PINEWOOD NEMATODES - AN UPDATE

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Summary

As of July 2, 1993 the European Community (EC) has required heat treatment for all unseasoned softwood lumber shipments from Canada except cedar. This paper briefly outlines the requirements of the Agriculture Canada Heat Treatment Program and summarizes the industrial implementation experience to date. Results show that heat treating times are site specific and vary substantially with different lumber sizes, chamber relative humidity levels and chamber performance. While high humidity treatment schedules produce the shortest heating times, totally saturated conditions are not necessary to eliminate drying degrade. Heat treatment using thinner stickers than normally used in kiln drying has been successfully demonstrated.

1. Introduction

At the 13th Annual Meeting Smith (1992) reported on research performed for the joint Government of Canada and forest industry Task Force on Pasteurization of Softwood Lumber that investigated methods of elimination of pinewood nematodes (PWN), *Bursaphelenchus xylophilus* (Steiner and Buhrer) Nickle, from Canadian lumber (Task Force on Pasteurization of Softwood Lumber 1991a, 1991b, 1992). The major conclusion was that the thermal death time of pinewood nematode is 56°C for 30 minutes. An industrial heat treatment process designed to ensure that each piece of heat treated lumber had reached the thermal death time at the core had been outlined and successfully demonstrated to the Europeans. However, no Canadian plant health program existed whereby heat treatment certificates could be issued and heat treated lumber shipped.

At the time of the last annual meeting continued shipment of Canadian softwood lumber under the mill certification program was due to cease June 1, 1993. In February 1993 industry representatives requested that the Government of Canada develop formal Heat Treatment procedures to minimize disruption to trade to their European customers should the EC enforce their directive on June 1. Forintek Canada Corp. was commissioned by the Government of Canada and five member companies to recommend detailed heat treatment procedures and to identify appropriate instrumentation upon which a practical heat treatment program could be based and quickly implemented. The work was directed by an industry led Steering Committee on Heat Treatment of Softwood Lumber which consisted of government, industry, and industry association representatives. This paper presents an overview of this work.

2. Agriculture Canada Heat Treatment Program

As of July 2, 1993 the European Community (EC) has required heat treatment for all unseasoned softwood lumber shipments from Canada except cedar. Cedars may be shipped under a separate Agriculture Canada program that verifies the species. Seasoned lumber may be shipped under the Agriculture Canada Kiln Drying Program. Under the Heat Treatment and Kiln Drying Programs schedules must be approved by Agriculture Canada before lumber will be accepted by the EC. In the case of the Kiln Drying Program, approval is straightforward under most drying schedules. The mill must use kiln schedules sufficient to ensure a wood core temperature of 56°C is reached for at least 30 minutes. The approval process under the Heat Treatment Program is more complex.

The EC requirements for heat treated lumber are that each piece of lumber reach a core temperature of 56°C for 30 minutes during heat treatment, that heat treatment be conducted at facilities approved and qualified by Agriculture Canada, that heat chambers and schedules be evaluated by an independent testing organisation approved by Agriculture Canada for this purpose and that each package of heat treated lumber be identified and traceable to its heat treatment record. These requirements form the basis of the Agriculture Canada Program for Heat Treated Lumber.

Participation in the heat treatment program consists of three basic steps. A facility manual outlining the treatment schedule(s) is developed jointly by mill personnel and an expert third party and is submitted to the grading agency and Agriculture Canada for approval. Once the facility and schedule are approved, heat treatment certificates are issued. Within-chamber temperature monitoring equipment is used to record subsequent heat treating runs to verify that the approved schedule has been used. Heat treatment records are subject to periodic inspections by the Grading Agency and Agriculture Canada.

3. Industrial Implementation

Detailed study methods and results are given in Mackay *et.al.* 1993.

3.1 Procedures

Past research on heat treatment (pasteurization) had been carried out in chambers operating at near saturated conditions. As many existing kilns that could be used as heat chambers did not have live steam capacity, a major industry implementation concern was the efficiency of lower humidity schedules and the ability to successfully heat treat without incurring significant drying degrade. To address these concerns, two heat treatment tests were carried out in the Forintek Western Laboratory 10 Mfbm steam-equipped kiln and the results confirmed in industrial tests at five participating mills.

Both laboratory tests used a target dry bulb temperature of 80°C. The first laboratory run was carried out under as close to saturated conditions as possible while the second run targeted a wet bulb depression as close to 10°C as possible. An assessment for drying degrade was performed after each run.

Heat treatment procedures (Cook *et.al.*, 1993) were followed in chambers at each of five participating mills. Species, lumber sizes used, and schedules were developed jointly with mill personnel. Of primary concern was the development or extension of surface and end checks. In four runs the grade or quality of one or more packages was noted before the lumber was loaded into the kiln for heat treatment. Following heat treatment the same lumber was re-examined for the presence of new defects or the extension of existing ones. Grade reduction was recorded.

When kiln drying, lumber is typically piled on 16 to 19 mm thick stickers. Mackay (1993) suggested that based on results of laboratory tests it might be possible to use thinner stickers in heat treating than were normally used for kiln drying. The potential benefits are increased volumes heat treated per run and reduced handling costs if export packages could be heat treated and shipped without destickering. A possible problem is that the heat treatment times could be substantially lengthened. Three mills explored the use of thinner stickers for heat treatment in the study.

3.2 Results

Time to 56°C plus 30 minutes for the slowest sample in the first, high humidity, laboratory run was 5 hrs. 36 min. For the second run, in an atmosphere not exceeding 70% relative humidity, the heat treatment time was 6 hrs. 36 min. The additional 18% of time required in the second run corresponds to earlier results (Task Force, 1991) where it was shown that heat treatment time was longer when the chamber was operated at a lower relative humidity. No loss in value due to degrade was incurred.

Table 1 lists the principal elements of the schedule development tests completed in this study. Heating times clearly vary considerably due to a combination of size and chamber performance. As an example of this an interesting comparison can be made between runs 2 and 6 where in one kiln 50 mm hem-fir required 6 hrs. 46 min., and in another kiln 83 mm hem-fir required only 4 hrs. 8 min. A major difference between the two is that the kiln with 83 mm lumber has an almost unlimited supply of steam and therefore could be run using high humidity, whereas the kiln with 50 mm lumber is a hot-air unit with no steam sprays.

An example of differences in kiln performance is shown by a comparison of runs 7 and 8, where two different sizes were heat treated in two different kilns at the same mill. Notice that the 76 mm stock in one kiln took less time to heat treat than the 51 mm stock in the other kiln. In this case, the difference in heating time is due to the differences in the steam heating capabilities of the two chambers.

Of the runs used to assess degrade, the schedules maintained relative humidities of at least 40% for the majority of the treatment time. Very little degrade was observed. Based on these data it was clear that such heat treatment schedules will not cause degrade in the products tested in this study. Products with higher quality demands than those tested may require higher humidity schedules.

Four of the industrial runs were conducted using thinner stickers than are normally used for kiln drying (Table 1, runs 7,8,10 and 11). Three of the runs used 9.5 mm lath and run 11 used 7 mm strips. In runs 10 and 11 packages strapped and ready for export were heat treated. In runs 7 and 8 the lumber was packaged into the mill's normal kiln bundle size. The results differed between mills.

Mill 4 (Table 1, runs 9 and 10) experienced reduced air flows, a 27% increase in heating time and heat treated less volume using 9.5 mm lath instead of 19 mm stickers. This was partially due to the mill's poor stickering and piling practices. The thin sticker tests at Mill 3 (Table 1, runs 7 and 8) and Mill 5 (Table 1, run 11) were more successful. All recommended practices for stickering, stacking and piling were followed. At Mill 5 the air velocity was comparable to that normally attained while kiln drying. The high air flows there were partially attributed to the close spacing of lath and the vertical air space left between adjacent export packages. Mill 3 was able to achieve a greater volume heat treated using thinner stickers (15% increase) while the volume heat treated at Mill 5 was approximately the same as a kiln charge of the same thickness material. Heating times remained below 8 hours.

From these results it was concluded that it is not necessary to use regular 19 mm kiln stickers for successful heat treatment. Use of 7-9.5 mm lath resulted in successful heat treatment provided steps were taken to ensure adequate air flow.

4. Conclusions

- Heating times are clearly site specific and vary with different combinations of size, relative humidity levels and kiln performance.
- Lower humidity schedules (which can result in partial drying) can be used to heat treat lumber without incurring degrade. In all cases, kilns without steam spray were able to maintain relative humidities greater than 40% and did not incur significant amounts of degrade.
- It is not necessary to use regular 19 mm kiln stickers for successful heat treatment. Use of 7-9.5 mm lath resulted in successful heat treatment with minimal increase in treating times provided steps were taken to ensure adequate air flow.

5. Literature

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Table 1
Summary of Principal Elements in Schedule Development Tests

Run	Kiln	Volume m^3	Species	Thickness mm	Sticker Thickness mm	Initial Temp. °C	Initial Adjustment min/°C	Max. D.B. Temp. °C	Humidity Range %	Avg. Air Flow FPM	Heating Time h-min.
1	Mill 1, #3	542	Douglas-fir	65	12	5	7	70	61 - 69	669	7 - 40
2	Mill 1, #1	480	Hem-fir	50	12	15	8	71	35 - 62	635	6 - 46
3a	Mill 1, #1	482	Douglas-fir	63	12	11	6.5	70	55 - 78	635	6 - 36
3b	Mill 1, #1	482	Douglas-fir	32	12	13	5	70	55 - 78	635	6 - 14
4a	Mill 1, #2	480	Douglas-fir	63	12	14	7.5	71	55 - 76	637	6 - 10
4b	Mill 1, #2	490	Douglas-fir	32	12	15	5	71	55 - 76	637	6 - 08
5a	Mill 1, #3	470	Hem-fir	105	12	16	11	74	54 - 70	669	8 - 17
5b	Mill 1, #3	470	Hem-fir	45	12	17	6	74	54 - 70	669	6 - 19
6	Mill 2, #1	472	Hem-fir	83	16	15	5	80	62 - 91	279	4 - 08
7	Mill 3, #1	143	E. Spruce	76	9.5	15	9	78	58 - 66	397	7 - 20
8	Mill 3, #2	162	E. Spruce	51	9.5	15	7	70	58 - 72	385	7 - 50
9	Mill 4, #1	432	S.P.F.	48	19	5	7	76	33 - 47	383	5 - 50
10	Mill 4, #2	425	S.P.F.	48	9.5	20	10	83	26 - 40	185	5 - 50
11	Mill 5, #1	562	Douglas-fir	75	7	18	9	67	47 - 80	542	7 - 04
12	Mill 5, #1	566	Hem-fir	50	15	12	8	83	60 - 76	542	7 - 40