DECOMPOSITION OF METHAM SODIUM TO METHYLISOTHIOCYANATE AS AFFECTED BY WOOD SPECIES, TEMPERATURE, AND MOISTURE CONTENT[1]

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ABSTRACT

The effect of various wood characteristics on decomposition of metham sodium to methylisothiocyanate in sixteen North American and Southeast Asian hardwoods and softwoods was investigated. While marked differences were noted in the degree of decomposition among some species, the relationship between decomposition and lignin content, extractive levels, wood pH, or 1% alkali solubility was slight within the various species. Wood moisture content had the greatest influence on decomposition, while temperature had a lesser effect. The results suggest that the wood environment could be manipulated to enhance metham sodium decomposition, thereby allowing dosage to be reduced or the period between applications to be prolonged.

Keywords: Fumigants, metham sodium, decomposition, wood chemistry, methylisothiocyanate.

INTRODUCTION

Metham sodium (32.1% sodium n-methyldithiocarbamate or NaMDC) is the most commonly used fumigant for controlling wood deterioration of large wood members in North America (Morrell and Corden 1986). This chemical is not particularly fungitoxic, but it becomes effective when it decomposes to produce fungicidal compounds. Potentially, thirteen decomposition products are possible, but only one, methylisothiocyanate (MITC), is considered to be important in fungal control in wood (Miller and Morrell 1990). MITC moves readily through most wood species, and its physical interactions with wood apparently produce long-term protection against fungal reinvasion (Zahora and Morrell 1989a, b).

Metham sodium is believed to decompose to MITC at a 40% efficiency rate; however, preliminary trials suggest that the rate is considerably lower (Zahora 1983). Decomposition is maximized at pH 9.5 and declines with increasing acidity (Turner and Corden 1963). Thus, the low pH of many wood species may adversely affect decomposition. Relatively low decomposition rates may help explain the inability to detect fungitoxic levels of MITC within 2 or 3 years of treating wood with metham sodium (Helsing et al. 1984). Preliminary small-block laboratory studies in which a number of softwoods and hardwoods were treated with metham sodium revealed a wide range of efficacy among the species tested (Morrell et al. 1992), suggesting that wood characteristics might affect metham sodium decomposition. In this paper, the effect of wood species on such decomposition is explored under controlled laboratory conditions.

MATERIALS AND METHODS

Samples were obtained from freshly sawn boards of the following North American and Southeast Asian softwoods and hardwoods:

[1] Paper 2903 of the Forest Research Laboratory, Oregon State University, Corvallis, OR. This paper reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate state and federal agencies before they can be recommended.

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Softwoods

Douglas-fir	[*Pseudotsuga menziesii* (Mirb.) Franco] (Coast and Rocky Mountain)
Loblolly pine	(*Pinus taeda* L.)
Sitka spruce	[*Picea sitchensis* (Bong.) Carr.]
Subalpine fir	[*Abies lasiocarpa* (Hook.) Nutt.]
Western hemlock	[*Tsuga heterophylla* (Raf.) Sarg.]
Western larch	(*Larix occidentalis* Nutt.)
Western redcedar	[*Thuja plicata* (Donn. ex D. Don)]
White fir	[*Abies concolor* (Gord. & Glend.) Lindl. ex Hildebr.]

Hardwoods

American beech	(*Fagus grandifolia* Ehrh.)
Apitong	[*Dipterocarpus grandiflorus* (Blanco)]
Bigleaf maple	(*Acer macrophyllum* Pursh)
Northern red oak	(*Quercus rubra* L.)
Red alder	(*Alnus rubra* Bong.)
Sycamore	(*Platanus occidentalis* L.)
Tangile	[*Shorea polysperma* (Blanco) Merr.]
White lauan	[*Parashorea malaanonan* (Blanco) Merr.]

The wood was ground to pass a screen with 2-mm-square mesh and was air-dried for one week to a MC of 7 to 9%. For each species, half of the wood remained dry and half was wetted to raise the MC to 50 to 100%. All wood was thoroughly mixed and equilibrated at 5 C for 6 weeks prior to testing. For both wet and dry wood of each species, 0.5 g of wood was added to each of 27 40-ml borosilicate vials, and 15 μl of metham sodium was added to each vial. Preliminary studies had shown that this dosage was sufficient to provide measurable decomposition, but low enough to permit quantification. The vials were sealed with plastic caps equipped with Teflon®-lined septa. The vials were incubated at 5, 23, or 32 C for one of three periods: 24, 48, or 144 h. At the end of each period, three vials per treatment combination were randomly selected and sampled. A headspace sample was removed from each vial and injected into a Varian 3700 Gas Chromatograph equipped with a flame photometric detector with filters specific for sulfur at the following conditions: injector temperature, 150 C; oven temperature, 100 C; detector temperature, 240 C, with nitrogen as the carrier gas (30 cm^3/min). A glass column (2-m by 2-mm inner diameter) packed with 10% carbowax 20M on 80/100 Supelcoport® solid support was employed. Sample sizes depended upon MITC concentration present. MITC levels were quantified by comparison with previously prepared standards.

After the air in the headspaces was sampled, the caps were removed and 3 ml of ethyl acetate was added to each vial. The ground wood in the vials was extracted for 15 minutes at room temperature, then the ethyl acetate extract was analyzed for MITC content as described above. Extraction periods were brief because, at longer periods, residual metham sodium in the wood tended to decompose in the ethyl acetate, artificially inflating the MITC levels.

The results for headspace analysis and wood extraction were used to calculate the air/wood ratio for MITC and to determine the total amount of MITC present in each vial at a given time. The latter results were divided by the total weight of metham sodium applied to produce a relative decomposition efficiency for each wood species.

The wood employed in these tests was further characterized by determining extractives content, Klason lignin content, and 1% alkali solubility according to ASTM Standards D1107-84, D1106-84, and D1109-84, respectively (American Society for Testing and Materials 1991a, b, c). Wood pH was determined by adding one volume of wood to five volumes of distilled water and measuring the pH of the resulting solution with a Corning 150 pH/ion meter (Farmer 1967). These measurements were made on three samples per wood species. The results of these analyses were regressed against average metham sodium decomposition at 48 h, the point when the highest levels of MITC were detected with most species, to determine if there were any relationships between wood chemistry and metham sodium decomposition.

The data were also subjected to an analysis of variance to determine the effects of temperature, time, and moisture on metham sodium decomposition. Interactions between species limited statistical comparisons; however, it was possible to examine the effects of the remaining variables on metham sodium decomposition. Comparisons were made by using the Student-Newman-Keuls multiple-comparison test at $\alpha = 0.05$.

RESULTS AND DISCUSSION

Metham sodium decomposition to MITC in dry wood was extremely low, ranging from 2.5 to 28.4% of the original dosage (Table 1). These levels are far lower than the theoretical yield and may result from the absence of moisture in the wood. MITC air/wood ratios generally ranged between 0.0003 and 0.2342 (data not shown), reflecting the high affinity this chemical has for wood even after prolonged extraction (Zahora and Morrell 1989a, b). In general, metham sodium decomposition was significantly greater in wet wood for all treatments and species (Table 2). Decomposition efficiencies in wet wood ranged from 10.2% for the 23 and 32 C red alder treatments after 144 h to 69.7% for the 23 C white fir treatment after 48 h. These improved efficiencies reflect the need for some water for decomposition to proceed (Lebow and Morrell 1993).

Improved decomposition efficiency in wet wood is a major asset for decay control since most decay fungi would become active there. Increased dosages would produce more rapid fungal control, thereby minimizing the risk of continued wood degradation. Slower decomposition in dry wood might provide a reservoir of unreacted chemical for later decomposition, although the ability of crystalline metham sodium to decompose in wood after liquid treatment has never been explored.

MITC levels in dry wood were generally lowest in the 5 C treatments and increased with increasing incubation temperature. Although increased temperature should enhance reaction rates, differences between the 23 and 32 C treatments were sometimes slight, indicating that temperature had a limited effect on decomposition. MITC levels in wet wood differed little with temperature, suggesting that decomposition was affected to a greater degree by moisture than by temperature.

While many in-service poles are treated during the warmer summer months, pole treatments sometimes extend into periods of inclement weather when lower temperatures could affect metham sodium decomposition. Lower temperatures would not appear to be detrimental in wet wood unless the wood froze; however, they might slow the release of MITC in drier wood.

Faster decomposition at elevated temperatures might improve the rate at which MITC moved through the wood to eliminate established decay fungi; however, the rapid release rate might also result in a more rapid loss from the wood, in turn resulting in a shorter protective period. This prospect has been investigated under tropical conditions in the Philippines, where metham sodium has performed very erratically (M. Y. Giron and J. J. Morrell unpublished). Our laboratory results suggest that, in dry wood, metham sodium decomposition is higher at elevated than at lower temperatures but that, in wet wood, this difference is minimal. Thus, the inability of metham sodium to provide protection under more tropical regimes may reflect a more active and chemically tolerant soil flora rather than an absence of chemical in the wood.

MITC levels in both air and dry wood generally increased over the 144-h period, although some declines were noted between 48 and 144 h. MITC levels in wet wood tended to increase for the first 48 h, then declined.

TABLE 1. *Effect of wood species and temperature on decomposition of metham sodium (NaMDC) to MITC after various periods in dry and wet wood.*

Species and temperature (C)	24 h				48 h				144 h			
	Dry wood		Wet wood		Dry wood		Wet wood		Dry wood		Wet wood	
	Total MITC[1] (μg)	NaMDC decomp. (%)	Total MITC[1] (μg)	NaMDC decomp. (%)	Total MITC[1] (μg)	NaMDC decomp. (%)	Total MITC[1] (μg)	NaMDC decomp. (%)	Total MITC[1] (μg)	NaMDC decomp. (%)	Total MITC[1] (μg)	NaMDC decomp. (%)
Softwoods												
Douglas-fir (Coast)												
5	388 (127)	6.4	3,023 (2,535)	50.1	347 (197)	5.8	2,210 (15)	36.6	451 (141)	7.5	2,119 (27)	35.1
23	503 (83)	8.3	2,067 (18)	34.3	309 (39)	6.1	2,255 (90)	37.4	407 (66)	6.7	2,018 (153)	33.4
32	460 (61)	7.6	1,976 (189)	32.7	492 (153)	8.2	2,172 (54)	36.0	840 (405)	13.9	1,816 (63)	30.1
Douglas-fir (Rocky Mt.)[2]												
5	152 (55)	2.5	—	—	346 (17)	5.7	—	—	314 (8)	5.2	—	—
23	780 (542)	12.9	—	—	347 (49)	5.8	—	—	615 (114)	10.2	—	—
32	470 (57)	7.8	—	—	1,118 (265)	18.5	—	—	963 (109)	16.0	—	—
Loblolly pine												
5	473 (94)	7.8	1,228 (836)	20.4	630 (98)	10.4	2,247 (8)	37.2	714 (211)	11.8	2,024 (108)	33.5
23	748 (336)	12.4	2,120 (122)	35.1	608 (104)	10.1	2,258 (107)	37.4	1,215 (20)	20.1	1,412 (371)	23.4
32	685 (108)	11.3	1,511 (509)	25.0	992 (56)	16.4	1,242 (705)	20.6	1,486 (98)	24.6	1,480 (39)	24.5
Sitka spruce												
5	586 (178)	9.7	2,023 (138)	33.5	697 (232)	11.5	1,974 (69)	32.7	332 (53)	5.5	2,044 (129)	33.9
23	604 (26)	10.0	1,885 (157)	31.2	703 (35)	11.6	2,150 (56)	35.6	1,242 (386)	20.6	1,746 (34)	28.9
32	917 (60)	15.2	2,080 (31)	34.5	1,012 (85)	16.8	2,693 (959)	44.6	1,059 (154)	17.5	1,692 (47)	28.0
Subalpine fir												
5	456 (170)	7.5	1,824 (32)	30.2	837 (103)	13.9	2,203 (175)	36.5	718 (51)	11.9	3,052 (85)	50.6
23	1,000 (574)	16.6	2,194 (222)	36.4	809 (57)	13.4	1,936 (111)	32.1	1,028 (371)	17.0	1,600 (67)	26.5
32	802 (56)	13.3	2,203 (73)	36.5	1,264 (169)	20.9	1,714 (207)	28.4	1,231 (67)	20.4	1,274 (503)	21.1
Western hemlock												
5	332 (43)	5.5	2,350 (1,322)	38.9	590 (169)	9.8	2,086 (159)	34.6	476 (72)	7.9	1,115 (109)	18.5
23	945 (155)	15.7	3,543 (844)	58.7	986 (111)	16.3	1,955 (191)	32.4	726 (117)	12.0	1,023 (74)	16.9
32	1,196 (37)	19.8	2,760 (1,160)	45.7	1,150 (136)	19.1	1,585 (119)	26.3	1,023 (54)	16.9	737 (87)	12.2
Western larch												
5	226 (121)	3.7	2,267 (60)	37.6	753 (96)	12.5	2,217 (13)	36.7	595 (50)	9.9	1,757 (58)	29.1
23	757 (48)	12.5	1,950 (275)	32.3	1,629 (186)	27.0	1,920 (135)	31.8	708 (93)	11.7	1,610 (67)	26.7
32	776 (111)	12.9	1,851 (69)	30.7	1,495 (141)	24.8	1,816 (123)	30.1	604 (159)	10.0	1,441 (65)	23.9

TABLE 1. *Continued.*

Species and temperature (C)	24 h				48 h				144 h			
	Dry wood		Wet wood		Dry wood		Wet wood		Dry wood		Wet wood	
	Total MITC[1] (μg)	NaMDC decomp. (%)	Total MITC[1] (μg)	NaMDC decomp. (%)	Total MITC[1] (μg)	NaMDC decomp. (%)	Total MITC[1] (μg)	NaMDC decomp. (%)	Total MITC[1] (μg)	NaMDC decomp. (%)	Total MITC[1] (μg)	NaMDC decomp. (%)
Western redcedar												
5	1,284 (45)	21.3	2,370 (248)	39.3	928 (36)	15.4	2,306 (453)	38.2	1,041 (187)	17.2	964 (175)	16.0
23	1,006 (69)	16.7	2,583 (159)	42.8	718 (33)	11.9	3,235 (811)	53.6	534 (106)	8.8	1,494 (294)	24.8
32	1,002 (95)	16.6	2,511 (331)	41.6	909 (52)	15.1	2,620 (188)	43.4	864 (45)	14.3	1,262 (127)	20.9
White fir												
5	472 (309)	7.8	2,675 (797)	44.3	316 (148)	5.2	3,819 (275)	63.3	633 (24)	10.5	2,517 (64)	41.7
23	790 (135)	13.1	2,905 (382)	48.1	758 (89)	12.6	4,209 (185)	69.7	833 (89)	13.8	2,181 (253)	36.1
32	926 (165)	15.3	2,581 (312)	42.8	604 (87)	10.0	2,119 (538)	35.1	659 (49)	10.9	1,744 (214)	28.9
Hardwoods												
American beech												
5	302 (66)	5.0	1,751 (963)	29.0	745 (38)	12.3	1,557 (941)	25.8	973 (111)	16.1	2,241 (361)	37.1
23	850 (150)	14.1	2,165 (86)	35.9	1,008 (80)	16.7	2,135 (108)	35.4	1,611 (849)	26.7	1,968 (187)	32.6
32	673 (24)	11.2	2,200 (78)	36.5	1,114 (161)	18.5	2,232 (58)	37.0	1,320 (210)	21.9	1,714 (38)	28.4
Apitong												
5	498 (32)	8.3	3,064 (63)	50.8	397 (52)	6.6	3,168 (45)	52.5	668 (80)	11.1	3,665 (123)	60.7
23	647 (35)	10.7	2,777 (103)	46.0	723 (19)	12.0	2,731 (127)	45.3	683 (32)	11.3	2,436 (64)	40.4
32	747 (46)	12.4	2,549 (80)	42.2	877 (54)	14.5	2,447 (156)	40.5	905 (32)	15.0	2,209 (157)	36.6
Bigleaf maple												
5	406 (108)	6.7	2,123 (54)	35.2	991 (45)	16.4	2,354 (68)	39.0	1,040 (71)	17.2	2,864 (79)	47.5
23	716 (53)	11.9	2,558 (188)	42.4	1,047 (136)	17.3	2,165 (158)	35.9	1,226 (86)	20.3	1,993 (564)	33.0
32	732 (81)	12.1	2,513 (23)	41.6	1,484 (140)	24.6	2,015 (146)	33.4	1,393 (109)	23.1	1,640 (801)	27.2
Northern red oak												
5	567 (156)	9.4	2,133 (17)	35.3	1,164 (55)	19.3	2,145 (150)	35.5	1,561 (143)	25.9	1,775 (63)	29.4
23	1,103 (240)	18.3	2,075 (283)	34.4	1,028 (121)	17.0	2,434 (29)	40.3	1,163 (224)	19.3	1,385 (46)	22.9
32	1,350 (87)	22.4	2,139 (264)	35.4	1,410 (409)	23.4	2,004 (17)	33.2	1,717 (227)	28.4	1,232 (75)	20.4
Red alder												
5	267 (93)	4.4	894 (181)	14.8	684 (88)	11.3	1,062 (172)	17.6	703 (5)	11.6	—	—
23	1,183 (587)	19.6	1,044 (64)	17.3	881 (41)	14.6	1,240 (19)	20.5	794 (64)	13.2	614 (16)	10.2
32	978 (248)	16.2	1,241 (172)	20.6	1,408 (560)	23.3	895 (40)	14.8	1,377 (240)	22.0	615 (15)	10.2

TABLE 1. *Continued.*

Species and temperature (C)	24 h				48 h				144 h			
	Dry wood		Wet wood		Dry wood		Wet wood		Dry wood		Wet wood	
	Total MITC[1] (μg)	NaMDC decomp. (%)	Total MITC[1] (μg)	NaMDC decomp. (%)	Total MITC[1] (μg)	NaMDC decomp. (%)	Total MITC[1] (μg)	NaMDC decomp. (%)	Total MITC[1] (μg)	NaMDC decomp. (%)	Total MITC[1] (μg)	NaMDC decomp. (%)
Sycamore												
5	307 (9)	5.1	2,082 (309)	34.5	299 (112)	4.9	2,487 (108)	41.2	547 (147)	9.1	1,665 (90)	27.6
23	461 (232)	7.6	2,496 (69)	41.4	696 (14)	11.5	3,156 (231)	52.3	—	14.9	1,711 (166)	28.3
32	1,099 (240)	18.2	2,202 (146)	36.5	1,341 (168)	22.2	2,290 (24)	38.0	1,553 (208)	25.7	1,604 (43)	26.6
Tangile												
5	1,029 (212)	17.0	1,483 (951)	24.6	756 (76)	12.5	2,703 (690)	44.8	377 (14)	6.2	2,215 (363)	36.7
23	1,203 (29)	19.9	1,583 (304)	26.2	877 (52)	14.5	1,948 (301)	32.3	563 (60)	9.3	2,098 (153)	34.8
32	962 (116)	15.9	1,504 (60)	24.9	987 (106)	16.3	2,556 (301)	42.4	725 (62)	12.0	1,483 (155)	24.6
White lauan												
5	462 (38)	7.6	3,434 (87)	56.9	521 (77)	8.6	3,145 (480)	52.1	772 (21)	12.8	3,947 (192)	65.4
23	1,096 (69)	18.2	2,546 (283)	42.2	969 (98)	16.1	2,207 (68)	36.6	980 (56)	16.2	2,267 (355)	37.6
32	1,284 (86)	21.3	2,793 (91)	46.3	976 (65)	16.2	3,115 (298)	51.6	817 (297)	13.5	2,491 (614)	41.3

[1] Mean (SD).
[2] Wet wood of Rocky Mountain Douglas-fir was not tested.

TABLE 2. *Effects of wood moisture content on decomposition of metham sodium to MITC at selected times and temperatures.*

Time and temperature (C)	MITC (μg/g of oven-dried wood)[a]			
	Dry wood		Wet wood	
	n	Avg.	n	Avg.
Day 1				
5	57	490	35	1,898*
23	57	813	36	2,201*
32	57	865	36	2,046*
Day 2				
5	57	613	36	2,234*
23	57	802	36	2,408*
32	57	1,052	36	2,019*
Day 3				
5	57	677	33	1,858*
23	55	923	36	1,605*
32	57	1,088	36	1,402*

[a] Values reflect means of MITC levels for the 17 species tested.
* indicates a significant difference (0.05 level) between MITC concentrations in dry and wet wood at a given time and temperature.

The vials used in these studies tended to lose some MITC with time as a result of small leaks, which may account for the gradual decline in MITC level between 48 and 144 h.

Wood species exerted a major influence on decomposition efficiency in both wet and dry wood (Table 3). A comparison of average metham sodium decomposition for each wood species after 48 h (all temperatures combined) indicated that, in dry wood, decomposition efficiency was slightly higher in hardwoods than in softwoods, but the opposite was noted in wet wood. In some instances, wet wood had a marked effect on decomposition. For example, metham sodium decomposition was only 6.7% in dry Coast Douglas-fir but increased to 36.7% in wet wood of this variety. Examination of decomposition means suggested that MITC levels did not differ significantly among many of the species tested (Table 3), although among the softwoods white fir and subalpine fir were associated with significantly higher decomposition levels in wet wood, while among the hardwoods northern red oak produced significantly higher decomposition levels in dry wood. The low level of decomposition in dry Coast Douglas-fir, which is among the woods

TABLE 3. *Extractives content, Klason lignin level, wood pH, and 1% alkali solubility of the tested wood species in relation to the decomposition of metham sodium (NaMDC) to MITC in wet and dry wood. Data for the three temperatures are combined at the 48-h time-point.*

Wood species	Extractives[1] (%)	Klason lignin[2] (%)	Alkali solubility[3] (%)	Wood pH[4]	NaMDC decomposition[5] (%)	
					Dry	Wet
Softwoods						
Douglas-fir (Coast)	4.88	31.5	—	—	6.7 F	36.7 B
Douglas-fir (Rocky Mt.)	4.91	—	21.43	3.3	10.0 EF	— —
Loblolly pine	3.46	35.8	14.25	4.1	12.3 BCDE	31.7 B
Sitka spruce	2.37	28.9	14.27	4.1	13.3 BCDE	37.6 B
Subalpine fir	3.26	30.1	15.19	4.6	16.1 BCD	60.8 A
Western hemlock	3.43	30.2	17.85	5.6	15.1 BCDE	31.1 B
Western larch	2.25	34.5	21.94	4.6	21.4 BCDE	36.8 B
Western redcedar	—	—	25.08	3.6	14.1 BCD	45.1 B
White fir	2.60	34.7	16.22	5.0	9.3 CDEF	56.0 A
Hardwoods						
American beech	1.29	23.9	19.00	5.3	15.8 BC	32.9 B
Apitong	2.32	29.8	16.24	4.1	11.0 CDEF	— —
Bigleaf maple	0.82	25.5	17.91	5.5	19.4 B	36.1 B
Northern red oak	4.74	26.3	22.21	4.3	19.9 A	36.3 B
Red alder	2.94	31.2	18.92	4.5	16.4 BCD	17.6 C
Sycamore	1.54	22.1	20.19	5.1	12.9 BCDE	43.8 B
Tangile	1.84	35.9	13.96	4.3	14.4 BCDE	39.8 B
White lauan	2.10	31.0	13.98	4.4	13.6 BCDE	32.9 B

[1] As determined by ASTM Standard D1107-84.
[2] As determined by ASTM Standard D1106-84.
[3] As determined by ASTM Standard D1109-84.
[4] As measured by placing 5 parts of distilled water in 1 part of wood and measuring pH of the solution. Values represent means of 3 replicates.
[5] Based upon application of 15 μl of 40% NaMDC to 0.5 g of each wood species and measuring MITC production 48 h later. Within the softwood and hardwood groups, values followed by the same letter indicate that decomposition over the three temperatures tested does not differ significantly by Student-Newman-Keul's multiple-comparison test at $\alpha = 0.05$.

most commonly treated with fumigants (Morrell and Corden 1986), suggested that there is considerable potential for improving decomposition efficiency through the use of additives. These additives might increase wood pH or alter moisture-holding capacity in wood adjacent to the treatment site.

Although many wood characteristics may affect metham sodium decomposition, there seems to be slight relationship between such decomposition and lignin content, extractives levels, wood pH, and 1% alkali solubility (Table 4). Regressions run after 48 h indicated that these wood characteristics were poorly correlated with decomposition. The highest correlations were between decomposition and both extractives content and 1% alkali solubility, but even these values were low, suggesting that other factors were more influential. Wood presents an astounding array of polymer interrelationships, and decomposition efficiency may reflect interactions between these constituents. One characteristic that should have a strong influence on decomposition is pH; however, the pHs measured in the species tested were all acidic. Since metham sodium decomposition improves as pH increases, it is likely that none of the pHs were adequate for optimum decomposition.

TABLE 4. *Correlations after 48 h between wood characteristics and metham sodium decomposition in dry and wet samples of the tested softwoods and hardwoods.*

Wood characteristics	Correlation (r^2)			
	Dry		Wet	
	Softwoods	Hardwoods	Softwoods	Hardwoods
Klason lignin	0.000	0.052	0.005	0.090
Extractives content	0.408	0.091	0.040	0.065
1% alkali solubility	0.567	0.280	0.004	0.001
Wood pH	0.170	0.132	0.082	0.012

CONCLUSIONS

The results indicate that temperature and wood species exert substantial influences on the efficiency of metham sodium decomposition. They also suggest that widespread application of fumigants to woods must be preceded by preliminary testing to determine if the characteristics of those woods make them amenable to treatment. These and other results also indicate that there is potential for improving the efficiency of metham sodium decomposition to the theoretical level. A separate study, for example, suggests that application of pelletized metham sodium in combination with buffers at pH 7 or 10 enhances performance as measured by degree of fungal control and residual MITC level (Sexton et al. 1991). Optimizing decomposition efficiency could help reduce dosages or, conversely, could extend the periods between treatments.

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