Recommendations for Applying Anti-Sapstain Biocides to Fresh Southern Hardwood Logs

RESEARCH ADVANCES
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INTRODUCTION

Microbial and enzyme-mediated discolorations in highly-valued Southern hardwood species have been a costly problem for the forest products industry. Sapstains and insects cause extensive degrade and a high subsequent monetary loss to the lumber market. Losses result principally from reductions in grade, value, and marketability of the discolored lumber. Researchers in Mississippi State University's Forest and Wildlife Research Center have been working on a solution to this costly problem. Research has found that hardwood log handlers should treat fresh log cross-sections with a biocide formulation to prevent discolorations and/or insect growth. This treatment should be conducted within 24 hours of a tree being felled. Log handlers will find that adding a biocide mixture to treat fresh logs provide numerous benefits including extended storage time and customer acceptance level of clear lumber. This is of significant importance when temperatures are above 70 degrees F and relative humidity is above 80%. If the biocide is mixed properly, applied in a timely manner, and logs are stored for no more than six weeks, discolorations will be minimized. Treatment of fresh hardwood logs with an anti-sapstain (biocide) formulation is recommended from March 15th until October 15th, in warm, moist regions. The following information will provide southern hardwood lumber producers with criteria for using anti-sapstain chemicals onto fresh southern hardwood logs.

Table 1

Anti-Sapstain Mixtures
Anti-Sapstain/H2O Mixture Chart
(calculated on a wt./wt. basis)

Mixture	0.02 (50/1)	0.025 (40/1)	0.05 (20/1) summer
oz./1 gallon	2.56	3.2	6.4
oz./2 gallon	5.12	6.4	12.8
oz./5 gallon	12.8	16	32
oz./25 gallon	64	80	160

vienna sausage can= 5 oz., standard soda can= 12 oz., spray-paint top= 4 oz.

Table 2

A partial list of commercial anti-sapstain brand names used in southern hardwood sawmills.

Brand	Distributor	Active(s)	pH	Hazards
Prosan	Buckman	Propiconazole	5.9 to 8	heavy eye / skin irritant
AntiBlu XP	Arch	3-Iodo-2-propynyl butyl carbamate (IPBC), Benzalkonium chloride, Propiconazole	6 to 9	low eye / skin irritant
NexGen	ISK	Chlorothalonil Tetrachloroisophthalonitrile, Methylene bisthiocyanate	7 to 9	low eye / skin irritant
Diamond Brite	Kop-Coat	Didecyl dimethyl ammonium chloride, IPBC	7.1	mild eye / skin irritant

Table 1 provides criteria southern hardwood lumber producers should follow for choosing, mixing, and applying anti-sapstain chemicals onto fresh southern hardwood logs The anti-sapstain market is quite extensive and competitively growing (Table 2). Current anti-sapstain biocides often are formulated to reduce mammalian toxicity by controlling the chemical formulation's pH. The closer the formulation's pH is to 7, the less toxic it is to humans and the environment (Table 2).

Mixing of an anti-sapstain should be done accurately. This ensures that the ratio of biocide to water required for microbial sapstain prevention is obtained.

Some anti-sapstain applicators add a fluorescent dye to the formulation for quality control measures. The dye has a different pH (range from 5-7) than that of the anti-sapstain; therefore, a dye should not be added to a biocide.

Hardwood logs should be protected immediately after felling. Relatively simple techniques commonly used to control drying (splitting and checking) and discolorations (mold, sapstain, and enzymatic) include timely utilization of logs, end treat fresh logs with a biocide, water-spray store logs (under 4 months during summer), and/or combinations of each. Many publications have been released concerning drying and/or discolorations of hardwood logs and lumber, and some of these are attached in the "suggested literature" section. Future research interests should incorporate log hauling logistical constraints, log sort yard methodology, and milling to kiln drying scheduling.

Sapwood Discoloration

Causes, Appearance, and Control[1]

Microbial

1. Usually caused by fungi, and sometimes bacteria.
2. Occur in sapwood.
3. In log or lumber cross-sections, usually appear as wedge-shaped radially-oriented discolored (bluish or black) areas along the rays.
4. Appear microscopically on the surface as pigmented spores that are spherical, oval, or other shapes or internally as pigmented thread-like strands.
5. Usually develop in logs due to poor inventory control and/or lack of water storage.
6. Discolored wood more permeable than normal wood.
7. May be associated with beetle damage.
8. If confined to lumber surfaces, (mold fungi) discolorations can be removed by surfacing the lumber.
9. Can be prevented by rapid utilization or water-storage of logs and treatment of freshly-sawn lumber with anti-sapstain chemicals.
10. Cannot be controlled by log fumigation or mechanically stressing the lumber.

Non-Microbial (Enzymatic)

1. Caused by enzymatic reactions in sapwood.
2. Occur in sapwood
3. In lumber cross-sections, appear as irregular-shaped discolored (gray or brown) areas that often begin near the heartwood-sapwood boundary.
4. Appear microscopically as amber globules located in the parenchyma cells (primarily the ray parenchyma)
5. Usually develop in lumber during poor air-drying conditions or prolonged bulk-stacking of freshly-cut lumber. Can develop in the log stored for prolonged period.
6. Discolored wood has the same permeability as normal wood.
7. Not associated with beetle damage.
8. Cannot be removed by surfacing the lumber.
9. Cannot be prevented by water-storage of logs or treatment of lumber with anti-sapstain chemicals.
10. Can be controlled by log fumigation or mechanically stressing the lumber.

Non-MIcrobial(Non-Enzymatic)

1. Caused by reactions of metals with wood constituents at the wood surface (iron stain), unknown soil factors (mineral stain), oxidations of wood extractives at the wood surface (surface browning) etc.
2. May occur in both sapwood and heartwood.
3. In log or lumber cross-sections, may appear uniformly across the wood (iron stain, surface browning), in distinct purplish bands (iron stain), or as irregular green to purple streaks (mineral stain).
4. Iron stains appear microscopically as blue to black discolorations. Iron stain and oxidative stains rarely penetrate the cross-section more than 1mm. Mineral stain appears throughout the cross section.
5. May develop in the living tree (mineral stain), at the ends or debarked areas of logs (iron stain, surface browning), or on the surfaces of lumber (iron stain, surface browning)
6. Discolored areas may have the same properties as normal wood (iron stain, surface browning), or exhibit hardness, brittleness, or dimensional instability (mineral stain).
7. Not associated with beetle damage.
8. Some can be removed by surfacing (iron stain, surface browning) and some cannot (mineral stain).
9. Cannot be prevented by water storage of logs and some may be more prevalent in lumber from water-stored logs (surface browning).
10. May be prevented by anti-sapstain formulations containing iron-stain inhibitors (iron stain), or may be less frequent when treated with some anti-sapstain formulations (surface browning).

[1]Amburgey, T. L., S. C. Kitchens, J. K. Baileys. 2001. Guidelines for the use of anti-sapstain formulations. American Wood-Preservers' Association, Proceedings 97:175-178.

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Suggested Literature

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