

Material Trends in Residential Decking

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Wood 493

Report Submitted in Partial Fulfillment of the
Requirements for the Degree of Bachelor of Science
in Wood Products Processing

In
The Faculty of Forestry

April 9th, 2012




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Abstract

Over the past two decades the North American market for residential decking has experienced significant growth that has been forecast to continue into the future. Materials commonly used for deck surfaces include; treated wood, naturally durable wood and wood plastic composites. While in the past ten years treated wood has held it's portion of the market, naturally durable species have lost a significant share of the decking market. Wood plastic composites were introduced into the market in the early 1990's and have experienced exponential growth that is predicted to continue into the future. Almost all decks built today are framed with treated lumber, however dissatisfaction with the quality and longevity of treated wood framing has left it susceptible to new market entrants. Recommendations are also provided for manufactures in the treated wood and wood plastic decking industry.

1.0 Introduction

Backyard decks are a familiar feature of many North American homes, providing an enjoyable outdoor living area for dining, lounging and entertaining. In the United States outdoor living spaces can be found in 82% of single-family homes (US Census Bureau 2006). It is estimated that there are 30 million residential decks in the United States (Truini 1996). The following paper will address past and current trends in the decking industry, explore some advantages and disadvantages of products being used, and offer recommendations for the future with respect to the industry.

1.1 Brief Historical Overview

The decking market has undergone tremendous growth over the past two decades. In 1987, approximately 3.6 million decks were constructed annually in the United States (Smith and Cater 1999). In 2001 the number of residential decks annually constructed significantly grew reaching 6.5 million (Shook and Eastin 2001). Additionally, an average annual growth of the market was recorded at 5.9% during the 2001 to 2005 period (Trex financials 2006).

As the overall volume of annual decks experienced growth, significant increase in the size of decks built also occurred simultaneously. In the late 1980's the average size of decks constructed was 198 sq ft (18.4 m^2) while decks built in 1999 were approximately 280 sq ft (26.0 m^2) (Alderman et al. 2001). Moreover, in 2003 the average size of decks was reported at 456 sq ft (42.4 m^2) (Ganguly and Eastin 2009). In short, over the past two decades there has been considerable growth in the quantity and dimension of decks built annually in North America.

1.2 Drivers of Market Demand

Residential decks are built both on new housing starts and as replacement decks on older homes. Decks built on new housing starts comprise 25% of the total volume of annual decks built in the United States (Ganguly and Eastin 2009). Between 1999 and 2003, 5.9 million new homes added an outdoor living space, which represents approximately 87% of all new homes built during that period (US Census 2005). New housing starts positively affect the demand for decks, as evidenced by the statistics.

The replacement of existing decks comprises approximately 75% of deck builder's volume, allowing the industry to maintain growth even through economic downturns (West 2004) and (Markarian 2008). During economic instability homeowners spend more on remodeling their existing homes, as they may not be in a position to purchase new and more expensive homes. The construction of new decks is a common remodeling expenditure, resulting in continuous demand, even during economic downturns. Interestingly enough, the decking market appears to have strong demand that is maintained even through less robust economic times.

1.3 Future Market Growth

As noted above, the residential decking market has experienced growth over the past two decades. All forecasts for future growth of the market look consistently positive. According to statements made from 2011, the growth of the market will increase at 2.7% annually through 2014 (Wood and Competitive 2011). Potentially the impact on the industry is a market with an estimated value at \$6.2 billion in 2014 (Wood and Competitive 2011). In 2005, the decking industry had an estimated worth of \$3.9 billion United States dollars (Smith and Wolcot 2006). Growth of the market to \$6.2 billion over a 9-year period is statistically significant.

In addition, with the prospect of an American housing rebound in 2014 resulting in an increase of housing starts (Wood and Competitive 2011), the decking

industry will, no doubt, benefit. Although the decking industry does not heavily rely on housing starts (Ganguley and Eastin 2009), based on historical evidence, over 80% of new homes built in the United States will add a deck within the first four years of ownership (US Census 2005). An increase in housing starts will create additional demand for residential decks.

Not only will the housing rebound increase deck construction on new homes, it has been forecast that home improvement expenditures will also increase (Wood and Competitive 2011). The growth of the replacement deck business should also occur during an economic rebound. Overall, the outlook for the future of the decking industry appears promising.

Further growth of the decking market can be attributed to the trend of building outdoor living spaces as an extension of the home (Trex 2006). Decks are no longer simple structures; they include outdoor kitchens, fireplaces and entertainment areas. The demand for outdoor living spaces is expected to increase into the future (Gangely and Eastin 2009). Both an increase in size and demand for decks from the outdoor living space trend will help drive ongoing growth in the marketplace.

2.0 Deck Surface Materials

Decks built in North America are surfaced from the following materials: treated lumber, naturally durable softwood (western red cedar and redwood), wood plastic composites, plastic lumber (vinyl and polyethylene), untreated lumber and tropical hardwoods (Shook and Eastin 2001) and (Ganguly and Eastin 2009). When considering only surface materials used for decks, the market share is approximately 40% treated lumber, 26% naturally durable species and 28% wood plastic composites. The remaining 6% market share is comprised primarily of plastic lumber, untreated lumber and tropical hardwoods (Ganguly and Eastin 2009). The shift in the market over the past two decades is astonishing as treated wood and naturally durable wood comprised 97.2% of the market in 1987 (George Carter 1987), but the introduction of new decking alternatives has reduced the market share of treated lumber and naturally durable lumber to 66% of the market by volume in 2003 (Ganguly and Eastin 2009).

2.1 Treated Lumber

Treated lumber has a long proven history of success when it comes to preserving wood products that are at risk of decay. The first method of preserving wood involved oil borne treatment systems, such as those commonly applied to railway ties. However, oil borne treated wood was not aesthetically suitable for decking applications. The development of copper based preservative systems allowed treated wood to enter the decking market. In the early 1970's chromate copper arsenic treated wood was introduced to the decking market to find a greater number of applications for treated wood products (Freemen and McIntry 2008). Through the 1970's and 1980's chromate copper arsenic treated wood gained a market share in the decking and residential outdoor market replacing traditional naturally durable species.

In the early 2000's there were growing concerns about the safety of chromate copper arsenic treated wood among consumers. Although scientific studies confirmed that there were not any health risks associated with chromate copper arsenic lumber, treated wood manufactures voluntarily restricted the use of chromate copper arsenic treatment for common residential applications that included decking surfaces and framing (Freemen and McIntry 2008). Alkaline copper quaternary and copper azole were introduced as replacement solutions for chromate copper arsenic systems designed for residential applications. The removal of arsenic from the treatment helped address concerns raised by the general public. The transition to a new preservation formula did not have a significant affect on the treated wood market for residential decks (Ganguly and Eastin 2009). Alkaline copper quaternary and copper azole treated wood rapidly replaced the former chromate copper arsenic treated lumber for deck construction.

Today, Canadian manufactures are still using alkaline copper quaternary and copper azole treated lumber for decks. In the United States, in regions with an abundance of southern pine, micronized copper quat systems have become the predominant preservative used for residential treated wood (Freemen and McIntry 2008). Prior copper systems were highly corrosive, however micronized copper quat has been acknowledged as only being slightly more corrosive than untreated wood, making it ideal for decks where fasteners are heavily utilized.

Treated lumber has maintained a relatively stable market share when accounting for both deck surfaces and structure. In 1987, the market share was approximately 83% (Cater 1989). In 1996, treated lumber was found to represent approximately 80% of the market (Truin, 1996). Surprisingly, even with the rapid growth of synthetic decking products it has been found that treated lumber has maintained market share (Ganguly and Eastin 2009) and (Ganguly et al. 2010).

Even with the increase of wood plastic composites, treated lumber is still used for economical decks. In the past higher end or upgraded decks were built with treated wood frames and surfaced with naturally durable lumber. Today these same upgraded decks are built with treated wood frames and surfaced with wood plastic composites. The growth of wood plastic composites was primarily at the expense of

naturally durable wood species. The economical deck market is still using treated wood as a surface product helping maintain treated wood's market share in the decking industry.

2.2 Naturally Durable Lumber

Naturally durable species commonly used in the North American decking industry include western red cedar and redwood. Prior to the introduction of copper based treated wood systems, naturally durable species had no competition in the decking marketplace. Western red cedar is dimensionally stable and has an aesthetically pleasing appearance making it an excellent choice for decks. Redwood has similar properties as cedar, but is only available in limited geographical regions of the United States. Nevertheless, redwood has a share of 4.6 percent of the decking surface market today (Ganguly and Eastin 2009). Unfortunately naturally durable species experience the greatest photo degradation, resulting in a less appealing appearance in the long run. Copper in treated lumber can be attributed to helping slow photo degradation (Archer and Preston 2006). Wood plastic composites are engineered with ultraviolet inhibitors to help prevent photo degradation. Of the three most common decking materials, naturally durable species will experience the greatest photo degradation, which is not ideal for deck surfaces that experience heavy exposure to sunlight.

In the 1980's and the early 1990's the use of naturally durable softwoods for decks remained relatively stable (Shook and Eastin 2001). Following a period of plateau, the market share of western red cedar and redwood decreased in the early 2000's (Shook and Eastin 2001) and (Ganguly and Eastin 2009). The decreasing market share of naturally durable lumber occurred, to a large extent, as a result of wood plastic composites gaining market share.

2.3 Wood Plastic Composites

Wood plastic composites were introduced into the residential decking industry during the early 1990's (Clemons 2002). Since then, they have grown to hold 28% of the market share for decking surfaces in 2003, primarily at the expense of naturally durable lumber (Ganguly and Eastin 2009). The share of wood plastic composites experienced a 12% growth from 2004 to 2007 (Trex financials 2007). Additionally, 80% of deck builders reported they increased their use of wood plastic composites in the period of 2003 to 2004 (Ganguly and Eastin 2009). Over the past two decades the growth of wood plastic composites has allowed them to now hold the position as the second largest decking surface product, overtaking naturally durable lumber.

2.3.1 Wood Plastic Composites Growth

Building materials used for decking are typically exposed to extreme environmental conditions including; moisture, freeze thaw cycles, ultraviolet radiation and foot traffic. In addition to enduring the elements, decking surfaces are expected to look aesthetically appealing. Wood used for decking surfaces will deteriorate over time, causing dissatisfaction in both performance and appearance (Alderman 2001). When homeowners were surveyed to determine their desire for deck replacements, their responses indicated that decayed wood and aesthetics are the top two most important factors when considering a decking product (Alderman 2001). Wood plastic composites are perceived to maintain their aesthetics and decay much slower than wood decking (Smith and Wolcott 2006), therefore making them a preferred choice by homeowners for outdoor deck surfaces.

Wood plastic composites were introduced into the decking market to satisfy the needs of consumers where wood decking could not (Smith and Wolcott 2006). Manufactures of wood plastic composites market their product's benefits over traditional wood decking, which include low maintenance, no risk of cracking and

greater durability (Clemons 2009). The growth of wood plastic composites in the residential decking industry can be attributed to the tangible benefits they bring over traditional decking options. Being more durable, wood plastic composites address the demands of consumers allowing them to gain a significant market share in the past two decades.

Given that the quality of lumber products has been deteriorating over the years due to fast growing secondary forests (Kilger et al. 1995) and (Chini and Gupta 1997), wood plastic composite producers have been beneficiaries of this trend. As the quality of wood declines, greater customer dissatisfaction with wood decking is felt in the market. The result is an increased demand in wood plastic composites.

The promotion and marketing is a critical factor when introducing and expanding new product sales. From 2003 – 2006, Trex invested \$61 million in promoting wood plastic decking to the general public (Trex 2006). The result of the influx of capital was a greater awareness of wood plastic composites, increasing sales and ultimately growing the wood plastic composite industry.

Treated wood products are sold as a commodity product. Most treated wood manufactures produce similar products, competing solely on price. Wood plastic composites compete in a differentiated product marketplace. Each manufacturer creates a slightly different product in a variety of colours and textures. Larger companies such as Trex have four product lines at different price and quality levels to meet the needs and demands of customers (Trex 2006). Customers have much greater choice when considering wood plastic composite products. The growth of wood plastic composites has been enriched by the many options available, including choice of manufacturer, product lines, texture and colour.

2.3.2 Wood Plastic Composites –Trex

Trex is the leading wood plastic composite manufacture; they currently hold the largest market share of wood product composite decking (Trex financials 2010). In addition to being the largest manufacture, Trex pioneered the use of wood plastic

composites in the decking industry in the early 1990's (Clemons 2002). Trex products are sold at distributors across North America; therefore their annual sales can be used as a gauge of wood plastic composite market growth across Canada and the United States. The company has seen significant growth over the past 12 years. In 1996, Trex had net sales of \$23 million (Trex Financials, 2002). In 1998, one year prior to its initial public offering Trex had \$49 million in net sales (Trex financials 2002). Company growth fluctuated but resulted in \$317million annual net sales in 2010 (Trex Financials 2010). Reviewing Trex's growth of annual sales over the past fourteen years suggests that wood plastic composites have made significant gains into the North American decking marketplace.

2.3.3 Wood Plastic Composites – AERT

Trex's main competitor and the second largest wood plastic composite manufacture worldwide is Advanced Environmental Recycling Technologies (AERT). Their products are also sold in both Canada and the United States allowing their annual sales to be used as a gauge for the growth of the North American wood plastic composite decking market. Advanced environmental recycling technologies' statement of operations in 2000 acknowledged annual net sales of \$27 million (AERT Financials 2004). Over a ten-year period the company experienced growth that more than doubled their annual sales to \$70 million (AERT Financials 2010). The growth of AERT's annual sales is less significant than industry leader Trex, however, it does confirm significant growth of wood plastic composites over the past decade.

2.4 Plastic Lumber

Although plastic lumber holds a minority share it should not be dismissed as insignificant. In 2003, it was estimated that plastic lumber was used for 2% of decking surfaces in the United States (Ganguly and Eastin 2009). Additionally, in 2005 it was estimated that 1% of all materials used for decking was plastic lumber

(Trex financials 2006). The market share of plastic lumber in the early 2000's was low, however at that time the boards were not considered to be aesthetically pleasing, resulting in a loss of market share.

However, the durability of plastic lumber is higher than wood plastic composite, placing it in ideal position for future growth (Carroll 2001). Decking manufactures are focusing on creating plastic lumber that better resembles natural wood, which should increase the demand for plastic lumber (Wood and Competitive 2011). Advanced plastic lumber decking now mimics the look of natural wood with a variegated wood grain appearance. Coupled with an increase in durability, plastic lumber should undergo significant gains in market share. Future projections expect plastic lumber decking to experience double-digit growth (Wood and competitive 2011). The growth in demand for plastic lumber will add another material to the marketplace.

2.5 Future Trends of Deck Surfaces

The wood plastic composite market share is expected to continue to grow over the next five years. Forecasts project an annual growth rate of 12.4% for wood plastic composites until 2016 (Wood-Plastic Composites: Technology and Global markets 2011). Additionally, growth in plastic lumber has been projected to reach double-digit growth rates through 2014 (Wood and Competitive 2011). Forecasts suggest market share growth of wood plastic composites and plastic lumber will occur. Consequently the usage of treated wood or naturally durable species may be on the decline.

Over the next ten years an increasingly large proportion of the population will be within the age bracket of 45 to 64. Being an older population they will be in a position to spend more on deck expenditures, while at the same time demanding higher quality products (Ganguly and Eastin 2009). Wood plastic composites are a perfect match for the age group as they can afford the higher initial cost while potentially enjoying the benefits of higher performing products. Given that many consumers perceive wood plastic composite decks to have greater durability and

minimal maintenance (Winandy 2004), and considering that consumers also desire longer lasting products to avoid future replacement issues, the demand for wood plastic composite will likely increase from this demographic.

Today the consumer is becoming more buyer savvy and aware of the environment when making purchasing decisions. Forecasts suggest that the environment is a growing concern among consumers (Woolverton and Dimitri 2010). The general public perceives wood plastic composites as a more environmentally friendly choice over wood (Markarian 2008). Additionally, treated wood is perceived as an adverse influence on the environment even when scientific data suggests otherwise (Preston 2000). The strength of consumer perceptions was clearly demonstrated when consumers of treated wood products were raising concerns over arsenate in exterior wood structures (Freemen and McIngly 2008). To satisfy consumers' perceptions wood preservers voluntarily restricted the use of chromate copper arsenic treatment switching to alkaline copper quaternary and copper azole preservatives in 2004. With a greener environment becoming an increasingly important factor in product buying decisions, coupled with the poor perceptions of chemicals and treated wood, the future growth of wood plastic composite decking is inevitably positive.

The use of micronized copper quat as a treatment system has been increasing. When North American wood preservers were asked about their use of micronized copper quat systems 67% answered they have increased the amount of treatment from 2006 to 2007 (Volsky 2009). Today, it is estimated that the majority of residential treated wood in the United States is a micronized copper systems (Freemen and McIntry 2008). Today Canadian preserved wood is still treated with amonical copper quat and copper azole. However, based on the trends in the United States we should see micronized copper quat treatment systems developed and commercially feasible in Canada shortly.

The growth of the decking market has caught the attention of many companies who wish to capture the market share. Innovative new products are being introduced and tested in the market frequently. Some potential products commercially available include thermally modified, acetylated and glass-infused

wood (Kolle 2011). Additionally, we may see advancements in existing technologies. The wood component in wood plastic composites typically is sourced from softwood waste in North America. SWB global solutions has seen ways to improve wood plastic composites by utilizing 70% bamboo fiber to increase hardness, durability and density (Gibson 2011). Once an innovative new product has proven itself and gained acceptance there can be an unpredicted shift in the market.

An interesting comparison can be made between treated wood and wood plastic composites. Prior to the introduction of residential treated lumber the decking market was dominated by naturally durable species. The introduction of chromate copper arsenic treated wood to the decking market provided an economical and durable choice for decks. When treated wood was brought into the decking market during the 1970's and 1980's, the growth pattern had many similarities to the growth of wood plastic composites over the past two decades (Winandy et al. 2004) and (Freemen and McIntry 2008). If this is an indicator of a product life cycle, wood plastic composites may soon hold a majority market share. Forecasts also support that there will be considerable growth of wood plastic composites in the next five years (Wood-Plastic Composites Technology and Global Markets 2011) and (Wood and Competitive 2011). However, it should also be noted that treated wood is used for structural applications in addition to deck surfaces. Wood plastic composites are used solely for surface applications; therefore the introduction of wood plastic composites to the market does not exactly parallel the introduction of treated wood 30 years ago. Additionally, treated wood had an economical advantage of a lower price over natural durable wood during its introduction, propelling its growth. However, the introduction of wood plastic composites to the decking market does not have the same benefits as treated wood did during its introduction. Nevertheless, a strong outlook for wood plastic composites growth can be anticipated in the future.

3.0 Deck Structure Materials

Deck builders currently use treated lumber for 91% of the residential deck structure regardless of the material applied to the surface (Ganguly and Eastin 2009). Even with wood plastic composite's growing share in decking surfaces wood plastic composites are not used for structural applications. Wood plastic composites have lower strength, stiffness and creep resistance than solid wood, making them unsuitable for structural applications (Clemons, 2002). Although wood plastic composites have captured a tremendous market share, treated wood has been relatively stable as there is still a strong demand for treated wood deck frames.

3.1 Future of Materials Used for Deck Structures

Increased deck longevity can be achieved when building with wood plastic composites and plastic lumber. These new decking surfaces now have a life expectancy greater than the treated wood structural frame (Shaw 2011). Some deck builders are now looking towards new structural products such as cold rolled light gauge galvanized steel frames. Decks built from galvanized steel frames last longer and result in a flatter deck. Unlike wood joists, steel does not crown, twist and warp under moisture changes, resulting in a better dimensionally stable deck. The cost of cold rolled steel framing is not much higher than traditional treated lumber framing for a deck (Shaw 2011). A study completed by Chini and Gupta (1997), compared the cost of building a new home with both steel and lumber. The results showed that both labour and material costs were very similar between homes framed with light gauge steel and traditional wood framing (Chini and Gupta 1997). Another study completed by Bateman (1997), suggests that the many advantages of light gauge steel framing give it an optimistic outlook for use in future residential construction. While the benefits of steel framing are high the cost remains similar to existing treated wood framing so the potential for steel framing to become a substitute product is high.

As previously mentioned, Trex, being the largest composite deck manufacture, is introducing a galvanized steel deck structural system to their product line in spring 2012. The product utilizes familiar beams, ledgers and joists however they are made from galvanized steel rather than treated lumber. The product will become available for sale through all their distributors that currently sell composite decking. Trex has substantial industry knowledge, a vast distribution network and financial support, potentially rendering steel deck framing an even greater threat to treated lumber.

Currently 38% of pressure treated lumber produced is used in the decking industry (Alderman 2001). With the growth of wood plastic composites, treated lumber was still used in the frames of these decks. If steel framing gains significant market share, large reductions in the use of treated lumber use will occur. Treated lumber's dependence on the decking industry would mean a significant change would adversely affect treated lumber manufactures.

4.0 Recommendations for Treated Wood Manufactures

To maintain competitiveness with new market entrances, treated wood manufactures must consider improving their marketing efforts and product quality. Traditionally, treated wood has been categorized as a lower end product that competes on price alone. Other benefits such as environmental friendliness and initial appearance must be brought to the attention of potential consumers to help convert and maintain customers. The quality of treated wood can also be improved to provide better satisfaction among treated wood deck owners. By producing better quality exterior finishes, the aesthetic appearance of decks may be improved upon. Additionally, the manufacturing of a 5/4" thick deck board should be studied in terms of advantages and disadvantages in the current market.

4.1 Marketing of Treated Wood Decking

To better compete against wood plastic composite manufactures, treated wood producers can improve their marketing efforts by focusing on the benefits of their product. Competing simply on price was an effective strategy to gain market share from naturally durable wood in the past, however, today's customers have many more options from competitive alternative products in the same marketplace. Treated wood producers must market all the benefits of their products to better compete or they may potentially experience an eroding market share.

When customers were asked what influenced them to purchase wood decking, the following three attributes were most common; price, appearance and environmental friendliness (Roos and Nyrud 2008). Today treated wood is the most economical choice for decking therefore giving this product a considerable competitive advantage over other products in the market. Additionally, most consumers are aware that treated wood is the economical choice therefore marketing it as well priced is not always necessary. However, rather than being seen

as the most economical option, treated wood producers should promote the benefits of wood to potential customers.

The beauty of natural wood is highly desirable and sought by many, which is clearly evidenced by wood plastic composite manufactures attempting to mimic the appearance of real wood. As a competitive advantage, treated wood manufactures should market their products as real wood with an authentic natural appearance. Additionally, the availability of quality exterior finishes allows decks to be tinted to almost any available colour. The benefit presented to customers should be that once a deck begins to age, it could be refinished to a like new appearance. In summary, treated wood manufactures could market their product more aggressively with a focus on colour options and the ability to readily refinish installed decks. Wood plastic composite manufactures are not able to offer this option.

Also, consumers of today are becoming more aware of the environment when making purchasing decisions (Woolverton and Dimitri 2010). To better compete with this emerging trend treated wood producers must educate deck customers about the environmental benefits of building with wood. Today, aggressive marketing campaigns by wood plastic composite manufactures suggest that their products are an environmentally friendly choice over wood (Smith and Baily 2002). To better compete, treated wood producers could market the environmental benefits of wood decking emphasizing sustainable forest management and the added longevity gained by treatment processes. Marketing the environmental benefits of treated wood decking will help gain customers in the growing trend of the eco-friendly customer.

4.2 Improving the Quality of Treated Wood

Improving the quality of treated wood decking will help secure future customers. Suggestions such as producing grooves and the use of wax additives with treatment have been studied, however currently this technology is not being implemented in North America. Improving the quality of available exterior finishes

will greatly benefit treated wood manufactures as it will benefit the appearance of finished decks resulting in greater customer satisfaction. Additionally, the manufacturing and sale of a 5/4 inch thick board should be reassessed to see if it helps or hurts the treated decking market share.

In the past, the treated wood industry has tried to improve its product to provide a better quality deck board. Some suggestions that were previously researched included adding a wax additive during the treatment process and placing grooves on deck boards. When customers were surveyed, the aesthetics of a deck board was ranked as the second highest reason for dissatisfaction (Alderman 2001). High levels of checking in deck boards results in a poor appearance. Studies completed on radiata pine decking suggest that the addition of a wax additive helps to reduce checking (Evans et al. 2003). Importantly, including a hydrophobic wax additive when chemically treating deck boards may help minimize dimensional changes resulting in an increase of the aesthetic appearance of wood decking.

As previously mentioned, the checking of deck boards results in a dissatisfaction in terms of the aesthetic appearance of decks. Another method of controlling the appearance of checks is to introduce machine grooves into the boards. Studies on the effect of profiling deck boards have concluded that checks are much narrower and are less visible if located at the base of the grooves (Evans et al. 2010). By machining grooves into wood deck boards the appearance would improve, producing a more desirable product. Manufactures of treated wood decking boards have experimented and considered the suggestions, however they are not being implemented at this time for treated deck boards in North America.

To reduce the damage caused by weathering it is recommended to apply a protective coating on exposed wood. The purpose of coating exterior wood is to minimize dimensional changes caused by moisture uptake, to protect the wood from ultraviolet radiation and to minimize microbial degradation (Meijer 2001). However, the durability of coatings available today is marginal. Many require yearly recoating with questionable longevity. Improvements in coating systems with regard to durability and life expectancy will help improve treated wood products. With more durable coatings readily available for exterior wood it will help improve

the aesthetic qualities of wooden decking. An improvement in the quality of finishes will help benefit treated wood by allowing deck owners to better protect and maintain their investments.

Traditionally decks were surfaced with a 2"x6". However, the introduction of a 5/4"x6" deck board provided a slightly more economical solution as less material is needed due to a 1/2" (12.7mm) thinner profile. Nevertheless, the thinner board may be more susceptible to cupping, warping and checking than the thicker 2"x6" board. Customer dissatisfaction with treated wood deck boards is already high. Therefore providing an even lower quality economical deck board may be counterproductive, adversely affecting future sales rather than benefit the market share of treated wood.

A further study of the checking, warping and cupping of a 5/4"x6" compared to a traditional 2"x6" treated wood deck board would be recommended. The objective would be to determine if significantly greater amount of aesthetic degradation occurs on the thinner deck board. If the results show a 5/4"x6" deck board to be more susceptible to cupping, warping and checking, manufactures should discuss discontinuing the production of a 5/4" thick board. Although a long-term business decision, it could bring significant benefits to the industry. It is possible that a 2"x6" treated wood deck board will become the most economical option for decking, as in the long run, the thicker profile should minimize warping, checking and cupping resulting in higher satisfaction among customers.

5.0 Recommendations for Wood Plastic Composites

Wood plastic composite manufactures have been successful at implementing their product as evidence by the exponential growth in the North American marketplace. A few recommendations for wood plastic composite manufactures include producing more authentic looking deck boards, better educating the consumer on the benefits of wood plastic composites and introducing more competitive pricing. Implementing these suggestions may help wood plastic composite manufactures maintain growth into the future.

The first generation composite boards had a poor appearance. However, newer deck boards have begun incorporating wood grain and the texture of real timber. Continued innovation and improvements will help man-made decking manufactures compete with wood. Many homeowners seek the appearance of real wood, however they would like to avoid the burden of extensive maintenance and poor durability. Developing a better more realistic looking man made deck board will help manufactures continue to gain market share. Manufactures of wood plastic composites and plastic lumber decking should attempt to replicate tropical hardwoods as best they can to create more visually appealing products.

As with the introduction of many products, challenges arose during the first years of manufacturing wood plastic composites. Many companies attempted to enter the market with products that were untested and not suitable for the harsh outdoor environment. As a result many companies have since gone out of business creating a poor reputation for wood plastic composites. Additionally, many wood plastic composite companies had claims that they provided a no-maintenance decking product. In 2009, although not admitting any wrongdoing, Trex settled a class action lawsuit over quality problems (Trex News Release 2009). Many consumers have poor perceptions of composites due to overpromised performance of earlier generations of wood plastic composites. To improve customer perception wood plastic composite manufactures must deliver on their warranties and provide

better service for customers. Enhancing the reputation of wood plastic composite manufactures will help them gain new customers.

The price of wood plastic composites is their greatest hurdle to gaining a majority share of the North American decking market. Currently wood plastic composites cost approximately twice that of treated wood decking (Smith and Wolcot 2006). To fully become a substitute product for treated wood decking manufactures will have to find ways to reduce prices. Through economies of scales and gains in manufacturing efficiencies wood plastic composite producers have the potential to close the price gap making wood plastic composites a more affordable option for consumers.

6.0 Conclusion

Residential decks are a common occurrence found in 82% of North American homes. The popularity of outdoor decks and the investment by homeowners has been increasing. The past decade has seen the annual number of decks built grow by 2.9 million. Additionally, the over all size of decks being built has more than doubled in the past two decades. Demand for decks is seen with new housing starts and replacement of existing decks. The market for new decks on new homes is linked to housing starts however; this only represents 25% of the deck builder's volume. The remaining 75% of deck builder's business is found in the replacement sector that is less affected by the economic cycles. The future of the decking market place looks positive with much anticipated growth. Materials used for deck surfaces are treated wood, naturally durable wood and wood plastic composites. Treated wood has maintained its market share over the past few decades despite the introduction and growth of new man made materials in the marketplace. Naturally durable wood species used for decks has declined over the past decade. Wood plastic composites were introduced into the decking market place in the early 1990's and have experienced tremendous growth, gaining a significant portion of the market. It is forecast that growth of wood plastic composites will continue into the future. Today, decks are almost exclusively built on treated wood frames, however, concerns have been raised that materials used on the surface are outperforming the substructure in quality and longevity. The potential for new products such as light gauge steel have the opportunity to penetrate the market causing a significant reduction in demand to the treated wood market share. Treated wood manufactures must make improvements in marketing efforts to better compete with new market entrances. To continue growth wood plastic composite producers must improve their reputations among consumers.

In conclusion, the North American decking market is quite vibrant and prosperous. There have been many developments in the decking industry that are expected to continue into the future. The decking industry appears to have a bright future, but further research can help address issues such as durability, efficiencies, the environment and sustainability.

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