ALTERNATIVE CHEMICALS FOR THE CONTROL OF SAPSTAIN IN FRESHLY CUT LUMBER

by J. Yuster

Troy Chemical, New Jersey, U.S.A.

The preparation of lumber for export is one of the largest industries in Western Canada. Of prime importance to this industry is the prevention of sapstain on the lumber during transport.

The current products which are in use internationally for sapstain control fall into the chemical class known as the substituted phenols. Specifically, the three major substituted phenols in use are: pentachlorophenol (PCP), sodium pentachlorophenol (NaPCP), and sodium tetrachlorophenol (NaTCP). The product used most commonly in Western Canada is a mixture consisting of 80% NaTCP and 20% NaPCP. Recently, there has been much concern about the toxicity of the substituted phenols. This has prompted a search to find a replacement for these chemicals.

Today, I would like to review some of the available data with reference to five possible alternatives. These five alternatives are: 1) methylene bisthiocyanate (MBT), 2) sodium tribromophenate (TBP), 3) 2-(thiocyanomethylthio)benzothiazole (TCMTB), 4) 3-iodo-2-propynyl butyl carbamate (IPBC), and 5) copper-8-quinolinolate (Cu-8). These materials are listed in Table 1. Specifically, we shall review the data available on these materials for acute toxicity, environmental toxicity, and efficacy.

Acute toxicity data is generally accessible and provides a good indication of the immediate risks to workers exposed to these materials. Probably the most well known, and most widely used acute toxicity measure is the LD_{50}. The LD_{50} is the amount of material which could be injested orally per kilogram of body weight, before a 50% chance of death results. Figure 1 shows the acute LD_{50}'s for each of these materials as supplied. For a point of reference we have included the LD_{50} of common table salt (NaCl). What in reality does this LD_{50} data mean?

Figure 2 attempts to answer this question. In this figure we show the LD_{50}'s of these chemicals for a 160 lb. (73 kg) man. In other words, how many ounces of these chemicals, as supplied, could a 160 lb. (73 kg) man drink before he had reached a 50% chance of fatality. The amount for a TCP/PCP mix would be 0.5 ounces or about 15 ml. A disturbing fact to note is that two of the alternatives namely MBT and TBP have LD_{50}'s which are the same as the TCP/PCP mix. This means that in terms of oral toxicity these materials are as hazardous as the ones they replace. The other alternatives range between 8 - 13 times less toxic.

Another acute toxicity measure is skin irritation. Table 2 presents the skin irritation ratings for the five chemicals. It is difficult to assess the difference between mild and moderate skin irritant. Obviously, one would like the least irritating chemical possible, especially in this industry where heavy skin contact is imminent.

The final acute toxicity measure I will cover is eye irritation. In order to understand the ratings it is necessary to define several terms. There are three possible ratings that can be assigned: non-irritating, irritating, and corrosive. An *irritating* substance is one which produces redness or swelling of the eye which *reverses completely* with no remedial treatment. It should be noted that this redness or swelling does not refer to the cornea. The occurrence of "redness or swelling" is analagous to a person getting a piece of dust in his eye. A *corrosive* rating signifies that a substance causes damage to the cornea which does not reverse itself. Table 3 shows eye irritation ratings for five anti-sapstain chemicals. All of the chemicals reviewed were corrosive to the eyes with the exception of the IPBC material.

Environmental toxicity is very important in this industry as most of the Canadian sawmills are in close proximity to water. Table 4 shows the acute toxicity of these anti-sapstain chemicals for fish and fowl. For reference the LD_{50} of TCP for rainbow trout is 0.04 - 0.06 ppm. TCMTB is two times and IPBC is nine times less toxic to fish than TCP. Cu-8, TCMTB, and IPBC are 100 to 300 times less toxic to avian species than Dieldrin. In summary, these alternatives appear to offer significant environmental advantages.

Regarding the question of efficacy and effectiveness. I would like to point out that many factors can effect the performance of an anti-sapstain chemical. Some of the most important factors are: 1) the way in which the chemical is formulated, 2) the wood species treated, 3) the weather conditions where the lumber is treated, 4) the condition of the lumber itself (e.g., rough vs. surfaced or green vs. dried) and 5) the method of application of the chemical.

Table 5 presents a summary of efficacy data for these chemicals. I must preface my discussion of this data by noting that all of these chemicals were not run at one time and under the same conditions. This shortcoming has since been alleviated with the completion of a study undertaken by Forintek Canada Corp. in which all five of the chemicals reviewed in this paper were evaluated. The preliminary evaluation of the data available although inconclusive, indicates that each of these materials is at least as efficacous as PCP, and most are more effective.

It is possible that no one chemical will be able to handle the diverse requirements of the Canadian wood market. Rather, it is likely several of these chemicals or perhaps a combination approach will meet the need for effective protection with reduced environmental and health risks.

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Figure 1 : ACUTE SINGLE DOSE LD50

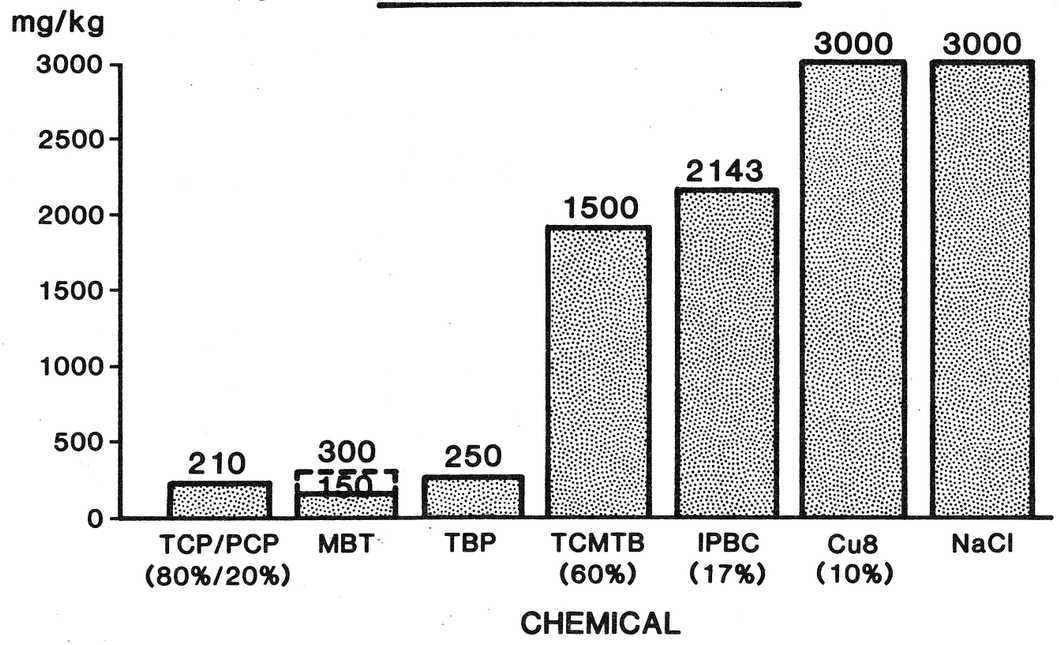

Figure 2 : LD50 FOR 160 LB (73kg) MAN

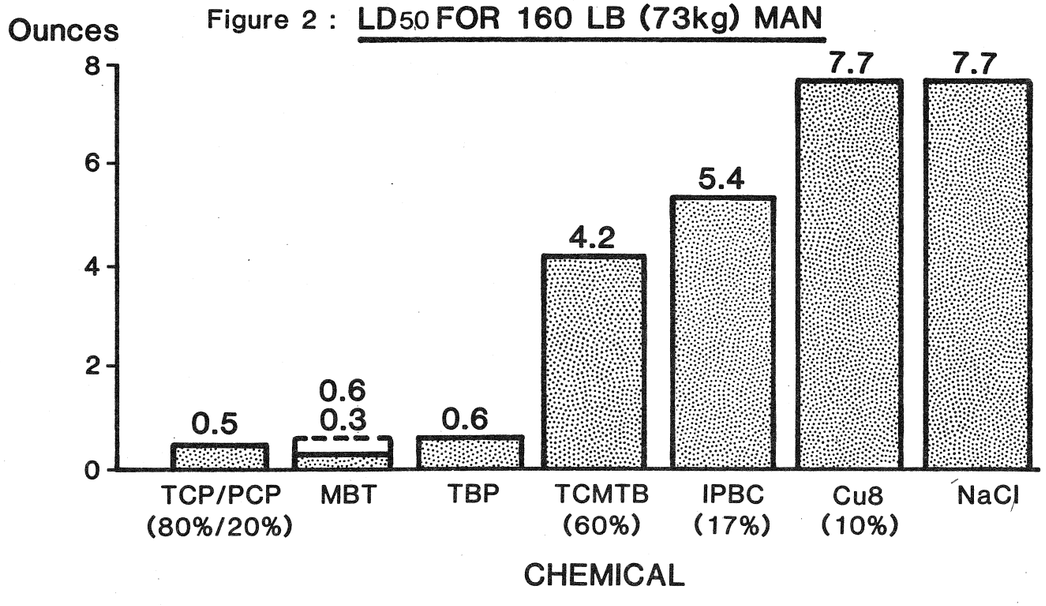

Table 1 — ALTERNATIVE CHEMICALS FOR SAPSTAIN CONTROL

Generic name	Trade name	Manufacturer	Concentration as supplied	Use concentration
pentachlorophenol/ tetrachlorophenol	49 - 167	Reichhold	20/80	a.i. 0.5
methylene bisthiocyanate		Comcor		0.3 - 0.5
sodium tribromophenol		Velsicol		0.5
2 - (thiocyanomethylthio) benzothiazole	Busan 30	Buckman	30	0.2 - 1.0
3 - iodo - 2 - propynyl butyl carabamate	17% Troysan Polyphase WD	Troy	17	0.5 - 1.0
copper - 8 - quinolinolate	Nylate - 10 PQ - 8	Seymour Chapman	10% 5%	0.02 - 0.05

Table 2 — SKIN IRRITATION

Chemical	Concentration as supplied	Rating
TCP/PCP	94%	Moderate
MBT		Moderate
TBP		Moderate
TCMTB	60%	Moderate
IPBC	17%	Mild
Cu - 8	5%	Moderate

Table 3 — EYE IRRITATION, UNWASHED

Chemical	Concentration as supplied	Rating
TCP/PCP	94%	Irritating and corrosive
MBT		Irritating and corrosive
TBP		Irritating and corrosive
TCMTB	60%	Irritating and corrosive
IPBC	17%	Irritating
Cu - 8	5%	Irritating and corrosive

Table 4 — TOXICOLOGY FOR FISH AND FOWL

Concentration product	LC_{50} trout (ppm)	LC_{50} sunfish (ppm)	8 day dietary quail (ppm)	8 day dietary duck (ppm)
DDT	0.0044	0.0074		
Dieldrin			30	84.4
Copper - 8 - quinolinolate (10%)			3,934	10,000
TCMTB (60%)	0.029	0.047	10,000	10,000
IPBC (40%)	0.31	1.24	7,683	7,182

Table 5 — ACTIVE INGREDIENT FOR EQUIVALENT PERFORMANCE

	Cserjesi (1978)		Cassens & Eslyn (1980)	Butcher (1973)	Butcher & Drysdale (1978)	Cserjesi Johnson (1981)
	Rough	Surfaced				
TCP/PCP	0.5%	1.5%	2	0.5 + 1.5 borax	0.5 + 1.5 borax	0.5
MBT	0.2%	0.6%	—	—	0.5%	0.2
TCMTB	0.6	1.8	—	0.1 - 0.25	0.3	0.6
Cu - 8	—	—	0.02%	—	0.05	0.022 - 0.064*
TBP	0.4	1.2	—	0.5	—	0.4
IPBC	—	—	between 0.25 - 0.50	—	—	—
Exposure/ conditions:	Field	Field	Laboratory	Laboratory	Laboratory	Field
Wood Species:	hemlock	hemlock spruce-pine	yellow poplar	Radiata pine	Radiata pine	Averaged results Douglas-fir hem-fir spruce-pine-fir

* Excluding Douglas-fir