OF BULK AND PRESSED
HNS AT VARIOUS TEMPERATURES
AND DURATION TIME

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DEVELOPMENT DIVISION

OCTOBER - DECEMBER 1975
P. O. NO. 58-7479

For
Sandia Laboratories
Albuquerque, New Mexico

Mason & Hanger-Silas Mason Co., Inc.
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AMARILLO, TEXAS 79177
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operated for the
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
under
U. S. GOVERNMENT Contract DA-11-173-AMC-487(A)

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ABSTRACT

Results of stabilization studies conducted on HNS I and II at various densities, temperatures and storage times are given.

DISCUSSION

Thermally aged HNS (bulk and pellets) at 80, 100, 140, and 170 C were periodically tested for surface area and dimensional changes. Temperatures and duration times were prescribed by Sandia Laboratories. Samples were aged in 2.5 mm glass tubes sealed with a plastic/paper screw cap. Bulk samples weighing approximately 1.5 g were loosely placed into the sample tube. Two pellets of a given density were placed in the sample tubes. HNS I (Chemtronics Lot 66-48) and II (Chemtronics Lot 66-47) at their respective bulk densities and at 1.3, 1.5 and 1.65 Mg/m³ were tested.

Specific surface area was measured by gas adsorption using nitrogen isotherms determined by a static BET apparatus (micrometric or surface-pore volume analyzer Model 2100). Dimensional distribution analysis was done by microscopy using the Zeiss Analyzer Model TGZ-3, Pantex modified.

HNS pellets before particle characterization were dispersed by soaking the pellets briefly in anhydrous ether. This allows individual particles to be easily separated without further mechanical action.

Table I lists mean particle length and specific surface area for the prescribed samples tested. Mean particle lengths determined by microscopy normally have a standard deviation of 0.5 μm for bulk powders and approximately 2.0 μm for pressed samples. The standard deviation of the specific surface area for bulk powders is approximately 0.2 m²/kg while that for pressed samples is dependent upon particle distribution and sampling technique used before pressing of the pellets.

CONCLUSIONS

Particle growth and surface area change are not apparent by this study and appear to follow similar studies conducted by Sandia. This completes the Sandia study of thermally aging HNS.

Table I. Stabilization of Bulk and Pellet HNS at Various Temperatures and Duration Times

Duration Time (hrs)	Bulk HNS I		HNS I (ρ 1.3)		HNS I (ρ 1.5)		HNS I (ρ 1.65)		Bulk HNS II		HNS II (ρ 1.3)		HNS II (ρ 1.5)		HNS II (ρ 1.65)	
	Mean* Length	Surface** Area	Mean Length	Surface Area	Mean Length	Surface Area	Mean Length	Surface Area	Mean Length	Surface Area	Mean Length	Surface Area	Mean Length	Surface Area	Mean Length	Surface Area
Oven Temperature at 80 C																
0	24.83	1.8100	21.99	2.0600	20.10	2.8050	18.44	2.8190	73.09	0.7985	60.38	0.7540		0.8590	41.45	1.3950
24	23.88	1.9080	19.21	2.4860	26.31	3.1320	23.31	2.9890	52.02	0.8030	52.79	1.2945	41.37	0.8265	37.10	1.2605
48	27.58	2.0200	28.57	2.7260	22.34	3.0370	20.34	2.8210	61.25	0.6780	47.46	0.9145	43.33	0.9225	56.02	1.1310
96	23.70	2.1590	NR	NR	NR	NR	NR	NR	76.28	0.8290	NR	NR	NR	NR	NR	NR
144	NR	NR	22.22	2.6995	24.83	2.6475	34.84	2.8465	NR	NR	66.97	1.2240	61.19	1.5195	41.04	1.1940
240	25.05	2.2350	NR	NR	NR	NR	NR	NR	74.08	0.6965	NR	NR	NR	NR	NR	NR
288	NR	NR	17.30	2.8030	10.73	3.2265	10.62	3.0525	NR	NR	51.34	1.0315	56.51	1.2195	50.23	1.5110
480	25.55	1.6430	NR	NR	NR	NR	NR	NR	59.34	0.7410	NR	NR	NR	NR	NR	NR
576	NR	NR	14.25	2.6550	14.42	3.0975	10.26	2.8215	NR	NR	59.37	1.1355	53.34	0.9975	50.13	1.4740
Oven Temperature at 100 C																
0	22.45	2.3575	16.61	2.1410	11.18	2.7490	13.87	2.6595	58.17	0.6955	47.07	0.9020	51.96	1.4265	45.09	1.0840
8	22.72	2.1745	NR	NR	NR	NR	NR	NR	61.16	0.5945	NR	NR	NR	NR	NR	NR
16	27.18	2.0985	17.40	2.7805	12.24	3.2995	14.12	2.8485	57.06	0.7185	48.57	0.8705	43.92	1.2580	53.74	0.9445
24	27.51	2.3955	NR	NR	NR	NR	NR	NR	60.29	0.7520	NR	NR	NR	NR	NR	NR
32	NR	NR	13.17	2.8500	13.73	3.0740	12.24	2.8430	NR	NR	59.82	1.0155	51.26	1.0080	43.62	1.3780
48	24.60	1.7380	NR	NR	NR	NR	NR	NR	57.67	0.5995	NR	NR	NR	NR	NR	NR
72	29.18	1.6285	NR	NR	NR	NR	NR	NR	60.14	1.0665	NR	NR	NR	NR	NR	NR
96	30.10	1.7825	11.34	2.6395	10.94	2.8455	9.40	2.0240	57.36	0.9030	50.75	0.8975	45.25	1.0565	42.18	1.0755
192	NR	NR	14.87	2.5680	11.86	3.2085	12.54	3.1565	NR	NR	53.41	1.5105	50.07	1.6345	45.02	1.6470
288	NR	NR	15.30	2.1370	12.11	2.7275	10.50	2.4805	NR	NR	45.85	0.7325	42.33	1.0945		1.1580

*Mean Length = μm **Surface Area = m^2/kg

NR = Not Requested

Table I. Stabilization of Bulk and Pellet HNS at Various Temperatures and Duration Times (Cont'd)

Duration Time (hrs)	Bulk HNS I		HNS I (ρ 1.3)		HNS I (ρ 1.5)		HNS I (ρ 1.65)		Bulk HNS II		HNS II (ρ 1.3)		HNS II (ρ 1.5)		HNS II (ρ 1.65)	
	Mean* Length	Surface** Area	Mean Length	Surface Area	Mean Length	Surface Area	Mean Length	Surface Area	Mean Length	Surface Area	Mean Length	Surface Area	Mean Length	Surface Area	Mean Length	Surface Area
Oven Temperature at 140 C																
0	24.35	1.7270	17.34	2.4135	14.88	2.5345	12.13	2.7380	48.10	0.7480		0.6490	50.16	0.8780		1.3975
4	32.37	1.5875	NR	NR	NR	NR	NR	NR	50.22	0.7000	NR	NR	NR	NR	NR	NR
8	29.84	1.7300	22.68	2.5535	17.39	3.1500	14.12	3.1225	52.42	0.6105	58.88	0.8715	57.82	1.0370	52.19	1.2960
16	24.17	1.5765	18.93	2.8225	15.85	3.4040	14.76	3.4460	64.21	0.5070	58.24	0.9045	52.86	1.2965	48.58	1.1710
24	23.76	1.6655	20.90	2.6425	15.31	2.6275	18.92	2.4860	61.19	0.8335	49.00	1.0930	47.40	1.2510	51.12	1.3010
48	22.81	2.0670	19.33	2.4825	17.88	3.4780	16.00	2.6995	72.98	0.8130	49.78	0.9405	49.28	1.0450	54.14	1.1500
72	25.13	1.9130	NR	NR	NR	NR	NR	NR	53.36	0.9290	NR	NR	NR	NR	NR	NR
96	NR	NR	18.78	2.8325	16.17	2.8945	16.79	2.9320	NR	NR	65.45	0.8860	51.22	1.0585	48.42	1.4055
Oven Temperature at 170 C																
0	25.76	1.8573	20.26	2.3190	19.84	2.7000	19.70	2.0930	47.61	1.1830		1.2450		0.9575		1.0310
2	23.65	1.9880	NR	NR	NR	NR	NR	NR			NR	NR	NR	NR	NR	NR
4			16.55	2.5440	12.89	2.5250	16.33	1.8385		0.9810	51.32	1.2510		1.0205	51.78	0.8365
6	19.61	1.9590	NR	NR	NR	NR	NR	NR	51.52	0.9820	NR	NR	NR	NR	NR	NR
8	NR	NR	14.91	2.6715	11.90	2.2575	10.11	2.4060	NR	NR	57.75	0.9615	59.14	0.7310	52.56	0.9430
12	31.06	1.9430	NR	NR	NR	NR	NR	NR		0.7975	NR	NR	NR	NR	NR	NR
16	27.66	2.0105	13.77	2.6385	12.64	2.6385	11.65	2.2280	53.39	0.7690	61.40	0.8915	53.22	0.9545	51.22	1.0370
24	27.00	1.9235	15.75	2.2615	14.49	2.5935	11.43	2.2040	50.47	0.6790	48.67	0.8665	51.28	1.0165	51.82	1.0825
48	24.77	2.0550	13.98	2.5200	14.46	2.7870	12.19	2.2250	56.49	0.7630	54.79	0.7370	57.83	0.8330	53.20	0.6715

*Mean Length = μm **Surface Area = m^2/kg

NR = Not Requested