
19 The Reuse of Treated Wood

Robert Smith, David Bailey, Delton Alderman
and Phil Araman

CONTENTS

19.1	Introduction.....	349
19.2	Evaluation of Barriers to Recycling Treated Wood	352
19.2.1	Properties of Spent Lumber Treated with Chromated Copper Arsenate.....	355
19.2.2	Recycling Decks Treated with Chromated Copper Arsenate.....	355
19.2.3	Properties of Spent Lumber Treated with Chromated Copper Arsenate.....	356
19.2.3.1	Chemical Retention	356
19.2.3.2	Mechanical Properties	358
19.2.4	New Products from Old Decks Treated with Chromated Copper Arsenate.....	361
19.3	Conclusion.....	364
	Acknowledgments.....	365
	References.....	365

19.1 INTRODUCTION

The primary goals of this chapter are to identify barriers to the reuse of treated lumber, to describe the physical properties of spent chromated copper arsenate (CCA)-treated lumber coming from residential decks and to identify potential products and markets that can use spent treated lumber. This chapter will focus primarily on CCA-treated lumber because it has been the primary chemical used since the early 1970s and represents the largest volume of treated lumber coming out of service. CCA treatment of lumber has been largely discontinued; however, the challenges facing the reuse of CCA-treated wood will most likely be similar to those posed by other types of treated wood in the future. Successful methods to reuse treated wood will have an effect in three principal areas: (1) conserving both public and private softwood forests, (2) reducing the area of public and private land utilized for landfills, and (3) providing new economic opportunities via the creation of recycling businesses.

Recycling is defined by the U.S. Environmental Protection Agency (EPA)¹ as turning materials that would otherwise become waste into reusable resources.

In 2001, the U.S. recycled approximately 32% of the municipal solid waste generated. Still, recycling rates in the U.S. compared with those of many other countries are significantly lower. France, Sweden, Switzerland, the Netherlands, Italy and Japan all have higher recycling rates than the U.S.² Wilson³ states that one of the major reasons for not developing a better waste-management system is cost. Those who have a high recycling rate have found an economic incentive in recycling,³ which has developed primarily from reduced landfill space and tighter governmental regulations.

This situation is occurring in the disposal of CCA-treated wood with foreseeable tighter regulations and a reduction in landfill space. Therefore, developing products and markets for recycled CCA-treated wood is vital in increasing the recycling rate of this material. Research has concluded that within the next several years, the disposal of CCA-treated wood will rise dramatically. Cooper⁴ estimated that from the year 2000 to the year 2020, the disposal of CCA-treated wood will increase ninefold, and several other investigators have reported similar results.^{5,6} Recent reports have indicated that a large volume of CCA-treated wood from residential decks is being removed from service each year. Alderman⁷ estimated that approximately 1 billion board feet a year of CCA-treated wood is being removed each year from the dismantling of residential decks. McQueen and Stevens⁶ estimated that in 1999, 935 million board feet was removed from spent residential decks. This research suggests that every year, one-half of the new CCA-treated wood used in the deck market is replacing discarded material.

Recycling is prevalent and successful in many industries. Recycling programs have been developed for metals, plastics and several wood products; these programs have helped decrease the potential of government regulations, negative public opinions toward the disposal, and increase social acceptance of the material. Wood recycling was 5% in 1997, but was projected to increase to 10% by 2000.¹ An increase in virgin wood prices and an increased consumer demand for recycled materials are the main reasons for the increase.⁸ The recycling rate will increase as more regulations are implemented and as landfill tipping fees are raised.

Marutzky⁹ stated the following preconditions for successful recycling of wood waste:

- The assortments are available continuously and in sufficient amounts.
- The quality of the assortment is in accordance with the proposed recycling.
- The recycled wood products have a market.
- The recycling produces no new disposal problems.

Meeting these criteria is important for successful recycling of CCA-treated wood waste, and the industry has several barriers associated with these conditions to overcome. Research has suggested that building contractors play an important role in whether recyclers receive sufficient amounts of spent CCA-treated wood from residential decks. Alderman⁷ suggested that in order to receive an adequate supply of spent CCA-treated wood for recyclers, marketing campaigns and financial incentives are needed to entice building contractors to bring in the material to be recycled. Also, the CCA-treated debris must be separated from other wood debris. Townsend and Solo-Gabriele¹⁰ found that approximately 6% of construction and demolition (CD) landfill wood debris is CCA treated. If CCA-treated wood is not separated from untreated wood, then the quality of the material will not meet the needs of the proposed recycling program.

Research has been performed on finding markets for spent CCA-treated lumber. A large amount of research has been conducted on the use of spent CCA-treated lumber in wood-based composite products.¹¹⁻¹³ Composite manufacturers have been evaluated as a viable option for recycling spent CCA-treated wood, but most research has found that these facilities are reluctant to consider spent CCA-treated lumber as a possible raw material source.^{14,15} The main reasons found were concerns over health and safety of mill workers, residual chemicals that the material may still have, and that products made from recycled treated wood may not have the same resistance to decay and insects as the original treated-wood product. Research has also been performed to remove the treating chemical from the spent CCA-treated wood. If this process can be performed successfully then the CCA-treated wood can be mixed with other wood waste for recycling. Wilson³ and Alderman⁷ have experimented with this method. Clausen's work has been successful in removing 92% of the copper and 42% of the arsenic, but there has been less success in removing the chromium because it is bound tightly to the lignin.⁷ Shiau et al.¹⁶ were successful in extracting over 80% of CCA chemicals from wood particles with citric acid.

The treated-wood industry is not the first to develop alternatives to landfilling. The wooden pallet industry faced many of the same obstacles several years ago, and now approximately 40% of the pallets in the U.S. are made from recycled pallets.¹⁷ The pulp and paper industry has also faced the same problems. The U.S. currently recycles 45% of its paper, mainly due to increased regulations and higher tipping fees.¹⁸

A program that has shown success is the curbside recovery of scrap lumber by the town of Aberdeen, Maryland.¹⁹ The curbside program collected 3.47 tons of wood waste by residents, and 35% (the largest contributor) was pressure-treated lumber. Seven hundred sixty-eight pounds of treated wood was then donated to the Hartford Glen Nature Center for nature and wildlife trail construction. The nature center indicated that it could use more pressure-treated lumber, so the scrap lumber collection program for 1997 emphasized the recovery of pressure-treated wood. This indicates that if recycling incentives and programs are set, then recovering CCA-treated wood for use in municipal recreational areas might have potential, assuming public safety concerns are addressed.

As stated previously, incentives need to be developed for building contractors to bring spent CCA-treated wood to recyclers. This will only happen if recyclers find economic viable products and markets for the recovered CCA-treated wood. To reduce the negative effects that the disposal of treated wood will entail, the useful life of treated wood must be extended. This will involve the recovery and recycling of spent treated-wood products. New alternative markets and products will need to be evaluated and proper programs established by manufacturers, recyclers and governments.

This chapter evaluates the barriers to recycling treated lumber and potential products that could be made from treated wood removed from residential decks. The initial portion of the chapter describes a mail survey that was given to residential deck builders located in the mid-Atlantic region of the U.S. to identify factors affecting the recycling of treated lumber. The second portion of the research describes the physical and chemical properties of treated wood removed from residential decks and the products made from this material. The chapter concludes with opportunities that the authors believe exist for the recycling of treated lumber.

19.2 EVALUATION OF BARRIERS TO RECYCLING TREATED WOOD

Contractors involved in the fabrication, demolition and deconstruction of residential decks were surveyed in 1999 to identify barriers to the recycling of existing treated-wood decks. The contractors sampled for this research were from Georgia, North Carolina and South Carolina. A total of 2833 questionnaires were mailed to randomly selected members from the sample frame. The primary data collection tool was a mail survey questionnaire. The mail survey and sequencing were modeled after Dillman's Total Design Method.²⁰

In total, 580 questionnaires were returned. The first question asked the respondent if their company fabricated decks. One hundred and eighty respondents answered *No*, and *Yes* was checked by 400 respondents. The total adjusted response rate of 20% was calculated by subtracting the bad addresses from the mailing total and dividing it into the usable responses.

The mean number of decks built per respondent in 1999 was 3.1, and the average size of the decks was approximately 25.3 m². The average number of decks demolished in 1999 was 8 per respondent, and the decks averaged about 18.4 m² per deck. The increase in the mean size of a deck should be encouraging news to the producers of treated lumber. Respondents indicated that nearly 35% of decks are either built or remodeled by the homeowner. Finally, over 7% of the lumber purchased to construct a deck resulted in discards or scraps. The average deck demolished in 1999 was approximately 18.4 m². To estimate the lumber required in a deck, dimensions of 3.7 × 4.9 feet were assumed, which results in a deck that contains 1.8 m² less than the average reported demolished deck. The treated lumber required for a 17.8-ft² deck was estimated to be 322.2 board meters (full sawn).

Contractors were asked questions concerning the costs associated with deck fabrication and demolition. The importance of these questions lies in the fact that financial incentives could be developed to encourage the recovery of used lumber. The average disposal cost reported by the respondents was nearly \$180 per deck. The respondents were asked to estimate the additional cost for dismantling a deck for recovery rather than demolishing the deck. The average cost for deck deconstruction was more than two times the estimated cost for demolishing a deck, nearly \$371 per deck. Regarding the percentage of treated lumber that could be potentially recovered, it was found that over 44% could be recovered. The mean percentage of lumber reported being recovered from dismantling a deck was over 51%.

Contractors were asked to rate factors concerning deck replacement on a scale from 1 to 7. The highest-rated factor for deck replacement was decayed wood at 5.3. This was followed by esthetics, which was rated 5.2. Third, the physical degradation of the wood components was rated at 5.1. Safety, or a structurally unsound deck, was the next highest factor rated for deck replacement, followed by homeowners preferring a larger size deck. Other reasons for deck replacement, in order of importance, were poor construction, a new deck style preferred, insect-infested wood, and finally, a new material was preferred (Figure 19.1).

Data were collected on the primary disposal methods and the facilities to which contractors directed their used lumber. Concerning the primary method of disposal

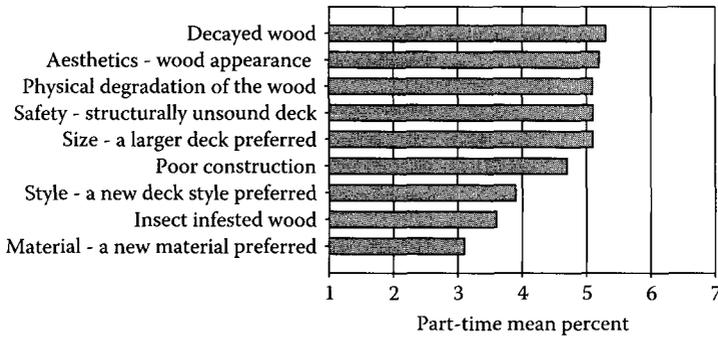


FIGURE 19.1 Reason for deck replacement. (Alderman, D., Smith, R. and Araman, P., A Profile of CCA-Treated Lumber Removed from Service in the Southeastern United States Decking Market, *For. Prod. J.*, 53, 38, 2003.)

contractors used, 289 reported they disposed of used lumber in municipal solid waste (MSW) landfills. Of this total, 179 respondents used MSW facilities exclusively. Additionally, 32 directed disposals to MSW landfills more than 90% of the time. Construction and demolition (CD) facilities were used by 48 respondents, and 21 respondents directed their used lumber to CD facilities exclusively. Fifty-one replied that they disposed of spent CCA-treated lumber at private facilities. Spent lumber was recovered for reuse by 64 respondents (15%), and one respondent indicated that he recovered all of his used lumber for reuse. Six respondents indicated that they reused the material more than 90% of the time. Contract disposal was utilized by 35 respondents, and 15 respondents used other disposal methods. Other disposal methods included using the recovered lumber to build deer stands, reuse at the home, disposal in a dumpster, giveaway by the homeowner, burial by the contractor and giveaway by the contractor. Fifty-two respondents reported burning used lumber as their primary or alternative disposal method. The burning of treated lumber is prohibited and is detailed on the consumer information sheet that is given to buyers at the time of purchase.

Contractors were asked to rate on a scale from 1 to 7 the factors that impede the recycling of CCA lumber. These factors included time, costs, a lack of recovery facilities, a lack of recovery programs in place to assist a contractor, the manpower to dismantle and equipment. Not surprisingly, a “lack of recycling facilities” was rated the highest at 6.2. This was followed closely by a “lack of recycling programs,” which had a mean rating of 6.1. The costs associated for dismantling a deck was the third-highest rated factor at 5.7. The next highest rated factor was time, followed by manpower and then equipment; health risk was the lowest rated factor. Most salient are the factors “lack of recycling facilities” and “lack of recycling programs,” which indicate that recovery programs and centers will have to be developed and built to facilitate the recovery and recycling of used CCA-treated lumber (Figure 19.2).

Contractors were queried for their opinion regarding what incentives or programs could be instituted or developed to initiate the recovery and recycling of spent CCA-treated lumber. Respondents offered 321 ideas or opinions on possible initiatives for the recovery of spent CCA lumber. The category with the greatest number of

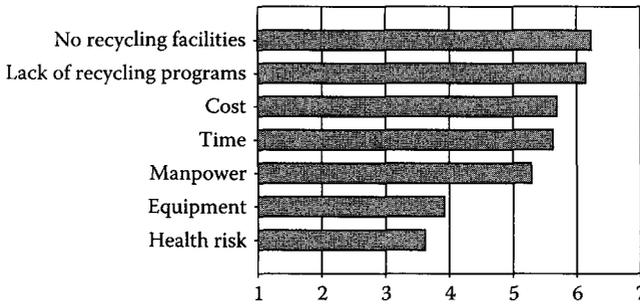


FIGURE 19.2 Reasons for not recycling treated lumber. (Alderman, D., Smith, R. and Araman, P., A Profile of CCA-Treated Lumber Removed from Service in the Southeastern United States Decking Market, *For: Prod. J.*, 53, 38, 2003.)

responses concerned financial incentives being offered to facilitate the recovery of used CCA-treated lumber, and over 40% reported that some type of financial incentive should be offered. This was followed by elimination of tipping fees and incentives that could be based on weight. Payment for recovery, tax breaks, retailer discounts and penalties or fines should be incorporated to initiate recovery.

The establishment of recovery facilities was the next most frequently reported response. Nearly 70% of the respondents indicated that recovery centers needed to be developed, and easy access to those facilities should be available to contractors. This was followed by the establishment of separate areas in the landfill and business entities establishing the recovery centers. The establishment of recovery programs was the next category at 11.2%. The most frequently reported option was the development of a buy-back program, followed by the establishment of industry or government pickup programs, development of a county government recovery program, building association program and local governments contracting with builders. Several respondents (nearly 9%) indicated that public education programs needed to be developed.

Participants were next asked to offer their opinion on the types of products that could be produced from spent CCA-treated lumber. It should be noted that the following results are reflections and actual responses of the study participants. Neither Virginia Polytechnic Institute, the Department of Wood Science and Forest Products at Virginia Polytechnic Institute, nor the U.S. Department of Agriculture Forest Service endorses or recommends any of the following recommendations, uses or products for spent CCA-treated lumber. The most frequently reported response was to utilize spent CCA-treated lumber to manufacture some type of engineered wood product (32.0%). The use of CCA-treated lumber for outdoor home applications was the next category at 24%. Frequently mentioned responses were to manufacture landscape borders, lawn furniture, playground structures, fencing materials, flower planters, lattice, pickets, birdhouses and feeders, tree houses, screen doors, gables and vents, or in the repair of porches. The manufacture of miscellaneous wood products from spent CCA-treated lumber was next (21.8%). Stakes, forming materials, other lumber products, firewood logs, posts, nonvisible support structures, mudsills, baller boards, artwork, spindles, parking stops, signs, crawl space lumber, deer stands, mats and material for subflooring were reported. The manufacture of

decking and decking-related materials was mentioned in 11.4% of the responses. This included the fabrication of small decks, walkways, stair treads and use in docks. The next product category was processed materials (7.8%).

19.2.1 PROPERTIES OF SPENT LUMBER TREATED WITH CHROMATED COPPER ARSENATE

Studies by McQueen and Stevens⁶ and Alderman⁷ reported the average ages of a deck at removal were 9 and 12.8 years, respectfully. Alderman⁷ estimated the average size of a removed deck was 18.4 m². There were many reasons for removal of the deck by the homeowner, but the research by Alderman⁷ and McQueen and Stevens⁶ both found esthetics to be one of the most important factors. Other factors that led to the replacement of a deck were the amount of decayed wood, physical degradation of the wood and structural integrity of the deck.⁷ The results raise questions as to the amount of usable lumber being discarded if esthetics was the most important factor for the removal of a deck. As stated previously, the reason for the removal of a residential deck was not always because of physically or mechanically deteriorated CCA-treated wood. Many factors such as esthetic appeal of the deck or the homeowner's desire for a larger deck were also major factors in deck removal. Therefore, the spent deck material may be recoverable and used in similar applications. Research by McQueen and Stevens in 1998⁶ stated that 17% of removed decks were reused, and Alderman's research in 2001⁷ indicated that only 4% of a spent CCA-treated deck is being reused. The building contractors in Alderman's research suggested that approximately 45% of a deck could be recovered.⁷

To determine if the spent CCA-treated material could be used in similar applications based on mechanical, chemical or physical characteristics, it was first necessary to evaluate these properties. For reuse in residential decks, the material would need to have sufficient preservative retention and mechanical properties. The material would also have to be in adequate physical condition for acceptance by consumers. Based on these findings, the authors constructed a number of products from the discarded treated lumber recovered from CCA-treated decks.

19.2.2 RECYCLING DECKS TREATED WITH CHROMATED COPPER ARSENATE

Building contractors were contacted in the area surrounding Blacksburg, VA to obtain spent CCA-treated residential decks. The contractors that were contacted specialized in the CD of residential decks. Once a CCA-treated deck was located, an accurate area and volumetric measurement and piece count of the deck was obtained (Figure 19.3). A total of six decks were obtained: four were demolished, following the typical building contractors techniques, and two decks were deconstructed. The deconstruction process is a "soft" removal alternative to demolition. Theoretically, deconstruction is the process of selectively and systematically disassembling the deck that would otherwise be demolished to generate a greater supply of materials suitable for reuse in the construction or rehabilitation of other structures. Deconstruction of the decks involved disassembling

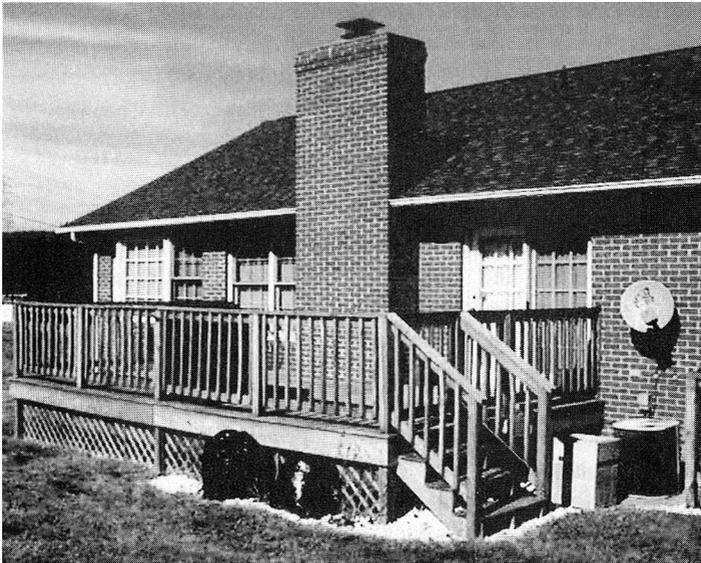


FIGURE 19.3 Typical deck before removal.

the decks while stressing the recovery of the material, not necessarily the most convenient process for the building contractor.

The discarded material was delivered to the Brooks Forest Products Laboratory's log yard, where the hardware was removed from each deck, and then similar dimensional lumber was stacked together, while keeping the deck separated. The unusable sections (such as damage caused by removal tools, splits and excessive nail holes) of the salvaged CCA-treated wood were removed, and then the volume of material remaining was calculated (Figure 19.4).

19.2.3 PROPERTIES OF SPENT LUMBER TREATED WITH CHROMATED COPPER ARSENATE

19.2.3.1 Chemical Retention

Sampling for the chemical retention of spent CCA-treated material was conducted in accordance with American Wood Preservers' Association (AWPA) standards. Because the majority of the decking material was 2×6^a and over 15 years old, the lumber was assumed to have been originally treated to an in-ground contact retention of 6.4 kg/m^3 of wood. In some cases, this was clearly marked on the lumber. It should be noted that retentions vary by piece of wood, and that reported retentions are an average of 20 samples. Individual retentions vary due to volume of sapwood vs. heartwood and differences among wood species.

^aThe term 2×6 refers to the nominal dimensions of the cross-section of a piece of dimensional lumber, in inches. This is an industry convention, and actual dimensions differ. This nomenclature will be used throughout this chapter with an absence of units.

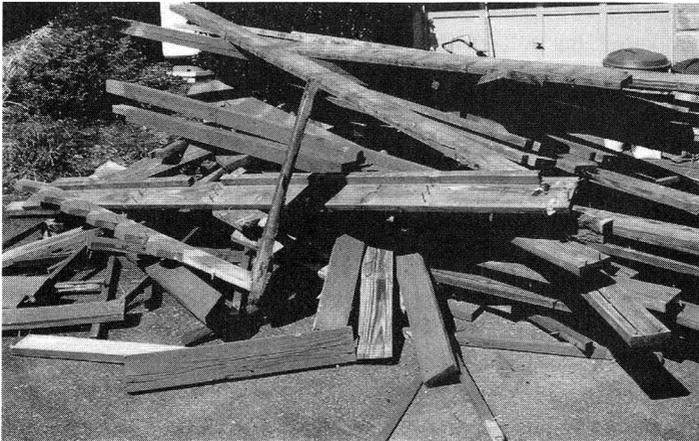


FIGURE 19.4 Spent CCA-treated lumber from removed decks.

A majority of the total retention levels from the chemical assay samples taken from the decking and joists of the residential decks were lower than the minimum standard required for recently treated wood, as shown in Figure 19.5. The chemical assay samples from the joist and decking from Deck No. 4 were above the minimum standards required by the AWP, as shown in Figure 19.5. Other than Deck No. 4, the decking samples used for chemical assay from Deck No. 1 were the only samples above the minimum preservative retention. Deck No. 5 had the lowest retention levels; these lower retention values could be a result of pressure treating mixed pine species with Southern pine species (treating both species at the same time might have altered the original retention in the wood). The recovered lumber from Deck No. 1 was also low in retention compared

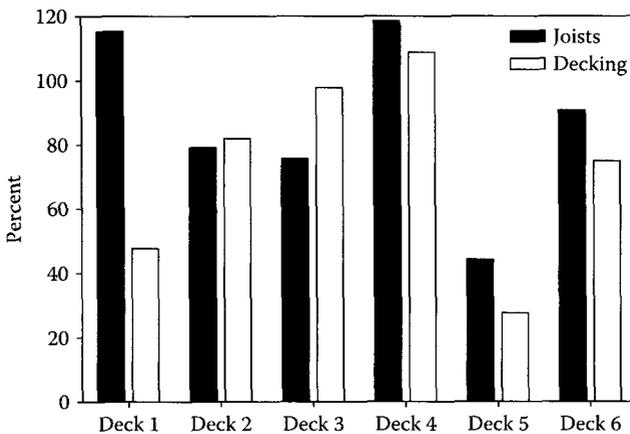


FIGURE 19.5 Ratio of CCA retention levels of deck members to original treatment. (Bailey, D.S., Smith, R.L. and Araman, P.A., An Analysis of the Physical Properties of Recovered CCA-Treated Wood From Residential Decks, *Wood Fiber Sci.*, 36, 278, 2004)

with the stamped level it was treated to. It is plausible that the decking was not originally treated to 6.4 kg/m^3 , but rather to 4.0 kg/m^3 and mistakenly stamped to be 6.4 kg/m^3 .

The recently treated 2×6 samples had a chemical retention that was above the required limit, but the $5/4 \times 6$ samples were 20% below required minimum standards. The average retention of the eight chemical assay samples from the removed decks that were reported to be pressure treated at a minimum of 6.4 was 4.5 kg/m^3 , approximately 30% below the level required retention after pressure treatment. The average of the four chemical assay samples tested that were originally pressure treated at a minimum chemical retention of 4.0 kg/m^3 were found to be equal.

No effect was noted between the service time of the decks the retention levels. Other factors, such as lower than required retentions during the pressure treatment process and environmental conditions while the decks were in-service, could have been larger influences on the retention of preservative-treating chemicals. It should be noted that even with 40 to 50% of the original retention, the material will maintain some decay resistance.

19.2.3.2 Mechanical Properties

Decking samples were collected from the six spent CCA-treated residential decks. Thirty random samples from the decking of each deck and recently treated 2×6 and $5/4 \times 6$ radius edge decking (RED) were obtained; therefore, there were 8 different sets, each containing 30 samples. Recently treated Southern yellow pine 2×6 and $5/4$ RED were tested because existing data regarding the strength values of the CCA-treated wood could not be found for comparison. Also, because no early data existed, an appropriate sample size to obtain normality could not be efficiently determined; therefore, the Central Limit Theorem was followed, and a sample size of thirty from each set was used.²¹

The samples were cut to a length of 30 in. and labeled, and were conditioned approximately 60 d to reach an equilibrium moisture content of 12%. Prior to testing, the width and thickness of each sample was recorded. A testline Mechanical Testing System (MTS) was used to test the strength properties, and a test span of 24 inches was selected to match the maximum joist spacing allowed for Southern yellow pine $5/4$ RED.²² Pieces were tested in flatwise bending to simulate the performance of the decking material in-service.

The samples were tested in a third point loading system for two main reasons. First, to reduce the effect of span-to-depth ratio on the ratio of apparent to true modulus of elasticity (MOE).²³ Second, the middle third load, where the majority of the failures occur, will have maximum force equally distributed, and no shear force is present. Table 19.1 displays the average and standard deviation from the mechanical strength tests of the decking samples from recently treated material and spent decking. The significance level for the Shapiro-Wilk normality tests, the t-tests for the $5/4 \times 6$ decking material and multiple comparison tests for the 2×6 decking are also shown in Table 19.1.

Although this information is from only six removed decks and two sets of new material, the analysis indicated that there is potential reuse of removed CCA-treated Southern yellow pine decking from residential decks. The stiffness of the decking material was found to be statistically equal to that of recently treated wood; however, the bending strength of the removed decking was overall lower than the recently treated wood. A valid theory for this phenomenon is that physical and climatic degradation or nail holes could have induced flaws that recently treated wood does

TABLE 19.1
Modulus of Rupture and Modulus of Elasticity Results
of CCA-Treated Decking

Modulus Of Elasticity Test Data				
	Average (PSI)	Standard Deviation (PSI)	Significance Level from Normality Test	Significance Level from t-Test or Multiple Comparison
Deck 1	1238272	299578	0.236	0.394
New 5/4 × 6	1306645	317426	0.317	
Deck 2	1096692	318098	0.141	0.229
Deck 3	917034	257320	0.436	0.999
Deck 4	813425	278345	0.455	0.448
Deck 5	932898	240950	0.365	1.000
Deck 6	1192649	211506	0.577	0.005
New 2 × 6	941178	299418	0.465	
Modulus of Rupture Test Data				
	Average (psi)	Standard Deviation (psi)	Significance Level from Normality Test	Significance Level from t-Test or Multiple Comparison
Deck 1	5903	1701	0.508	0.000
New 5/4 × 6	7877	1874	0.236	
Deck 2	5675	1602	0.265	0.802
Deck 3	4887	1579	0.098	0.024
Deck 4	3682	1356	0.325	0.000
Deck 5	4592	1282	0.153	0.002
Deck 6	5762	1487	0.688	0.900
New 2 × 6	6170	2222	0.759	

Source: Alderman, D., Smith, R. and Araman, P., A Profile of CCA-Treated Lumber Removed from Service in the Southeastern United States Decking Market, *For. Prod. J.*, 53, 38, 2003.

not have. Therefore, crack propagation could occur in several more locations on the samples of spent decking and cause the ultimate failure of the specimen.

Age was seen as a nonfactor for lower mechanical strength properties. Deck No. 2 was the oldest deck in service at 27 years and had the same bending strength and stiffness as recently treated material. Conversely, Deck No. 4, which was in service for 18 years, had MOE values statistically equal to recently treated samples, but modulus of rupture (MOR) values statistically less than the recently treated specimens.

The mechanical property tests concluded that the recovered CCA-treated wood could be used in many applications. The MOE properties are similar to those of recently treated wood, but the strength properties are lower, indicating that this material can be used in applications where bending strength is not as important as elasticity. Products where light load is applied and released, such as outdoor furniture,

TABLE 19.2
Products Manufactured, Material and Volume Used of CCA-Treated Wood, Type and Cost of Hardware,
and Worker Hours Needed to Complete

Product	Material (bd. ft.)	Total Board Feet	Hardware	Cost of Hardware	Worker Hours
Porch swing	2 × 4 (8.4), 5/4 × 6 (14.8)	23.2	3-1/2" & 2" screws, 3-1/2" lag screws. 3-1/2" lag bolts	\$8.68	2.5
Chair	2 × 4 (6.7), 1 × 4 (4.4)	11.1	2-1/2" screws, 3-1/2" lag screws. 3-1/2" lag bolts	\$8.71	3
Trash container	1 × 4 (5.1), 2 × 2 (1.8), Lattice (14 ft ²)	6.9	1-3/4" screws, 1-1/4" nails	\$2.00	4
Trellis	2 × 6 (22), 2 × 4 (7), 4 × 4 (81.7), 2 × 8 (15.4), 2 × 2 (7.5)	133.6	Corner bracket, 5-1/2" lag screws, 3-1/2" lag bolts, 3" & 2-1/2" screws	\$28.70	27
Planter box	5/4 × 6 (4.5)	4.5	1-3/4" screws, 1-1/4" nails	\$1.20	1.5
Planters	2 × 4 (12)	12	3-1/2" & 2-1/2" nails	\$0.60	2
Patio tables	4 × 4 (18.4), 2 × 2 (3.8), 5/4 × 6 (12.4), 1 × 6 (5)	39.6	2" & 3" screws, 6" lag screws	\$18.00	8
Picnic table	2 × 6 (65), 2 × 4 (6.2)	71.2	2-1/2" & 3" screws, 3-1/2" lag bolts	\$18.31	8.5
Porch railing	2 × 2 (10), 2 × 4 (8.1), 4 × 4 (8.2)	26.3	All treated, 2-1/2" nails	\$6.75	8.5
Deck	2 × 8 (108.8), 5/4 × 6 (100.8), 4 × 4 (36.8)	246.4	Joist hangers, 2-1/2" screws, 1-1/2" nails	\$26.18	22
Sawhorse	2 × 6 (10.3), 1 × 6 (2.2)	12.5	3-1/2" & 2-1/2" nails	\$0.35	1.25
Block pallets	1 × 4 (3.8), 1 × 6 (5), 5/4 × 6 (9.7), 4 × 4 (4.8)	23.3	2-1/4" and 1-5/8" spiral shank nails	\$4.83	2.25
Stringer pallets	2 × 4 (5.3), 1 × 4 (5.1), 1 × 6 (4)	14.4	2-1/4" spiral shank nails	\$2.52	1.75

decking components such as railings, decking, stairs and pallets, could use spent CCA-treated wood as successfully as recently treated material.

19.2.4 NEW PRODUCTS FROM OLD DECKS TREATED WITH CHROMATED COPPER ARSENATE

The products manufactured were chosen because they were practical, easily fabricated, required little carpentry training or skill, required a small number of inexpensive tools and effectively utilized the recovered CCA-treated wood from the residential decks. The manufacture of these types of products will aid recycling centers in hiring and training qualified employees, and also enables people or organizations that acquire the recycled wood to produce products for do-it-yourself (DIY) outdoor projects. The designs of the products made by this work were from DIY outdoor wood furnishings, designs taken from published books or over the Internet.

Several products were made that fit the criteria of being practical to use and make, cost feasible and required little previous experience and training in wood carpentry. Table 19.2 lists the products made from recycled CCA-treated lumber, along with the type of CCA-treated wood used, volume, type of hardware, cost of hardware, and the worker hours needed to create the product. Figure 19.6 through Figure 19.10 illustrate products made from used deck material.

Several products were made from recovered CCA-treated wood. The products produced in this study included outdoor home furnishings, landscaping products, pallets and residential decks and components. The products produced were uncomplicated designs that allowed researchers with limited knowledge or skill in wood carpentry to complete successfully. The products were also inexpensive to produce, requiring a small amount of monetary investment in tools and hardware. The products also utilized the highest volume of CCA-treated wood coming from spent residential decks, wood that measures 2×6 and 2×8 . This study made only a few products that could be made from recovered CCA-treated wood; several other items can be made, including but not limited to benches, raised walkways, walking bridges, trail guides and paths, and residential and commercial landscaping. Pallets made from the recovered CCA-treated wood were found to perform similarly to untreated wooden pallets of the same species and similar quality. Recycled CCA-treated

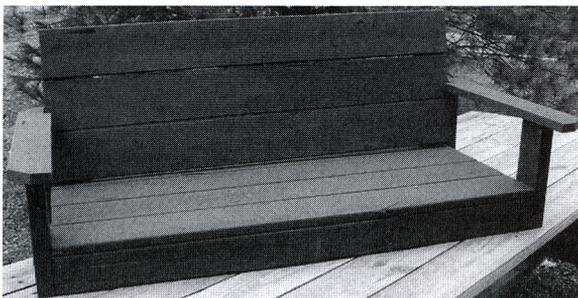


FIGURE 19.6 Porch swing constructed from reused treated wood.

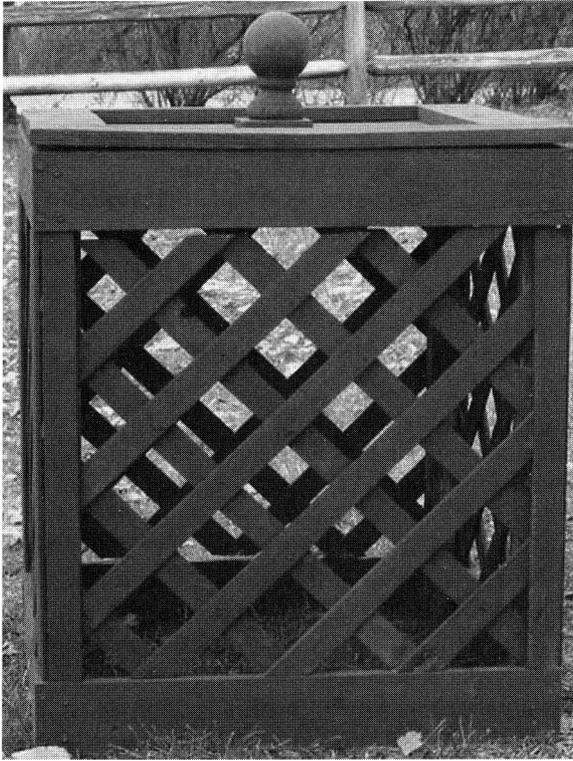


FIGURE 19.7 Trash can container constructed from reused treated wood.

wood can be used in several different applications as effectively as new CCA-treated wood.

Several barriers exist in the reuse of recycled CCA-treated wood. Landfills stated that they receive little CCA-treated wood, and believed that separating it from other waste would not be cost effective because there are no markets. Recycling centers also



FIGURE 19.8 Picnic table constructed from reused treated wood.



FIGURE 19.9 Porch railing constructed from reused treated wood.

claimed it would not be possible to recover the material, most citing that there are no markets and that a consistent supply of spent CCA-treated wood was not available. Several potential users stated that they could use the material, but did not know where to get it. From the personal interviews it appears that the biggest barrier to the recycling of CCA-treated wood waste is lack of communication between all interested parties.

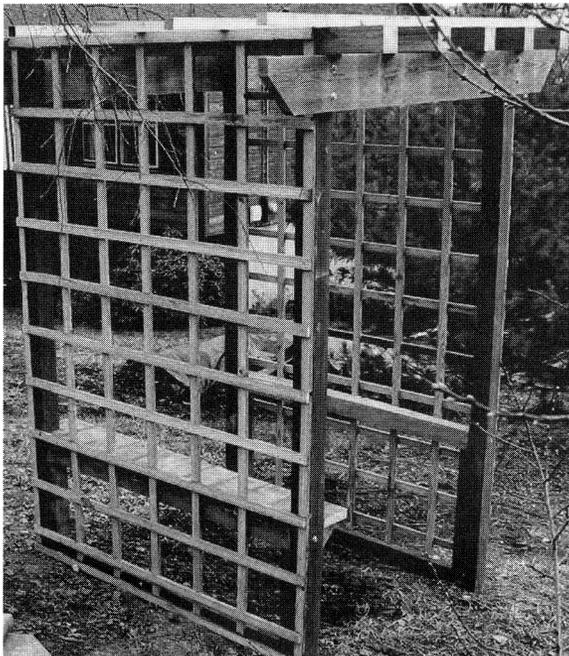


FIGURE 19.10 Trellis constructed from reused treated wood.

19.3 CONCLUSION

Several groups will influence the success of recycling CCA-treated wood from residential decks. These groups include manufacturers of CCA-treated wood, building contractors or other “waste” producers, government organizations, and landfills and recyclers. Many manufacturers have not evaluated the effect their product has on their profitability after it has been sold. This has already occurred with the removal of CCA-treated wood in residential applications at the end of 2003. The attack by environmental groups and the media on the use of CCA-treated wood, though questionable, has forced the industry to spend millions of dollars on new chemical development and treatment processes, and also a loss of market share that might have been avoided if the issue was confronted earlier. The industry is currently facing another negative attack on its products with the possible adverse safety and environmental side effects on the disposal of spent CCA-treated wood. Therefore the industry must be proactive and support the development of recycling programs and markets, through financial incentives or other forms of support in order to keep CCA-treated wood markets sustainable.

Building contractors currently dispose of CCA-treated wood in landfills because it is less expensive than recycling this material and because there are no other alternatives. Therefore, the development of recovery programs for landfill and recycling centers are needed; support by local government is also required. Incentives need to be provided to CCA-treated waste producers that bring separated CCA-treated wood waste into the facility. This can be achieved by lowering tipping fees for sorted CCA-treated wood waste, or by raising the fees on unsorted CD wood waste. The CCA-treated wood waste producers will only make an effort to recover the waste if there are no cheaper alternatives.

To make CCA-treated wood recycling successful, local governments need to support and initiate programs that foster communication and awareness of the amount of CCA-treated wood reaching landfills and the potential reuse of the material. Landfills, recyclers and potential users (individual citizens, parks and recreation, nonprofit organizations) need to be informed how each sector can benefit from the recovery of CCA-treated wood. Government officials should help develop markets for the material, and aid recyclers in developing business opportunities in making recycled CCA wood profitable. Government officials and recyclers should develop easy drop-off and purchase sites for CCA-treated wood.

In summary, the recycling of CCA-treated wood from residential decks can be achieved if all affected parties are aware of the issues and potential reuse of the material. If industry, builders, governments, recyclers, and users associated with the use, disposal and recycling of CCA-treated wood understand the needs of each party, and respond accordingly, then the barriers to the reuse of spent CCA-treated residential decks can be diminished. The future areas of research include evaluating government agencies programs that could enhance the recycling of treated lumber, evaluating what may be occurring in other countries to recycle treated lumber, and identifying and evaluating successful treated-wood recycling programs, if they exist. Certainly, continued research is needed in the areas of more environmentally friendly wood preservatives, and recycling efforts for these materials when they come out of service.

ACKNOWLEDGMENTS

This paper was based on work funded by the U.S. Department of Agriculture Forest Service Southern Experiment Station in Blacksburg, VA and the Center for Forest Products Marketing and Management in the Department of Wood Science and Forest Products at Virginia Polytechnic Institute and State University, Blacksburg, VA. The authors recommend Alderman et al.²⁴ and Bailey et al.²⁵ for additional reading concerning barriers to recycling or properties of spent treated wood.

REFERENCES

1. Environmental Protection Agency, Puzzled about Recycling's Value? Look Beyond the Bin, Report No. EPA530-K-98-008, <www.epa.gov/osw>, January, 1998.
2. Hershkowitz, A., In defense of recycling, *Soc. Res.*, 65, 141, 1998.
3. Wilson, A. Disposal: the Achilles' heel of CCA-treated wood, *Environ. Building News*, 6, 3, 1996.
4. Cooper, P.A., Disposal of treated wood removed from service: The issues, in *Proceedings: Environmental Considerations in the Manufacture, Use, and Disposal of Preservative-Treated Wood*, Carolinas-Chesapeake Section of the Forest Products Society, Richmond, VA, May 13, 1993.
5. Felton, C.C. and DeGroot, R.C., The recycling of preservative treated wood, *For. Prod. J.* 46, 37, 1996.
6. McQueen, J. and Stevens, J., Disposal of CCA treated lumber, *For. Prod. J.*, 48, 86, 1998.
7. Alderman, D.R., An Investigation into Attitudes towards Recycling CCA Treated Lumber, Ph.D. dissertation, Department of Wood Science and Forest Products, Virginia Polytechnic Institute and State University, Blacksburg, VA, 2001.
8. Sherman-Huntoon, R., Wood waste study provides clues to recycling success, *Bio-cycle*, July 2001, 68.
9. Marutzky, R., *Disposal and Recycling of Wood Waste*, Wilhelm-Klauditz-Institut, Fraunhofer-Institut für Holzforschung Braunschweig, Germany, 1996, 107.
10. Townsend, T.G. and Solo-Gabriele, H., CCA wood waste issues, in *Proceedings from the Southeast Recycling Market Development Roundtable and Workshop*, December 6, 2000.
11. Mengelöglu, F. and Gardner, D.J., Recycled CCA-treated lumber in flakeboards: evaluation of adhesives and flakes, *For. Prod. J.*, 50, 41, 2000.
12. Munson, J.M. and Kamdem, D.P., Reconstituted particleboards from CCA-treated red pine utility poles, *For. Prod. J.*, 48, 55, 1998.
13. Vick, C.B., Geimer, R.L. and Wood, J.E., Flakeboards from recycled CCA-treated southern pine lumber, *For. Prod. J.*, 46, 89, 1996.
14. Falk, B., Wood recycling: opportunities for the wood waste resource, *For. Prod. J.*, 47, 17, 1997.
15. Smith, R.L. and Shiau, M., The identification of markets to spent CCA-treated wood fiber, in *The Use of Recycled Wood Paper in Building Applications*, U.S. Department of Agriculture Forest Service and The Forest Products Society, Madison, WI, September 1996.
16. Shiau, R.J., Smith, R.L. and Avellar, B., Effects of steam explosion processing and organic acids on CCA removal from treated wood waste, *Wood Sci. Technol.*, 34, 377, 2000.

17. Bejune, J., Bush, R.J. and Araman, P., Wood use trends in the pallet and container industry, Research Update, Virginia Polytechnic Institute, Center for Forest Products Marketing and Management, Blacksburg, VA, 2001.
18. American Forest and Paper Association (AFPA), <[www.afandpa.org/ recycling/ Rec_introduction.html](http://www.afandpa.org/recycling/Rec_introduction.html)>, May 7, 2001.
19. Litke, J., Demonstration study: recovering scrap lumber at curbside, *Biocycle*, 1996.
20. Dillman, D.A., *Mail and Telephone Surveys: the Total Design Method*, John Wiley & Sons, New York, 1978.
21. Ott, L. and Longnecker, M., *An Introduction to Statistical Methods and Data Analysis*, 5th ed., Duxbury, Pacific Grove, CA, 2001.
22. Southern Pine Inspection Bureau, *Special Product Rules for Radius Edge Decking, Effective June 1*, Southern Pine Inspection Bureau, Pensacola, FL, 1986.
23. Bodig, J. and Jayne, B., *Mechanics of Wood and Wood Composites*, Van Nostrand Reinhold Company, New York, 1982.
24. Alderman, D., Smith, R. and Araman, P., A Profile of CCA-Treated Lumber Removed from Service in the Southeastern United States Decking Market, *For. Prod. J.*, 53, 38, 2003.
25. Bailey, D.S., Smith, R.L. and Araman, P.A., An Analysis of the Physical Properties of Recovered CCA-Treated Wood From Residential Decks, *Wood Fiber Sci.*, 36, 278, 2004.

Environmental Impacts of Treated Wood

Edited by
Timothy G. Townsend
Helena Solo-Gabriele



Taylor & Francis

Taylor & Francis Group

Boca Raton London New York

CRC is an imprint of the Taylor & Francis Group,
an informa business