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Calorific value and flash point of paints

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NATIONAL RESEARCH COUNCIL OF CANADA

DIVISION OF BUILDING RESEARCH

No.

154

TECHNICAL NOTE

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K. Sumi and J. Harris

N.B.H.

PREPARED FOR

DATE

Dept. of National Defence (Army)

Aug. 24/53

SUBJECT

Calorific Value and Flash Point of Paints

In view of the increasing interest shown by building code and fire protection authorities on the "fire load" concept, the Department of National Defence (Army) requested the Fire Research Section, Division of Building Research, National Research Council to investigate the calorific value of paints. In addition, the Army requested an estimation of the flash points of paints. This work is to assist in the design of a storage warehouse for flammable materials to be constructed in Cobourg, Ontario. The results of this investigation are tabulated in three appendices.

In Appendix A, the paints are divided into different classes with the calorific value of each class determined by calculation based on the compositions of the paints. These results are converted into B.t.u./lb., B.t.u./gallon, and lb. "equivalent wood"/gallon in Appendix B. In this case, each pound of combustible material is assumed to have a calorific value in the range of paper and wood, i.e., about 8,000 B.t.u./lb.

A rough estimation of the fire load in a paint storage warehouse may be made by assuming that each imperial gallon of paint has a calorific value equivalent to 20 lb. of a combustible material such as paper or wood. This means that when gallon cans of paint are piled two cans high at one-foot intervals each way, the fire load is about 40 lb./sq. ft. of gross floor area. If it were assumed that only 50% of the gross floor area was used for storage and the remainder used for aisle spaces, etc., a fire load of 30 lb./sq. ft. would be obtained when stacking the cans three cans high. Such a fire load can produce a 3-hour fire severity. This would mean that a 3-hour fire resistive construction is required if the building, without other protection, is to resist a burn-out of the contents.

In Appendix C the paints are grouped according to their approximate flash points.

TECHNICAL REPORT

NOT FOR PUBLICATION

W.B.H.

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Aug. 26/53

Dept. of National Defence (Army)

Calorific Value and Flash Point of Paints

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In Appendix A, the paints are divided into different classes with the calorific value of each class determined by calculation based on the composition of the paints. These results are converted into B.t.u./lb., B.t.u./gallon, and lb. "equivalent wood" (gallon in Appendix B. In this case, each pound of combustible material is assumed to have a calorific value in the range of paper and wood, i.e., about 8,000 B.t.u./lb.

A rough estimation of the fire load in a paint storage warehouse may be made by assuming that each imperial gallon of paint has a calorific value equivalent to 20 lb. of a combustible material such as paper or wood. This means that when gallon cans of paint are piled two cans high at one-foot intervals each way, the fire load is about 40 lb./sq. ft. of gross floor area. If it were assumed that only 50% of the gross floor area was used for storage and the remainder used for aisle spaces, etc., a fire load of 30 lb./sq. ft. would be obtained when stacking the cans three cans high. Such a fire load can produce a 3-hour fire at variety. This would mean that a 3-hour fire resistance construction is required if the building, without other protection, is to resist a burn-out of the contents.

In Appendix C the paints are grouped according to their approximate flash points.

APPENDIX A

Composition of Paints and Respective Calorific Values

<u>Paint</u>	<u>Volatile Content</u> (% by weight)	<u>Vehicle Solids</u> (% by weight)	<u>Pigment</u> (% by weight)	<u>Calorific Value</u> Kg. Cal./gm.
1. Oil paint, white	10	25	65	3.38
2. Oil paint, solid colours	10	30-50	40-60	5.83
3. Enamel, gloss				
(a) Black	56	41	3	9.3
(b) dark brown #1, maroon, olive brown	50	40	10	8.4
(c) bright red	50	40	10	9.0
(d) light green, azure blue, Oxford blue	40	38	16	7.9
(e) Focal orange, yellow #56	33	33	34	6.0
(f) remaining colours (of enamels)	35	45	20	7.1
4. Flat paint	39	15	56	5.5
5. Priming paint for metal and wood	40	20	40	5.9
6. Enamel undercoater	39	15	56	5.5
7. Ammunition marking paint	35	20	45	5.3
8. Aluminum paint	50	35	15	9.4
9. Lacquer, pigmented	70	25	5	8.2
10. Asphalt varnish	60	40	--	10.6
11. Bituminous paint	50	50	--	10.4
12. Oleoresinous varnish	50	50	--	10.5
13. Shellac	60	40	--	8.0
14. Sealer, clear	75	25	--	10.5
15. Tire black, enamel	56	41	3	9.3
16. Underbody compound	45	25	30	7.5

APPENDIX A

Composition of Paints and Respective Calorific Values (Continued)

<u>Paint</u>	<u>Volatile Content</u> (% by weight)	<u>Vehicle Solids</u> (% by weight)	<u>Pigment</u> (% by weight)	<u>Calorific Value</u> Kg. Cal./gm.
17. Stains in solution				
(a) spirit (ethanol)	99	--	--	7.1
(b) oil soluble (in mineral spirits)				
Mineral spirits	99	--	--	11.25
(c) N.G.R. (i.e., non- grain-raising) (cellosolve solvent)				7.8
(d) Water				0
18. Thinners				
(a) turpentine				10
(b) mineral spirits				11.25
(c) lacquer thinner (1-GP-50)				9.8
Ketone or esters	50			
Alcohols	10			
Hydrocarbons	40			
(d) High solvency (1-GP-70)				
Mixture of aromatic hydrocarbons				10.5
19. Others				
(a) camouflage PR 19 Equivalent to flat paint				5.5
(b) luminous paint vehicle and topcoat Equivalent to varnish or clear lacquer.				10.5

APPENDIX A

(Continued) Composition of Salts and Minerals (Continued)

Sample	Weight %	Chemical Formula	Analysis	Comments
1.1	1.1	NaCl	99.9	Sample 1.1
1.2	1.2	NaCl	99.9	Sample 1.2
1.3	1.3	NaCl	99.9	Sample 1.3
1.4	1.4	NaCl	99.9	Sample 1.4
1.5	1.5	NaCl	99.9	Sample 1.5
1.6	1.6	NaCl	99.9	Sample 1.6
1.7	1.7	NaCl	99.9	Sample 1.7
1.8	1.8	NaCl	99.9	Sample 1.8
1.9	1.9	NaCl	99.9	Sample 1.9
1.10	1.10	NaCl	99.9	Sample 1.10
1.11	1.11	NaCl	99.9	Sample 1.11
1.12	1.12	NaCl	99.9	Sample 1.12
1.13	1.13	NaCl	99.9	Sample 1.13
1.14	1.14	NaCl	99.9	Sample 1.14
1.15	1.15	NaCl	99.9	Sample 1.15
1.16	1.16	NaCl	99.9	Sample 1.16
1.17	1.17	NaCl	99.9	Sample 1.17
1.18	1.18	NaCl	99.9	Sample 1.18
1.19	1.19	NaCl	99.9	Sample 1.19
1.20	1.20	NaCl	99.9	Sample 1.20
1.21	1.21	NaCl	99.9	Sample 1.21
1.22	1.22	NaCl	99.9	Sample 1.22
1.23	1.23	NaCl	99.9	Sample 1.23
1.24	1.24	NaCl	99.9	Sample 1.24
1.25	1.25	NaCl	99.9	Sample 1.25
1.26	1.26	NaCl	99.9	Sample 1.26
1.27	1.27	NaCl	99.9	Sample 1.27
1.28	1.28	NaCl	99.9	Sample 1.28
1.29	1.29	NaCl	99.9	Sample 1.29
1.30	1.30	NaCl	99.9	Sample 1.30
1.31	1.31	NaCl	99.9	Sample 1.31
1.32	1.32	NaCl	99.9	Sample 1.32
1.33	1.33	NaCl	99.9	Sample 1.33
1.34	1.34	NaCl	99.9	Sample 1.34
1.35	1.35	NaCl	99.9	Sample 1.35
1.36	1.36	NaCl	99.9	Sample 1.36
1.37	1.37	NaCl	99.9	Sample 1.37
1.38	1.38	NaCl	99.9	Sample 1.38
1.39	1.39	NaCl	99.9	Sample 1.39
1.40	1.40	NaCl	99.9	Sample 1.40
1.41	1.41	NaCl	99.9	Sample 1.41
1.42	1.42	NaCl	99.9	Sample 1.42
1.43	1.43	NaCl	99.9	Sample 1.43
1.44	1.44	NaCl	99.9	Sample 1.44
1.45	1.45	NaCl	99.9	Sample 1.45
1.46	1.46	NaCl	99.9	Sample 1.46
1.47	1.47	NaCl	99.9	Sample 1.47
1.48	1.48	NaCl	99.9	Sample 1.48
1.49	1.49	NaCl	99.9	Sample 1.49
1.50	1.50	NaCl	99.9	Sample 1.50
1.51	1.51	NaCl	99.9	Sample 1.51
1.52	1.52	NaCl	99.9	Sample 1.52
1.53	1.53	NaCl	99.9	Sample 1.53
1.54	1.54	NaCl	99.9	Sample 1.54
1.55	1.55	NaCl	99.9	Sample 1.55
1.56	1.56	NaCl	99.9	Sample 1.56
1.57	1.57	NaCl	99.9	Sample 1.57
1.58	1.58	NaCl	99.9	Sample 1.58
1.59	1.59	NaCl	99.9	Sample 1.59
1.60	1.60	NaCl	99.9	Sample 1.60
1.61	1.61	NaCl	99.9	Sample 1.61
1.62	1.62	NaCl	99.9	Sample 1.62
1.63	1.63	NaCl	99.9	Sample 1.63
1.64	1.64	NaCl	99.9	Sample 1.64
1.65	1.65	NaCl	99.9	Sample 1.65
1.66	1.66	NaCl	99.9	Sample 1.66
1.67	1.67	NaCl	99.9	Sample 1.67
1.68	1.68	NaCl	99.9	Sample 1.68
1.69	1.69	NaCl	99.9	Sample 1.69
1.70	1.70	NaCl	99.9	Sample 1.70
1.71	1.71	NaCl	99.9	Sample 1.71
1.72	1.72	NaCl	99.9	Sample 1.72
1.73	1.73	NaCl	99.9	Sample 1.73
1.74	1.74	NaCl	99.9	Sample 1.74
1.75	1.75	NaCl	99.9	Sample 1.75
1.76	1.76	NaCl	99.9	Sample 1.76
1.77	1.77	NaCl	99.9	Sample 1.77
1.78	1.78	NaCl	99.9	Sample 1.78
1.79	1.79	NaCl	99.9	Sample 1.79
1.80	1.80	NaCl	99.9	Sample 1.80
1.81	1.81	NaCl	99.9	Sample 1.81
1.82	1.82	NaCl	99.9	Sample 1.82
1.83	1.83	NaCl	99.9	Sample 1.83
1.84	1.84	NaCl	99.9	Sample 1.84
1.85	1.85	NaCl	99.9	Sample 1.85
1.86	1.86	NaCl	99.9	Sample 1.86
1.87	1.87	NaCl	99.9	Sample 1.87
1.88	1.88	NaCl	99.9	Sample 1.88
1.89	1.89	NaCl	99.9	Sample 1.89
1.90	1.90	NaCl	99.9	Sample 1.90
1.91	1.91	NaCl	99.9	Sample 1.91
1.92	1.92	NaCl	99.9	Sample 1.92
1.93	1.93	NaCl	99.9	Sample 1.93
1.94	1.94	NaCl	99.9	Sample 1.94
1.95	1.95	NaCl	99.9	Sample 1.95
1.96	1.96	NaCl	99.9	Sample 1.96
1.97	1.97	NaCl	99.9	Sample 1.97
1.98	1.98	NaCl	99.9	Sample 1.98
1.99	1.99	NaCl	99.9	Sample 1.99
2.00	2.00	NaCl	99.9	Sample 2.00

APPENDIX B

Conversion of Calorific Values into Pounds of Equivalent Wood per Gallon

	<u>Kg. Cal./gm.</u>	<u>B.t.u./lb.</u>	<u>Specific Gravity</u>	<u>B.t.u./gal.</u>	<u>Lb. "Equivalent Wood"/Gallon</u>
1. Oil paints, white					
1 GP 9	3.4	6,130	2.34	143,000	18
1 GP 10	3.4	6,130	2.2	135,000	17
1 GP 28	3.4	6,130	1.77	108,000	14
2. Oil paints, solid colours					
1 GP 41	5.8	10,420	1.1-1.7	160,000	20
3. Enamels gloss					
Black	9.3	16,750	1.0-1.3	170,000	21
Dark brown #1, maroon, olive brown	8.4	15,100	"	170,000	21
Bright red	9.0	16,200	"	170,000	21
Orange, yellow	6.0	10,800	"	140,000	17
Green	7.9	14,200	"	185,000	23
Blue	7.9	14,200	"	170,000	21
Others	7.1	12,800	"	170,000	21
4. Flat paints	5.5	9,900	1.2-1.3	130,000	16
5. Priming paints for metal and wood					
1 GP 65					
1 GP 81	5.9	10,620	1.3-1.6	170,000	21
1 GP 84					
6. Enamel undercoater	5.5	9,900	1.2-1.3	130,000	16
7. Ammunition marking paints	5.3	9,550	1.5-2.0	170,000	21
8. Aluminum paints					
1 GP 69	9.4	16,920	1.0-1.1	170,000	21

APPENDIX B

Conversion of Calorific Values into Pounds of
Equivalent Wood per Gallon (Continued)

	<u>Kg. Cal./gm.</u>	<u>B.t.u./lb.</u>	<u>Specific Gravity</u>	<u>B.t.u./gal.</u>	<u>Lb. "Equivalent Wood"/Gallon</u>
9. Lacquers, pigmented 1 NB 93 C 28-13 et al	8.2	14,700	1.0	150,000	19
10. Asphalt varnish Brunswick Japan	10.6	19,100	0.9-1.0	190,000	24
11. Bituminous paints	10.4	18,720	0.9-1.0	190,000	24
12. Oleoresinous varnish 1 GP 18 1 GP 36 1 GP 99	10.5	18,900	0.9-1.0	190,000	24
13. Shellac	8.0	14,400	0.9	130,000	16
14. Sealers, clear	10.5	18,900	0.8-0.9	160,000	20
15. Tire black, enamel	9.3	16,700	1.0-1.1	170,000	21
16. Underbody compound	7.5	13,500	0.9-1.0	130,000	16
17. Stains in solution					
Spirit	7.1	12,800	0.8-0.9	110,000	14
Oil soluble (in mineral spirits)	11.3	20,300	"	160,000	20
N.G.R.	7.8	14,000	"	130,000	16
Water	0.0	0			

APPENDIX B

Conversion of Calorific Values into Pounds of Equivalent Wood per Gallon (Continued)

	<u>Kg. Cal./gm.</u>	<u>B.t.u./lb.</u>	<u>Specific Gravity</u>	<u>B.t.u./gal.</u>	<u>Lb. "Equivalent Wood"/Gallon</u>
18. Thinners					
Turpentine	10.0	18,000	0.8-0.9	155,000	19
Mineral spirits	11.25	20,300	"	155,000	19
Lacquer thinner (1 GP 50)	9.8	17,600	"	160,000	20
High solvency (1 GP 70)	10.5	18,900	--	160,000	20

APPENDIX C

Classification of Types of Paints According to Flash Point

Group 1 - Generally Highⁱⁿ Flash Point: (80°F. or over)

- Oil paints
- Flat paints
- Varnishes
- Bituminous paints
- Sealers
- Aluminum paints
- Tire black
- Oil soluble stains

Group 2 - Intermediate in Flash Point: Can be Above or Below 80°F.

- Enamels
- Priming paints
- Underbody compound

Group 3 - Low in Flash Point: Below 50°F.

- Lacquers
- Spirit stains
- Lacquer thinner
- High solvency thinner
- Shellac