CWPA Proceedings, 2004, pp 77-89

OPPORTUNIES FOR TREATED WOOD IN CHINA

Wayne Iverson, COFI
Mike Jahraus, BC Wood

Summary

This manuscript has been prepared in support of Canada Wood's market development program in China. It provides an overview of the treated wood market and identifies export opportunities for Canadian wood treaters, sawmills and exporters.

The treated wood industry in China dates back to the early 1930s when the Ministry of Railways established manufacturing plants for the treating of railway sleepers and utility poles using domestic Chinese pine. As timber became scarce, the Chinese government substituted from treated wood to concrete and today concrete railway sleepers dominate the market (except on railroad curves and bridges). Many of these original state-owned manufacturing plants are no longer in business. The few state-owned plants that still exist (most are in receivership) continue with the railway sleeper and utility pole business but some have now started producing CCA and ACQ treated sawn wood products, mainly for the growing landscaping industry.

The size of China's treated wood market is approximately 600 thousand m^3/year (including the large Boron treated rubber wood industry for furniture). However, the treated wood market represents less than 0.4% of the total wood consumption (160 million m^3/year). Today there are approximately 120 wood treaters in China, with an average treating capacity of 4,000m^3 annually. The main preservatives being used today are Boron (for rubberwood), CCA and ACQ. Most treated wood is currently being used for furniture, railway ties, agricultural posts, structural lumber, fences, decking, walkways, gazebos, cooling towers, and mining poles. Domestic producers represent between 40% to 50% of the treated sawn wood market (most of which is CCA treated wood for landscaping applications). Given the continuing growth in large landmark projects in urban areas, the development of public forest parks, real estate projects and private gardening projects for wealthy residents, demand for treated wood can be expected to surge in Chinese coastal cities in the next few years.

Treated wood imports have experienced significant growth in the past three years. In 2003 approximately 20,000m^3 to 25,000m^3 of treated wood was imported. Finland's Finnforest has experienced unrivaled success due to their intense image and branding campaign launched in 1997. Today Finnforest treated wood (fenlan mu) is synonymous with treated wood to the extent that specifiers and users of treated wood use the term "fenlan mu" (Finnforest treated wood) when making reference to treated wood. This demonstrates the importance of unified branding initiatives in the Chinese market.

A national standard for treated wood exists, but it only applies to treated wood used in structural applications. The treated wood industry is currently in the process of drafting two 'industry standards' (not compulsory) and these will soon be published. These standards allow the use of CCA regardless of its place of origin. A ban on the usage or importation of CCA treated wood is unlikely, as this would greatly harm the domestic treated wood industry. Domestic supply is increasing in capacity and improving in quality. As witnessed in other industries in China, it is only a matter of time before domestic treaters achieve quality levels that are more comparable to that of foreign treaters.

In the short to medium term, a window of significant opportunity exists for imports of treated wood products. However, growing restrictions on foreign treaters (in their home markets) in supplying CCA treated wood along with domestic competition will likely make it increasingly difficult for foreign treaters (including Canadian) to gain easy access to the Chinese market without strong product image and branding efforts. While it will undoubtedly be difficult for Canadian treaters to compete with domestic producers in future years, as their quality and image improve, there will be a growing opportunity for sawmills and exporters to export Canadian species such as Hemlock, Amabilis Fir, Douglas fir, and Pine as stock that can then be treated in China.

1 Introduction

The objective of this manuscript is to provide an overview of the treated lumber market in China (past and present) and to provide an assessment of treated lumber opportunities for the Canadian forest industry. It is expected that the information contained in the manuscript will provide the necessary background to encourage a more focused market development program for Canadian forest products in China.

Much of the information in this manuscript has been collected by the Council of Forest Industries (COFI) and BC Wood Specialties Group (BC Wood) in support of their respective market development programs. The Government of Canada, under its Canada Wood Export Program (CWEP), and the Province of British Columbia's Forestry Innovation Investment (FII) provided financial assistance for this manuscript.

Canada Wood (group) in China is a partnership between industry associations and government. Partner associations include BC Wood, Canadian Plywood Association (CanPly), Coast Forest & Lumber Association (CFLA), Council of Forest Industries (COFI), Quebec Wood Export Bureau (QWEB), SPF Group.

These associations, with their respective member companies, are working together under the Canada Wood name (with offices in Shanghai and Beijing) in an effort to create name recognition and branding of all Canadian initiatives / wood products in China. The Canada Wood offices play two key roles. First, Canada Wood provides technical and training support to ensure a local competency for the use of Canadian products and species. Secondly, Canada Wood engages in product and species promotion activities.

The list below outlines some of the ongoing activities in the Canada Wood Office.

2 Methodology

The information in this manuscript is based on extensive countrywide interviews that were held with government, associations and industry representatives throughout China. Numerous site visits to treaters, distributors, and treated wood importers provided a practical perspective to the writing of this manuscript.

3 Results and Discussion

The production of treated wood started in Northeast China during the 1930's for the sole purpose of treating railway sleepers. During the 1950s, railway construction boomed causing the treated wood industry to prosper. Within a few short years, the Chinese government established several treating plants across China. In the 1970s, the treated wood industry experienced its peak with annual production of treated wood (mainly creosote treated sleepers & telephone poles) reaching approximately 1 million m^3.

The blossoming economy of the 1980s led to a dramatic increase in the demand for railway sleepers. However, because of China's timber shortage, the Central Government and Railway Bureau turned from using wooden sleepers in favor of using concrete sleepers. Since that time, the Ministry of Railway's treated wood plants have been in a state of decline. Today, these state owned enterprises (SOEs) are undergoing major reforms, privatization, and in many cases, bankruptcy. Many workers are leaving the government plants in search of stable employment and many of them are joining private treated wood ventures. The majority of personnel in these new ventures can be traced back to government owned treated wood plants, which today form the heart of the treated wood industry. Today, seven primary state-owned (Ministry of Railways) treated wood facilities remain.

Urban renewal and real estate development became major industries in the late 90s. City planning and real estate projects were looking for new products to use during the construction boom. Imported pressure treated wood soon became the desired construction material for some specifiers and construction companies. Today, many major coastal cities are using pressure treated wood for landscaping projects including decks, boardwalks, fence, gazebos, bridges, flower boxes and outdoor furniture. The landscaping industry is fast becoming a major market for pressure treated wood in China.

Historical Application of Treated Wood in China

A. Railway sleepers. Although most of the wooden railway sleepers have been replaced by concrete, wooden sleepers are still being used for curves, corners, bridges and junctions.
B. Rubber Wood Furniture. The treated rubber wood market in terms of volume represents approximately 70% of the treated wood market with an annual

production of 200,000m³. Treated rubber wood is primarily used in the furniture and joinery industries.

C. Cargo container soleplates. About 70% of Chinese containers have the soleplate treated before they are shipped overseas.
D. Heritage and historical wooden structures. Approximately 5,000m² of wooden heritage buildings are treated each year. Some buildings in Beijing's famous Forbidden City have recently been treated with CCA. In Feb of 2004, China issued new rules to protect ancient areas and buildings. According to the new rules, damaging or demolishing historical buildings or altering the traditional style of old buildings is prohibited.
E. Landscaping. Landscaping traditionally has been limited to small-scale projects such as residential gazebos, walkways and decks. Today, the landscaping industry is booming as the Gardening Ministry, civil and private projects are investing millions of dollars in "greening" China. Large civil projects today include park landscaping and ocean boardwalks.

Treated wood makes up a very small portion of the total wood market in China, accounting for approximately 600 thousand m³/year (less than 0.4% of the total wood consumption of 160 million m³/year). The normal consumption of treated wood in developed countries is 10 to 15 percent of the total wood usage.

The following table gives an overview of the domestic treaters, their products and volumes.

Items	Numbers of plants	Preservatives	Regions	Wood species / Products	Amount (1000 m^3)	Type of wood
Railroad railway ties	25	Creosote	Haer Bin, Chengdu, Wuhan, Beijing Yingtan Liuzhou Zhenlai	Larch, Pinus massoniana	230	Sawnwood
Electricity poles	2	Creosote		Larch, Pinus massoniana	6	Logs
Rubberwood	43 (55 cylinders)	Boron	Hainan, Yunnan, Guangdong	Furniture, flooring	200	Sawnwood

Fire resistant wood for interior decoration, flooring in public building	21	Phosphate salts, polyphosphate, Boron		Various	42	Sawnwood
Agricultural posts	7	CCA	Guangdong	Eucalyptus, Chinese fir	16	Logs, small diameter
Mining poles	4	CCA	Fujiang		8	Sawnwood, logs
Structure, fence, decking, horticultural components	12-15	CCA, ACQ, CuAz	Shanghai, Zhejiang	Scots pine, hemlock, SPF	50	Sawnwood
Cooling tower	1	CCA	Jiangsu	Hemlock	2	Sawnwood
Others (modification)	1	NA			NA	Sawnwood

Source: Chen RW *et al*., (2003).

Domestic Capacity

According to the China Wood Industry magazine (Jan. 2004), there are approximately 120 treating plants in China. Ten percent of the treating plants are large plants, with an annual capacity between 10,000m³ to 50,000m³. Forty percent are medium size with a capacity between 5,000m³ to 10,000m³and the remaining 50% of the manufacturers are classified as small plants having a production capacity of less than 5,000m³ a year.

At present, the domestic treated wood industry employs approximately 5,000 people. This is a relatively small number when compared with other industries in China. As sales and marketing personnel account for more than half of the people in the industry, there are more people trading, marketing and selling treated wood products than those involved on the manufacturing side. Knowledge about wood species, treating processing, applications, handling, and after sales service are areas where expertise is often lacking.

Treated Wood Imports

According to Chinese customs statistics, approximately 15,000m³ of treated sawn wood (primarily CCA treated wood for landscaping applications) was imported in 2003. This figure is likely understated, as it is quite common for importers to declare goods at a lower value in an attempt to avoid tax. A common tactic for importers is to declare treated lumber as untreated lumber, which has a lower value. However, through extensive interviews with importers and treated wood wholesalers, it is more reasonable that the volume of imported pressure treated wood in 2003 is between 20,000m³ to 25,000m³.

Treated wood imports have experienced significant growth in the past three years. Finland's Finnforest has experienced unrivaled success due to their intense marketing campaign which was launched in 1997. For the first four years (1997-2001) Finnforest experienced limited sales. However, the market developed quickly in 2001, resulting in

rapid sales growth for Finnforest. A Shanghai Finnforest representative recently reported, “the market suddenly took off in 2001-2002 and we enjoyed a great deal of success and were able to establish a brand as there was almost no competition.” It was not long before others saw the opportunities that existed and within the next year, there were several trading companies entering the market. It is worth noting that the Finnforest treated wood (fenlan Mu in Mandarin) brand is well known throughout China; so well known that for many Chinese, the Finnforest brand is synonymous with treated wood. For example, it is common for specifiers to specify “fenlan mu” (Finnforest treated wood) for public projects (rather that just saying “treated wood”) as many specifiers think they are the same. This misconception could be blamed on the lack of product knowledge, but it is more likely attributable to Finnforest’s early market entry as well as their aggressive marketing campaign. As foreign treating companies began finding success, local companies started to enter the market. Today, it is estimated that domestic producers represent 40% to 50% of the treated wood market.

The future for the treated wood market looks very promising as the Chinese economy and real estate development continue to grow at significant rates. The National Statistic Bureau and the central government reported that the Chinese economy grew 9.1% in 2003 and is expected to grow 7% in 2004. Real estate and urban development is expected to grow at an even faster rate.

Drivers

Timber Shortage

As the domestic demand for timber continues to grow and the Government's forest protection policy continues to be enforced, China is expected to become increasingly dependant on wood imports. The Chinese Academy of Forestry has estimated that by the year 2010, China will have a fiber deficit of more than 175 million cubic meters. China's market for industrial timber, pulp, and paper has now become the second largest in the world after the United States. As China’s dependence on wood imports grows, it is increasingly becoming a significant export market for Canadian wood products.

According to the latest statistics from China's Customs, in 2003 log imports totaled 25.46 million cubic metres valued at US$2.447 billion, a year on year increase of 4.6% in volume and 14.6% in value. However, the rate of growth of log imports fell by around 40% in volume over the previous year. In 2003, China's sawn wood imports have been reported by Customs as 5.5117 million cubic metres valued at US$ 1.19 billion, a year on year increase of 2.1% in volume and 2.7% in value. However, as for logs, the rate of growth in sawn wood imports fell by 31% compared to the previous year. However, China's plywood imports enjoyed rapid growth and amounted to 800,000 cubic metres worth of US$ 355 million, a year on year increase of 25% in volume and 37% in value, a significant change on recent trends. Source: ITTO

Construction

China's building industry, according to the latest data, realized 720 billion yuan in total output value in 2002, making up 7% of the Gross National Products. Of the total, output value from the national interior improvement and decoration sector was 420 billion yuan

representing a 30% year on year increase. According to local analysts, the annual growth in this sector will outpace national economic growth rates by at least 3 to 4 percent over the next 10 years. By 2010, it is expected that output value of the timber industry generated by the construction sector will exceed 1000 billion yuan, making the sector one of the most important growth points in the national economy. The housing joinery, moldings and woodworking sector will undoubtedly grow in tandem with the development of the housing construction sector. From a consumer viewpoint, improved housing has become number one among the main 5 points identified by consumers as important along with automobiles, travel, education and information services. With the rapid development of the economy and improvements in living standards, consumption patterns have changed from the traditional "food, clothing and daily necessities" to "housing and travel". Viewed from an international perspective, housing in China is ripe for growth. A per capita housing area in developed countries is around 35 square metres or more. In contrast, the per capita housing area in China is only at best 21 square metres.

China's "Tenth Five Plan", calls for this to increase to 22-23 square metres for urban areas and to 25+ square metres in rural areas by 2005. According to the national housing development program, China will complete at least 200 million square metres of housing construction area per year over the next 10 years. In terms of city developments, the rate of urbanization is expected to increase rapidly, could have grown by around 45% by 2010, and could exceed 50% by 2020. Based on current urban populations, five square metres of housing area per capita must be built if the planned increase of 1 square metre in per capita housing areas is to be achieved. If the urban population will increase to 640 million (190 million more than that in 2002) then by 2010, some 418 million square metres of housing area must be built in order to meet the housing demands of the increased population calculated at 22 square metres of housing per capita. From the housing industry (including building timber, metallurgy, commerce, and services) point of view, such growth would translate to an estimated 150-170 yuan for every 100 yuan of investment in housing. Analysts also estimate that for each 100 yuan of housing sold there is a boost to other goods consumption of 130-150 yuan. Source: ITTO

Heritage Construction Restoration

The Central Government's Ministry of Construction has a policy in place to preserve and restore historic sites and relics. Those that come under the plan include ancient city walls, former residences of imperial families and famous historical figures, temples, and sections of the Great Wall. At present, Beijing has 3,500 historic sites, with a total floor space of two million square metres. Hundreds old wooden buildings are in great need of restoration as many are in danger of collapsing due to large sections of wood that are severely damaged or missing. (Source: 2004 Xinhua News Agency)

Greening

Perhaps one of the largest factors driving the increasing consumption of treated wood in China is the creation of greening policies. The central government, supported by strengthening consumer pressures, is determined to enforce new environmental laws. The recent enforcement of various antipollution laws and preparation of new criminal codes for environmental offenses have shown the country's determination to act more

proactively to tackle its ecological problems. Any party found guilty of damaging, demolishing and restructuring historical buildings; altering the traditional style of old buildings; and illegal occupation or destruction of gardens, grasslands, lakes, and roads may be punished and imprisoned under the new set of laws.

The National Garden Ministry, responsible for providing and maintaining parks, gardens and other types of public open space, has launched a campaign to further its commitment to greening urban areas. Extensive green creation programs such as large-scale public park projects are underway. Furthermore, various promotion programs have been organized to encourage greening of school campuses, home gardening and good practices in the landscape profession. The Garden Ministry's programs are managed at the municipal level by Municipal Gardening / Greening Administrative Bureaus.

Greening Bureaus throughout China are actively involved in trying to assist older cities to reach "Garden City" status. To be a "Garden City," 35 percent of a metropolis' public lands need to be covered with green plants, while per capita green space should be at least 7 square meters. Shanghai has just recently achieved "Garden City" status. The city's green coverage rate was just 30 percent until last year.

Publicity for greening the city is conveyed through the Green China Campaign, which encourages greater green-consciousness amongst the public, private developers and professionals involved in development projects.

The following table shows the dramatic increase of land that has been developed as green space during the last three years. (Source: Shanghai Greening Bureau).

Region	2001 (m^2)	2002 (m^2)	2003 (m^2)
Guangzhou	147,710,000	187,580,000	229,130,000
Shanghai	466,350,000	1,081,000,000	1,096,000,000
Beijing	260,000,000	284,000,000	300,000,000

Beijing (Green) Olympics 2008

China has made sure that its efforts to green the 2008 Beijing Olympic Games will be visible-and thus has devoted significant time and resources to ensure projects reflect this. One government official underscored the desire to look good, suggesting that Beijing is cleaning its environment "just as you might...clean the curtains before visitors arrive." Beijing officials promise that park areas will account for more than 60 percent of the main Olympic venue and maintain that, by the time the Olympic torch arrives in China, 40 percent of Beijing will consist of parks and waterways. Beijing Municipal Bureau of Environmental Protection plans to spend 4% of the city's gross domestic product - some $ 1.5 billion annually - on environmental protection.

Treated Wood Standards

In terms of product standards and quality control, the Chinese domestic pressure treated wood industry is in a state of disarray. China has traditionally been without an organization to harmonize preservative standards and practices. Key issues such as

species classifications, preservative usage, penetration rates, application criteria and quality assurance are handled differently by each manufacturer. Unfortunately, the lack of standards and regulation has meant an influx of many new, inexperienced players to the market who may be producing substandard and even environmentally harmful products. Their pursuit to reduce costs (at the expense of quality) and undercut the competition leads them down the path of no return as they simply stay in business just long enough harm the industry's reputation.

A national (compulsory) treated wood standard does exist within the newly published design code for timber structures (GB50005—2003)) and the national quality acceptance of timber structure code for construction (GB206—2002). These two codes only pertain to treated sawn lumber, laminated timber, structural composite lumber and plywood that are to be used in timber construction. They DO NOT address preservation requirements for timber in applications other than in construction.

In an attempt to address the lack of standards, the State Administration of Forestry's China Wood Standards Technical Committee (CWSTC) organized a treated wood standards committee made up of treated wood representatives from Canada, Finland, US, Japan, the Chinese Academy of Forestry and some domestic treaters. As can be expected, each participating party is inclined to propose submissions that are self-serving which often results in disagreements on some crucial points relating to species selection and classification.

Two Treated Wood Standards under development
The committee has specifically drafted two separate treated wood standards. They are:

1. Use category and specification for treated wood standard (deals with wood species classifications for treaters)
2. Wood Preservatives Standard (deals with wood preservative for chemical and preservative companies.

The most recent meeting took place in Beijing on March 15, 2004. They were able to recommend key alterations that will prove critical to the marketing of Canadian treated lumber. The most critical points from Canada's perspective are the penetration requirements and the classification of durable vs. non-durable species. Within the current 'Use Category' standard, durable wood refers to wood that is "moderately durable or better" and does not have a penetration requirement. According to the draft standard (prior to the March 15 meeting), Canadian species such as Hem-Fir and SPF are classified as non-durable wood.

The Canadian objective was to ensure that Canadian species were removed from the non-durable classification by creating a "moderately durable" classification. This would make sure that competing species did not have an undeserving marketing advantage. After much discussion and through the persistence of the Canadian team, the expert review panel finally supported the suggestion to separate moderately durable wood from durable wood and list it as an independent category like that of non-durable wood. The expert review panel required that the drafting committee modify the penetration requirements and resubmit them to the panel for approval later.

The 2nd standard, called the wood preservatives standard, is much less controversial because it merely stipulates the proportion of active ingredients of waterborne wood preservatives, and their maximum or minimum amount in solid, paste or solution. This standard also includes active ingredients of organic wood preservatives and chemicals against mold and stain. It does not include the technical parameters for solvents of organic wood preservatives and assisting agents for chemicals against mold and stain. The technical content of this standard is based on the American Wood Preservers' Association (AWPA) 2002 standard as well as the Japanese Industry Standards (JIS) K1570s.

The standard specifies the proportion of active ingredients in the following preservatives:

Waterborne Wood Preservatives

1. Chromated Copper Arsenate (CCA)
2. Alkyl Ammonium Compound (AAC)
3. Boron (B)
4. Ammoniacal Copper Quat (ACQ)
5. Copper Azole (CA)
6. Ammoniacal Copper Citrate (CC)

Organic Wood Preservatives

1. Organic Mothproofing Agent
2. Organic wood preservative

Both the use category and specification for treated wood standard and the wood preservation standard are expected to be published in late 2004.

Standards & Future Implications

The current draft standards allow the use and production of CCA treated wood regardless of its place of origin. China's domestic treaters are all setup for CCA and new many new treaters are surfacing in the hope that countries such as the US and Canada will soon restrict the export of CCA treated products. It is very unlikely for the standards committee to draft any codes that ban the production, usage or importation of CCA products, as this would decimate the domestic treated wood industry. There are a handful of CCA preservative manufacturers that would also be tremendously impacted if CCA were not permitted.

Although many treaters throughout China believe CCA will be permitted indefinitely for years to come, some are researching other arsenic free preservatives such as ACQ. The interest in these alternative chemicals comes from the realization that government specifiers and consumers will be influenced by negative stories surrounding CCA in foreign countries and will want to have so called 'safer' alternatives. In the meantime, most treaters will give their customers the option to buy either product (CCA or ACQ) with the realization that the majority of their customers are not prepared to pay for the premium attached to alternative arsenic free treated products. In a country where

standards are difficult to regulate and enforce, customers ordering arsenic free treated products will undoubtedly have difficultly in ensuring that the preservative of choice was in fact used.

Although the 'industry level' treated wood standards are nearly published, it will take time before they are recognized, adopted, and adhered to (especially because they're not mandatory). Assuming that Canadian treaters can continue to ship CCA product to China, Canadian treated wood will have an opportunity in the market, particularly in the short term. The opportunity exists because Canadian treated wood is regarded to be a cut above the domestically produced product, but more notably Chinese buyers will put their trust in foreign treated wood products ahead of domestic treated wood because of their positive perception of and trust in foreign products and standards.

4 Conclusions

The treated wood market in China has experienced strong growth in recent years. Given the continuing growth in large landmark projects in urban areas, the development of public forest parks, real estate projects and private gardening projects for wealthy residents, demand can be expected to surge in Chinese coastal cities in the next few years.

Domestic supply is increasing in capacity and improving in quality and as witnessed in other industries, it is only a matter of time before domestic treaters achieve quality levels that are more comparable to that of foreign treaters.

The current scenario where importers are charging significantly higher prices for treated wood than domestic treaters will also likely change in the future. Many companies in the treated wood business are currently enjoying healthy margins. In Beijing, it has been reported that pressure treated wood is sometimes selling at a price greater than that of Western Red Cedar! As more players enter the market, greater competition will make the market more transparent, resulting in more competitive pricing and improved service levels for all parties.

It is likely that domestic treaters will continue to follow the standards and expertise provided by foreign competitors. However, the Chinese treating industry could well develop their own technical competencies in the future to improve quality and reduce costs.

In the short to medium term, a window of opportunity exists for imports of treated wood. However, growing restrictions on foreign treaters (in their home markets) in supplying CCA treated wood, coupled with the improving competitive position of domestic treaters will likely make it increasingly difficult for imported treated wood to compete in the Chinese market.

5 Literature

1. Li, Yudong, “The Chinese Wood Preservation Industry: A Review of the Current Situation, Problems and their Solutions”, China Wood Industry, Issue 1, 2004.

2. China Wood Industry, Chen, Xuhe, Wu,Junqi, “The Outlook of International Timber Trade”, Issue 1, 2004.

3. International Wood Industry, “Trade & Market information”, “Business News”, Issue 10 and 12, 2003

4. Dictionary of Wood Science and Technology, Science Publishing House, 1985

5. “Examples of Products That May Be Treated With CCA Effective December 31, 2003”, January 2004, Treated Wood News published by Western Wood Preservers Institute

6. Treated Wood News published by Western Wood Preservers Institute, “Treated Wood Industry in Transition”, January 2004.

7. Zhang, Ningcun, “Yunnan Lijiang Toll Booth”, Feb. 2004, AFPA China Newsletter.

8. Finnforest, Hoover’s Chinese version brochures

9. Domestic treaters & Traders (Yingtan, Jiahao Jia, Jinheng, Jianfeng, Kimura, Great World, Ferns, etc.) company brochures

10. Morning Edition of Jiefang News, Shanghai, “Undervalued Construction Industry:”, “Analysis of China Subdivision Industries of Agricultural Industry”.

11. “Highlights of national promoted techniques – Preservation of Wooden heritage building, and other wood frame structure”, Research Institute of Wood Industry Chinese Academy of Forestry.

12. Marketing Forest Products by Dr. Jean Mater with M. Scott Mater and Catherine M. Mater, published by Miller Freeman, Inc. 1992

13. Value-added Wood Products by Ed M. Williston, published by Miller Freeman, Inc. 1991

14. Canada Wood Bureau, People’s Republic of China, Market Opportunities For Wood-Frame Construction, written by David Cartwright, Dr. Christopher Gaston, Dr. Chun Ni and Dr. Chunping Dai, October 2002.

15. Changes in Preservative Use Patterns (From CCA to Alphabet Soup) P.I. Morris. Group Leader: Durability and Protection. Forintek Canada Corp. Vancouver BC Canada

Electronic

1. http://www.qgby.com/xslt7.htm Alternatives Anti termites preservatives Mo, Jianchu, University of Zhejiang
2. http://www.chinatimber.org/w/doc/future2.asp China Timber market, current and future. Mr. Zhu, Guangqian, Chairman of China Wood Distribution Association, May, 2003. March 25, 2003
3. Reports of 2001/2/3 Guangzhou Economy, Guangzhou Statistic Bureau.

Useful websites:

1. www.chinamf.cn, China Wood Preservation Institute
2. www.chinawood.org, One of top ones in the Chinese wood industry.
3. www.chinatimber.org, Another major industrial web site run by the China Wood Distribution Associations.
4. www.chinaccm.com, One of the main general web sites that designed for Chinese business communities.
5. www.bjghw.gov.cn, Beijing Urban Design Bureau
6. www.cin.gov.cn, Ministry of Construction
7. www.chinahouse.gov.cn, Housing Industrialization Center of MOC
8. www.chinagreen.gov.cn, National Greening Committee
9. www.3see.com, Famous marketing research website
10. www.rose-china.com One of the main gardening and landscaping web sites.