A SURVEY OF ANTI-SAPSTAIN AND ANTI-BORER CHEMICALS USED AT SAWMILLS IN GHANA

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ABSTRACT

A survey of 50 different sized sawmills in and around Kumasi (Ashanti region) and Takoradi (Western region) indicated that as many as eight anti-sapstain and 10 anti-borer chemicals were used mostly by dipping application for the control of sapstain and borer attack in white coloured logs and sawn timber species. Nearly 38 % of the companies still use pentachlorophenol and its derivatives, in spite of their hazardous nature and their ban in many countries. Problems associated with the use of chemicals at sawmills include safety measures associated with handling of chemicals, disposal of effluent, checking of chemical concentration being used for treatment and handling of treated wood. The development of periodic workshops for treatment plant workers to address these and other problems in the industry is recommended. It is further recommended that a search for effective antisapstain and antiborer chemicals be made to replace the banned pentachlorophenol.

Keywords: Anti-sapstain, anti-borer, organochlorides, prophylactic, timber

INTRODUCTION

Sapstain and borer attack on Ghanaian hardwoods constitute an enormous economic loss to Ghana that is estimated to cost the country millions of dollars annually (Addo-Ashong & Ampong, 1975). Sapstain is caused by species of Ascomycetes and Fungi imperfecti that mainly discolour the sapwood and white coloured timbers (Findlay, 1975). In Ghana, sapstain occurs extensively in light coloured species with or without discernible heartwood such as Wawa (*Triplochiton scleroxylon*), Kyere (*Pterygota macrocarpa*) and Kyenkyen (*Antiaris toxicaria*). Sapstain reduces the decorative appearance and leads to downgrading, resulting in reductions in value of wood (Scheffer, 1973). Freshly cut logs and sawn timber of such timber species need to be prophylactically treated or promptly dried to moisture contents below the fibre saturation point to avoid attack (Zabel & Morrell, 1992; Panell, 1963).

Pinhole borers, which may cause structural damage to starch containing hardwoods, belong to the entomological families of *Platypodidae* and *Scotylidae*. These beetles are capable of attacking standing trees, freshly cut logs and lumber in Ghana but cannot initiate attack in dry timber or in well preserved wood. Susceptible timbers in Ghanaian sawmills are given prompt prophylactic treatment using anti-borer insecticide or a mixture of anti-borer and antisapstain chemicals. Treated wood is then air or kiln dried before being used locally or exported.

Until recently, the most effective and widely used chemical to control sapstain in Ghana was the sodium salt of pentachlorophenol. This chemical is slightly soluble in water and slightly volatile so that it can achieve control beyond the depth that it penetrates (Scheffer & Lindgren, 1940). The use of this chemical, however, is banned or restricted in many countries because of the presence of dioxins. Some dioxins are highly toxic to most life forms including humans and most are very persistent in the environment (USDA, 1980; Rao, 1978). Therefore a number of alternative chemicals have been introduced and some of these are being used at sawmills in Ghana. However, chemicals that are effective in temperate countries may not be as effective under Ghanaian tropical conditions although many manufacturers base chemical efficacy on their experience with temperate conditions. The reasons for this are many, including differences in composition of infecting flora, different wood species, environmental conditions and different methods of chemical application and handling of wood after processing. There is little knowledge of current Ghanaian treatment practices, making it difficult to determine how to help improve chemical usage at mills. Therefore, we conducted a survey to document the chemicals used at the sawmills and to ascertain application methods and perceptions of efficacy.

METHODOLOGY

Sixty sawmills representing four different sized companies were selected from the urban centres of Kumasi and Takoradi, the two most important metropolitan centres for wood processing. A questionnaire prepared by the research team was supplied to saw millers. In addition, personal observations were made during mill inspections to verify answers to the questionnaire given by the millers. Observations were centred on treatment procedures, treatment schedules, handling methods after processing, methods of effluent disposal and ascertaining the concentration of the various chemicals used at the mills.

Sawmills Visited

Fifty of the sixty sawmills surveyed provided responses. The few that did not were either suspicious of our intentions or had thought only *Triplochiton scleroxylon* (wawa) needed prophylactic treatment and since they were not processing wawa, they could not be bothered.

Companies' Profiles

All the respondent sawmills were producers of lumber. In addition, 48 % were also producing other wood products like plywood, veneer and furniture. The number of employees in the responding companies ranged from 35 to over 1,500 (Table 1). Thirty four (68%) of the responding companies were from Kumasi in the Ashanti Region and 16 (32%) from Takoradi in the Western Region of Ghana.

Source and Type of Prophylactic Chemical

Prophylactic chemicals are special fungicides and insecticides that are used for temporary protection of logs and sawn timber against incidence of sapstain and borer infestation. They include antioxidants and fumigants (Kitchens & Amburgey, 1966). Table 2 shows the trade names of various chemicals that were in use at the responding sawmills at the time of the survey in June 1998. Table 3 shows the anti-borer chemicals in use. These tables also show, where available, the active ingredients of the chemicals use for stain and borer control, the recommended concentrations, the average number of years that the chemicals have been used and the local suppliers. Figures 1 and 2 show the percentage distribution of anti-sapstain chemicals and anti-borer chemicals in use at responding sawmills. The chemicals, Fossilit G1 and Maxyl SE 3 both serve as anti-sapstain and anti-borer chemicals. Two respondents also use fumigants when lumber is shipped in containers for export. The fumigants, Venelo and Gastoxin, come in the form of volatile tablets marketed locally. However, methyl bromide, one of the effective common fumigants was not in use.

Figure 3 shows the percentage distribution of past users of anti-sapstain and anti-borer chemicals at respondent sawmills. Apart from Fossilit EC and Fossilit G1, which are marketed by a company in Abidjan in Côte d'Ivoire, all the chemicals have local agents marketing them. Forty percent of the sawmills have used their preferred chemicals for over 5 years, which is an indication of the trust they have in their choice of chemical (Tables 2 & 3).

TABLE 1

Level of Work Force in Sawmills Responding to Our Survey

Class	Employee Population	Kumasi Respondents	Takoradi Respondents
1	Under 100	8	2
2	100 – 150	24	4
3	500 – 1000	2	8
4	Over 1000	0	2
Total		34	16

TABLE 2

Anti-sapstain Chemicals Used in Ghana's Wood Industry Sector

Chemical Trade Name	Number of Respondent Users	Active Ingredient	Manufacturer's Recommended Concentration %	Average Number of Years Used	Suppliers
Manro *	14	Sodium pentachlorophen-ate /Borax	2	3	Mayfair, Accra
Antiblu 3737	16	Methylene bis-thiocynate, /Boric acid	2.5	8	Mayfair, Accra
Bumper 25EC	4	Propiconazole	3	2	Dizengoff, Accra
Fossilit L4 *	4	Sodium pentachlorophenate	2.5	5	Good Choice, Kumasi
Protecta AB	4	___♣	3	4	Arbor Nova, Takoradi
Fossilit GI	4	___♣	1.0	4	Sadafoss, Abidjan
Basiment 540	2	Methylene-bisthiocynate	3-4	10	C. Woermann, Accra
Maxyl SE 3	2	Chlorothalonil /carbendazim	2-4	2	Chemagro, Accra

* Non-recommended chemicals containing PCP or its derivatives

♣ Information was not available from manufacturer

TABLE 3

Anti-borer Chemicals Used in Ghana's Wood Industry Sector

Chemical Trade Name	Number of Respondent Users	Active Ingredient	Manufacturer's Recommended Concentration %	Average Number of Years Used	Suppliers
Hicksons 200	16	Lindane	0.5	3	Mayfair, Tema
Pyrinex 48 EC	16	Chlorpyrifos	1.0	3	Dizengoff, Accra
Anti-borer 3767	6	Synthetic pyrethroid	0.5	7	Mayfair, Accra
Dursban 4E	4	Chlorpyrifos	1.0	2	Mayfair, Accra
Basiment 475	2	Phoxim	2.5	10	C Woermann, Accra
Fossilit G1	4	———♣	1.0	4	Sadafoss, Abidjan
Protecta C	4	———♣	1.0	4	Abor Nova, Takoradi
Lantrex 4E	2	Chlorpyrifos	———♣	4	Obek Agro, Kumasi
Maxyl SE3	2	Cypermethrin	2-4	2	Chemagro, Accra
Fosset 88	2	———♣	———♣	5	Carbury Hall, Kumasi
Fossilit EC	2	Carbamates	5	5	Sadafoss, Abidjan

♣ Information was not available from manufacturers

Forty percent of the sawmills have used their preferred chemicals for over 5 years, which is an indication of the trust they have in their choice of chemical (Tables 2 & 3).

While the survey failed to establish the actual concentrations of the various chemicals used at the mills, it was noted that over a third of the responding sawmills had facilities to check the concentrations at any given time, and that the concentrations used were lower, in most cases, than those recommended by the manufacturers. This we believe might be the situation with most of the mills since these chemicals are very expensive. One sawmill that substituted kiln drying for prophylactic treatment claimed that once sawn lumber is kiln dried, the incidence of sapstain was negligible. Kiln drying can indeed prevent the incidence of sapstain but only when log is converted soon after logging.

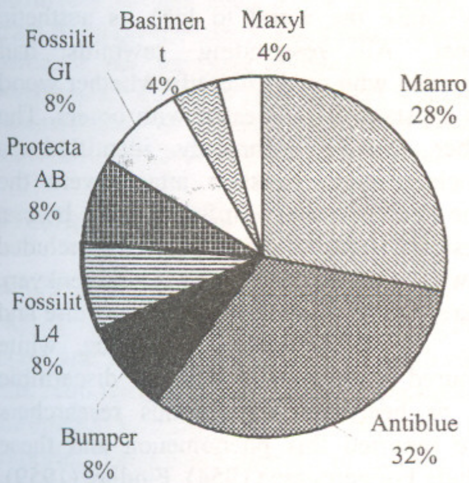

Fig. 1. Respondent users of various Antisapstain Chemicals

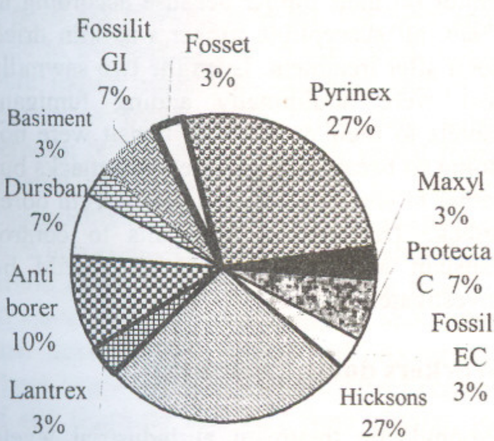

Fig. 2. Respondent users of various Antiborer Chemicals

Unfortunately, this schedule cannot easily be met. In general, mills in Ghana lack adequate quality control measures, so substituting kiln drying for prophylactic treatment is probably not feasible.

The chemicals used by sawmills depended not so much on their efficacy but rather on the price per unit volume. Companies that had access to more than one chemical were using cheaper ones for treating wood meant for kiln drying and an expensive chemical for air-drying. Availability and familiarity with a chemical, as well as the destination of the final product, were also deciding factors in the choice of a chemical. High cost of chemical added heavily to the processing cost, therefore, none of the responding sawmills was treating timber meant for local markets.

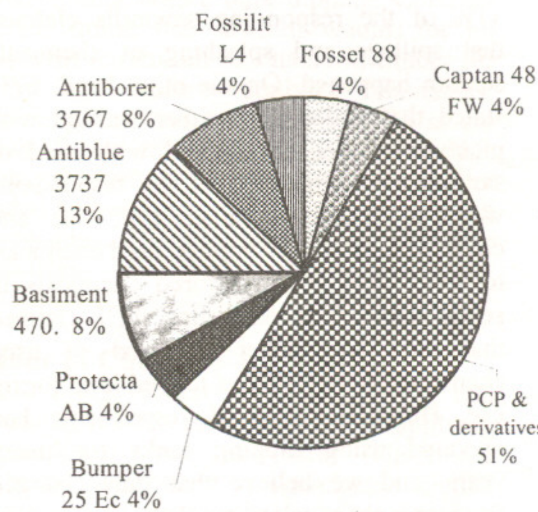

Fig. 3. Respondent past users of Antisapstain and Antiborer Chemicals

Use of Protective Clothing During Treatment

Protective clothing should be worn by all workers doing prophylactic treatment and shall include plastic gloves, goggles, overalls, boots, and facemasks, all of which should be cleaned regularly. All the respondents claimed that the workers in charge of treatment had at least some of these materials as well as first aid facilities.

However, these were not visibly available for inspection in 75% of responding sawmills. Workers at one sawmill were seen treating wood without protective clothing and rushed off to lunch break without properly cleaning their hands with a detergent. When questioned, the affected workers produced torn gloves that it was understandable on their part to choose to work with bare hands.

Disposal of Chemical Effluent

Improperly disposed chemical effluent can leach into streams, public drainage and open sewers. Therefore, spillage and splashes of preservative chemicals should be disposed in a properly designated location. About 37% of the responding sawmills claimed that spillage and splashing of chemicals seldom happened. On the other hand, 67% stated that spills were either washed with plenty of water or covered with sand or sawdust. Forty percent of the respondents would drain used chemicals with water and cover with sand; 7 % applied used chemicals to spray logs and 11 stored chemicals in septic tanks. The remaining 42% claimed that they had never disposed of used chemicals as they always topped it up for re-use. However, 42% of respondents had operated using dipping tanks for many years, and we believe that they changed from one chemical to another. We became convinced that because of environmental issues, they would not truthfully disclose how they disposed of their chemical waste.

Interestingly, over 30% of the respondents in Kumasi had drains leading from their yards into fields where people cultivate sugarcane and cocoyam meant for human consumption. Environmental Protection Agency Standards on disposal of chemical effluent should be enforced at all wood treatment plants to ensure maximum safety at all times.

Identification of Sapstained and Borer Infested Wood

Sapstain, which results in blue, gray or black discolouration in the sapwood is caused by the hyphae of Ascomycetes and Fungi Imperfecti. Ambrosia beetles or pinhole borers can also disfigure wood. Although neither sapstain nor borer infestation appreciably affects strength properties, they may cause the wood to lose its aesthetic appeal. All responding sawmills had personnel who could identify whether wood was sapstained or infested with borers. The timber species commonly identified as associated with sapstain attack were the same species usually infested with borers. These according to the respondents included Wawa, Ofram, Wawabima, Kyenkyen, Kyere, Emire, Asanfina, Emire, Avodire and Esa. All these species produce white coloured wood mostly with no discernible sap or heartwood. Numerous researchers have reported this phenomenon and these include Fougerousse (1954), Findlay (1959), Mommoh (1966), Olofinboba(1967) and Teyegaga & Ofosu-Asiedu (1973).

All respondents ranked the economic importance of sapstain and borer attack as minor on their timber because according to them, all susceptible timber was kiln dried soon after treatment. Even the two sawmills that were additionally adding fumigant tablets to their products in transit were not doing so because of any previous attacks but rather to ensure additional safety from borer attack. The use of fumigants to control sapstain and borer infestation should be investigated further.

Workers doing Treatment

Prophylactic treatment at industrial levels usually involves a group of two to six workers depending on the size of the treatment plant and whether the operation is mechanised or manual. The number of workers responsible for treatment at the sawmills ranged from two to six; the number depending on the volume of wood treated per day. Sawmills with mechanised facilities for treatment generally had fewer treatment workers.

The levels of education in over 80% of the workers responsible for treatment were low; many had a basic school education that, it seemed, managed to carry out their duties only through experience. Over 80% of the workers interviewed, therefore, responded positively to the need for a workshop to train them on the use of wood preservatives in particular and anti-borer chemicals. A training workshop for treatment plant workers is strongly recommended, as is the need for a trained supervisor to be in charge of quality control.

Treatment of Logs

White coloured timber species meant for export require chemical treatment against borer and fungal infestation. Failure to meet this requirement has resulted in contractual abrogation costing millions of dollars to the exporter. Chemicals applied to the ends of logs (end-coating) limit access by fungi and borers and minimise splitting by retarding end drying. All respondents claimed to apply chemicals to susceptible sawn timber, meant for export. However, only 60% applied chemicals to logs out of which 40% applied the chemicals at the log yard and 20% at the logging site in the forest. Logs were mostly treated by brushing and in a few cases by spraying. The time lapse between felling and processing varied from sawmill to sawmill. Forty five percent of respondents claimed that susceptible species were processed within seven days after their arrival at the sawmills; 35% said it took 7-30 days, and 20% were unsure about the time lapse between felling and processing. These times indicate that the effectiveness of any chemical will vary from sawmill to sawmill, depending amongst other factors on how promptly logs are processed. Chemicals can be expected to be less effective on timbers that are not promptly processed where staining might have already set in before chemical application. The recommended practice, therefore, is to convert untreated susceptible logs within 48 hours of logging or apply a topical treatment.

Treatment of Sawn Timber

Conversion of logs into sawn timber removes the protective bark and exposes ray parenchyma rich in storage sugar to microbial and borer attack (Dawson-Andoh & Morrell, 1996). Therefore, sawn timber must be seasoned rapidly below the fiber saturation point (20% moisture content) to prevent attack by sapstain fungi and pinhole borers (Zabel & Morrell, 1992). Sixty-eight percent of respondents claimed that they treated their sawn timber within 24 hours after sawing; the rest took longer times, sometimes extending 36 hours before treatment. The delay usually results from time consumed in stacking and bundling sawn timber before bulk dipping. Contrary to the norm, one sawmill would, for no apparent reason, air dry its sawn timber for two days before applying chemicals, claiming that was the usual practice at the sawmill for many years. Even with this unusual method of treatment, the miller stated he had never had claims by importing companies. This and other negative practices underscore the need for educational workshops.

Mode of Chemical Application

Bulk or individual dipping, spraying and brushing are the usual methods of applying antisapstain and anti-borer chemicals. Fifteen percent of respondents applied chemicals to sawn timber only by spraying, 25% applied by spraying and dipping and 60% applied only by dipping. None of the respondents applied chemicals to sawn timber by brushing. The length of dipping time varied from 30 seconds to well over 5 minutes for most sawmills. Forsyth & Amburgey (1992) recommended a 5-minute dipping time as being adequate for treatment of oak boards using 5% sodium bisulphite. The length of dipping time in most cases was not based on manufacturer's recommendations but rather on the time it takes the chemicals to completely cover the wood. All of the respondents that used spraying used mist blower machines with no fixed spraying speed. Speed adjustments were often left to the discretion of the sprayer. Sawmills who applied spray treatment claimed their treatment was not only equally efficacious but also more cost effective. One sawmill interestingly was dipping timber intended for air-drying but spraying timber meant for kiln drying. The reason given was that in spraying very little of the chemical was absorbed by the wood as compared to dipping and hence the need for kiln drying after spray treatment.

Application of chemical through brushing was limited to only a few logs.

Handling of Wood After Treatment

All respondent sawmills stickered and stored treated wood in the open under sheds. However, logs were exposed to the rain and sun whether or not they had been treated. Most sawmills used untreated stickers in stacking wood that were of the same species as the wood being stacked. Where treatments were made by individually dipping in chemicals, stickers were in most cases treated separately before use. This, however, was not the case when spraying or bulk dipping was carried out. In such instances, treatments were effected with the stickers already stacked in the wood with little thought about the chemical's inability to penetrate the contact areas between the sawn wood and the stickers. A better method would be to spray them individually before stickering or in the case of bulk dipping, narrow stickers be used with increased dipping time. Over half of the sawmills were kiln drying sawn timber soon after treatment - a practice that needs to be encouraged to ensure better quality of treated timber in the industry.

Concentration of Chemicals

In spite of treatment costs, two respondent sawmills used concentrations slightly higher than the recommended. They claimed that manufacturers' recommendations were based on environmental conditions that were less severe than in Ghana and felt that using high dosages produced better results. This practice is laudable, as indeed studies have shown that higher concentrations of antisapstain chemicals may be needed to control incidence of sapstain in the tropics (Oteng-Amoako, 1989). The rest ((96%) of the respondents claimed that they prepared their chemicals strictly according to the manufacturer's recommended concentrations. Thirty-five percent of respondents had kit facilities to measure concentrations during use while 65 % did not have them. In spite of this, all the respondents rated the results of their treatments as either "good" or "excellent", basing their ratings on the fact that they had never had claims for either fungal staining or borer attack on their exports.

Use of Organochlorides

As already shown in Table 2, 18 sawmills, which constituted 36% of respondents, were using chlorophenols in spite of its hazardous nature and its ban in many wood-importing countries. Table 4 shows that 60% of the respondent sawmills have stopped using organochlorides (PCP, Basilit PN, Fossilit L4, DDT, and Manro) but the reasons for not using them were not solely based on toxicity but also on non-availability. Some of the 36% respondent sawmills use Manro and Fossilit L4, which contain PCP, but were doing so because either they were ignorant about its side effects or they did not know that the proprietary chemicals contain organochlorides. They, however, were aware that these chemicals were only used to treat wood meant for countries where the ban on the chemicals is not enforced.

CONCLUSIONS AND RECOMMENDATIONS

The study revealed that as at June 1998, eight anti-sapstain and 10 anti-borer chemicals were being used in Ghana to control incidence of sapstain and borer infestation on white coloured logs and sawn timber. Treatment workers, most of whom had only basic education, usually wore some form of protective clothing and applied chemicals by spraying, brushing or bulk dipping. Although environmentally friendly derived chemicals such as synthetic pyrethroids are used, chemicals containing hazardous organochloride derivatives were used by 36 % of the respondents. Many of these users did not appear to be aware of their hazardous nature. The most common problems facing the industry include quality control to ensure effective concentrations of chemicals for treatment, effective disposal of preservative effluents and continued use of hazardous organochlorides. It is recommended that periodic training workshops should be instituted for workers to address these and other shortcomings in the industry.

TABLE 4

Chemicals that had been previously used by responding sawmills

Chemical	% Respondent Past Users	Reason for Stopping Usage
Basilit PN *	5	Not available
Basiment 470	10	Not available
Antiblue 3737	15	Expensive, not easily available
Antiborer 3767	10	Expensive, not easily available
Fossilit L4 *	5	Expensive, replaced with kiln drying
Fosset 88	5	Expensive, replaced with kiln drying
PCP *	40	Poisonous, scarce, only for selected countries
Captan 48FW	5	Not available
Bumper 48EC	5	Expensive
Protecta AB	5	Not very effective
DDT *	10	Not available
Manro *	5	Poisonous

* Chemicals containing PCP or its Derivatives

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