PART II

TREATABILITY OF EASTERN CANADIAN SPF WITH MCA, MCQ, AND ACQ-D

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Purpose

The purpose of this project was to compare the treatability of Eastern Canadian SPF with micronized copper quat (MCQ) and micronized copper azole (MCA) to the current NW 100-C + DDACarbonate treatment (NW) and processing procedures used by Timber Specialties in the treatment of Canadian species. The micronized copper source used was the PMRA registered version MicroPro 200C-TS. The following Canadian lumber species/commodity were selected for evaluation in this project:

- Eastern Canadian Spruce-pine-fir (S-P-F) dimensional lumber including:
  - 192 pieces – 2" x 8"-12' from Domtar
  - 144 pieces – 2" x 8"-14' from Tembec
  - 144 pieces – 2" x 8"-16' from Tembec

The new CSA O80 Series - Wood Preservation Use Category System and specifically the Residential Product Group C provide the treating process and standards as a guideline. Treatments were performed at the Griffin Development Center, Griffin, Georgia using pilot plant equipment which simulates commercial operation. The evaluation included:

- Full-cell treatment of Canadian S-P-F East 2" x 8" incised dimensional lumber obtained from two different geographic sources treated with ACQ, MCQ and MCA using CSA O80-08 Product Group C as the guide

Procedural Summary

Treating solutions were prepared at the GDC using information and formulation recommendations supplied by the Osmose Research Division at the time. The micronized copper source used was the currently registered PMRA version of MicroPro 200C-TS. The commercially available NW 100-C was supplied by Osmose and is the same as currently supplied to Canadian customers using the NW 100-C + DDACarbonate preservative system formulated into the 2:1 copper oxide (CuO) to DDACarbonate quat active ratio. Additional DDACarbonate quat was available for use in adjusting the quat balance of treatment solutions as required. The appropriate mold inhibitors were added to the treating solutions at each initial makeup and replenishment. Antifoam was also available and added to the NW, MCA and MCQ treating solutions whenever necessary. Solution samples were taken immediately before and after each charge for chemical analysis.

Initial Shakedown:

To determine the relative treatability of the two sources of eastern SPF, 2 separate shakedown charges were performed with MCQ only. The initial parameters for treatment were the same as for the proposed CSA treatment charges. Depending on the outcome of the initial shakedown charges, it was decided whether to proceed with the CSA treatment charges with or without modification.

CSA Treatment Charges:

Ample material of all species/commodities previously mentioned was available so that a maximum of three charges could be treated with each of the three preservative systems, if needed. The parent boards were sequentially numbered as received in full packs. All treatment charges consisted of 4' long pieces cut from 12', 14', or 16' parent boards with each cut piece labeled using the parent board number as a prefix followed by A, B or C for each cut piece.
Note: the remaining 4' sections of the 16' boards were identified as D and set aside for a separate pressure comparison. The order of labeling of the cut pieces as A, B or C were shifted for each consecutive parent board to distribute the location of the cut pieces, within the board, across the different treatments. When the 12', 14' or 16' parent board had been cut into three 4' boards, the A pieces will be treated with NW, the B pieces with MCQ, and the C pieces with MCA. The results of treatment using MCQ and MCA were compared to results of NW treatment and evaluated. The following are the initial process treating parameters which were used for evaluation and comparison:

- Solution temperature - ambient for all treatments
- Initial 30-minute vacuum at 22" Hg for all treatments
- Minimum pressure shall be 180 PSI
- Product Group C – 120 minutes minimum pressure time (2" x 8" incised)

The above treating parameters were considered initial starting points and were based upon the current commercial practice with NW and conformance to the requirements of the CSA 080 Series – Wood Preservation Use Category System, Residential Product Group C.

Before treatment, each piece was weighed, and its moisture content measured. Following treatment, each piece was re-weighed and increment core borings were taken from each piece for penetration and retention determinations in accordance with the appropriate CSA O80-08 Wood Preservation Standards or the applicable AWPA Standards. A representative cross section was also cut from each of the pieces from each charge to characterize penetration.

All treatment information including gross and net absorptions, absorption rates, retention by weight gain and assay and penetration as measured by core borings and cross sections was compiled for each charge. Digital images were taken for all core borings and cross sections for visual documentation. Appearance of the treated wood immediately following treatment and after surface drying was also observed and digital images taken.

150 psi Treatment Charges:

In addition to the treatment charges treated at 180psi, a series of treatments were performed at 150 psi to compare penetration and retention as some treating plants cannot treat above 150 psi. All treatment charges consisted of 4' long pieces cut from the Tembec 16' parent boards with each cut piece labeled using the parent board number as a prefix followed by the letter D. For comparison purposes, two (2) charges of end-matched D samples were treated with each preservative. The results of the 150-psi treatment using ACQ and MCQ were compared to results of the corresponding treatments at 180 psi. The following are the process treating parameters which will be used for evaluation and comparison:

- Solution temperature - ambient for all treatments
- Initial 30-minute vacuum at 22" Hg for all treatments
- Minimum pressure was 150 PSI
- Product Group C – 120 minutes minimum pressure time (2" x 8" incised)

Before treatment, each piece was weighed, and its moisture content measured. Following treatment, each piece was again weighed and increment core borings will be taken from each piece for penetration and retention determinations in accordance with the appropriate CSA O80- 08 Wood Preservation Standards or the applicable AWPA Standards. A representative cross section was also cut from each of the pieces from each charge to characterize penetration.

All treatment information including gross and net absorptions, absorption rates, retention by weight gain and assay and penetration as measured by core borings and cross sections was compiled for each charge. Digital images were taken for all core borings and cross sections for visual documentation. Appearance of the treated wood immediately following treatment and after surface drying was observed and digital images taken.

MATERIALS AND METHODS

Wood:

Each source of eastern SPF was intentionally selected with a relatively high spruce content. Material with high pine or fir content was avoided. The relative amount of spruce-pine-fir in each bundle for each source was identified by spraying the ends with a pine heartwood-sapwood reagent (see Figure 2). Only bundles containing at least 80% spruce was included in this study. The material was incised with a commercial incisor to an incision depth between 5-8 mm on all four sides with a minimum incision density of 12,000 incisions/m^2.

In all cases the producing mill, grade stamp and species were identified and labeled accordingly.

At the time of arrival at the GDC, all material was randomly checked for moisture content by moisture meter. Any board above 25% was removed and replaced with another meeting the moisture content requirement.

Preservatives:

Alkaline Copper Quat Type D – ACQ-D was identified as the control preservative and was tank mixed containing a 2:1 copper oxide (CuO) to DDACarbonate quat active ratio. The preservative solution was formulated by adding the water to the treatment work tank, followed by addition of the NW 100-C and Carbo-NT concentrates. Acticide 14 mold inhibitor was added at 30 ppm actives. Additional Carbo-NT was added to adjust the quat balance of treatment solutions whenever necessary.

Micronized Copper Quat – MCQ was tank mixed containing a 2:1 copper oxide (CuO) to DDACarbonate quat active ratio. The formulation included MicroPro 200C-TS plus Carbo-NT. The preservative solution was formulated by adding the water to the treatment work tank, followed by addition of the individual active concentrates. Acticide 14 mold inhibitor was added at 45 ppm. Additional Carbo-NT was available to adjust the quat balance of treatment solutions whenever necessary.

Micronized Copper Azole – MCA was tank mixed containing a 25:1 copper metal (Cu) to tebuconazole active ratio. The formulation included MicroPro 200C-TS plus MTZ (tebuconazole concentrate). The preservative solution was formulated by adding the water to the treatment work tank, followed by addition of the individual active concentrates. Acticide 14 mold inhibitor was added at 45 ppm actives as well as 100 ppm actives of Acticide 45. Additional MTZ was available to adjust the balance of treatment solutions whenever necessary.

Treatment Preparation:

Two 2' diameter x 10' long GDC treatment cylinders were used to perform the treatments for this project (see Figure 1). Treatment of products with NW were performed using the current requirements listed in CSA O80.08 for ACQ-D. Treatments utilizing MCQ and MCA were performed in accordance with the same specifications. The following are parameters used for the evaluations:

- CSA Residential Product Group C:
    - Target Retention-
        - NW 4.0 kg/m3 (0.25 pcf)
        - MCQ 4.0 kg/m3 (0.25 pcf)
        - MCA 1.7 kg/m3 (0.11 pcf)
    - Target Solution Concentration-
        - NW 1.8%
        - MCQ 1.8%
        - MCA 0.9%

Treatment Processes:

The following treatment parameters were used for all charges unless otherwise indicated:

Preservative	Initial Vacuum @ 22" Hg	Pressure Raise (0-180 psi)	High Pressure Time	Pressure Relief Time (180-0 psi)	Final Vacuum Time
NW	30 minutes	5 minutes	120 minutes	5-10 minutes	20 minutes
MCQ & MCA	30 minutes	5 minutes	120 minutes	5-10 minutes	20 minutes

Evaluation of Solution Samples:

Solution samples were taken after the initial solution make-ups, all solution replenishments and before and after each treatment charge. The GDC performed the copper and quat analysis for each solution as well as mold inhibitor analyses.

Evaluation of Wood Samples (all treatment charges):

After treatment, each piece was re-weighed to the nearest .005 kg (0.01 lb). Two increment core borings were taken from the edge at the midpoint of each MCQ and MCA treated piece from each charge. One boring was taken from the edge of each piece of NW treated material also near the midpoint of a piece. The borings were used to determine and record the depth of copper penetration to the nearest 1 mm (0.04"). At this time, the copper penetration indicators Chrome Azurol S and PAN indicator were used on the two borings taken from each piece of MCQ and MCA treated wood in accordance with AWPA Standard A3-08, Methods 2 and 14.
Chrome Azurol S was used with the NW treated wood. Heartwood/sapwood reagent was also used in accordance with AWPA Standard M2-07 to determine heartwood content of each piece. Note: Heartwood/sapwood indicator does not work on spruce, thus will only show the heartwood of pines. Digital images of all borings documenting penetration of all charges were taken. An example is shown in Figures 3 and 4. The borings sprayed with Chrome Azurol S were then cut to the appropriate assay zone (13 mm) in accordance with the CSA 080 Series, Residential Product Group C and all borings were analyzed by Osmose Research Division.

From each treatment, a representative 3" long cross section was cut at the approximate midpoint of each piece and placed in an oven at 120°F for at least 24 hours to stabilize penetration and prevent "saw drag" of preservative. When cutting the cross sections, knots, wood defects or unusual growth patterns were avoided. The removed samples were identified with the same identification code as the parent piece.

After oven-drying, two fresh cross sectional faces from the MCQ and MCA treated pieces were opened on each sample and the penetration was determined and recorded to the nearest 1 mm (0.04 inch) by the application of Chrome Azurol S and PAN Indicator on each freshly cut face.

One fresh cross-sectional face for the NW treated pieces was opened to evaluate penetration with Chrome Azurol S. For any boards previously identified as pine, heartwood/sapwood reagent was used to determine heartwood content of each piece. A boring simulation method was used on each cross section to determine the depth of penetration and pass/fail for the pieces on all 4 faces. Digital images were also taken of all cross sections to document cross sectional penetration.

RESULTS

The penetration and retention results for all treatments are shown in Appendix A. It should be noted that all these results were reviewed and submitted by a third-party agency. Penetration and retention (by assay) results for each charge are summarized in Tables 1-5. A summary of the calculated gauge retentions, treating solution analysis and treatment cycles by charge a shown in Tables 6-10.

Table 1 shows the penetration and retention results for ACQ treated at 180 psi. All of the Domtar charges passed the penetration requirement while only 3 of the 5 Tembec charges passed the minimum penetration requirement of 5mm. However, all the ACQ charges passed the minimum retention of 0.40 pcf. Table 2 shows the results for MCQ with all charges passing retention and 8 of 10 charges passing penetration with only the 2 Tembec charges failing to meet the minimum penetration of 5mm. Table 3 summarizes the results of the MCA charges which shows that 9 of 10 charges passed penetration and all charges passed the minimum retention. Only one charge of the Tembec material failed to meet the minimum penetration requirements.

Tables 4 and 5 show the penetration results for ACQ and MCQ treated at 150 PSI (1032 kPa) for the more difficult to treat Tembec material. In this case, both ACQ charges passed the minimum penetration and retention requirements. For the matched MCQ treatments, both charges passed the minimum penetration requirements but one of the charges did not meet the minimum retention.

With respect to gauge retention, the variability between the two different sources of material can be seen. For example, generally the material sourced from Domtar treated much better than the Tembec material. Tables 6-8 show that the gauge retention results for each treatment are generally much higher for the Domtar material compared to the Tembec material. In the case of ACQ, on average the gauge retentions for the two sources is 4.2 kg/m3 versus 2.9 kg/m3 for Domtar and Tembec respectively. For MCQ, the differences are similar, with the average gauge retentions of 4.8 kg/m3 and 3.6 kg/m3 for Domtar and Tembec mills respectively. Lastly, similar trends for MCA are shown in Table 8 with average retention for Domtar charges of 2.4 kg/m3 and 1.9 kg/m3 for the Tembec charges treated at 180 psi.

Tables 9-10 show the treating results and gauge retentions for the Tembec charges treated at 150 psi with ACQ and MCQ. In this series of charges, the gauge retention for MCQ is slightly higher than for ACQ at the same solution concentration.

SUMMARY & CONCLUSION

The results of the study clearly show that that Eastern Canadian spruce lumber can successfully be treated with ACQ, MCQ and MCA to meet the minimum requirements of the CSA O80 Wood Preservation Standard for material used in residential construction. The results also show the variability inherent in the wood within this species group. It should be noted that proper incising is necessary to successfully treat spruce and careful attention should be made to ensure the depth of incisions and spacing is sufficient to meet the minimum penetration and retention requirements of the appropriate standard.

It should be noted that this information was submitted to the CSA Wood Preservation Technical Committee for consideration in 2010 and is now approved in the CSA Standard. It should also be noted that a submission to include SPF 2" dimension lumber in ground contact was made to the CSA Technical Committee in October 2017 and was subsequently approved. Both submissions will be included in the new edition of the CSA O80 Standard scheduled to be published in June of 2019.

Figure 16 - Test cylinders at Osmose Research and Development Centre, Griffin Ga.

Figure 2 - Identification of pine in SPF using Heartwood/Sapwood reagent

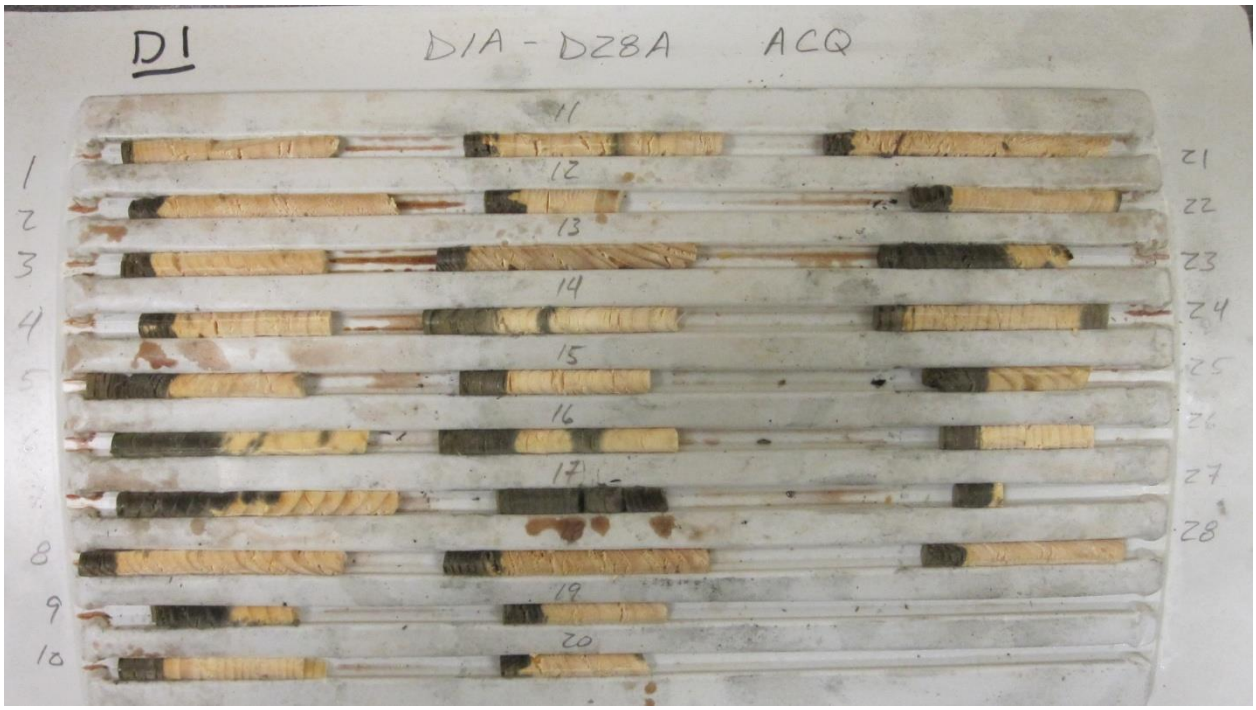

Figure 3 - ACQ Boring Penetration Results for Charge D1A

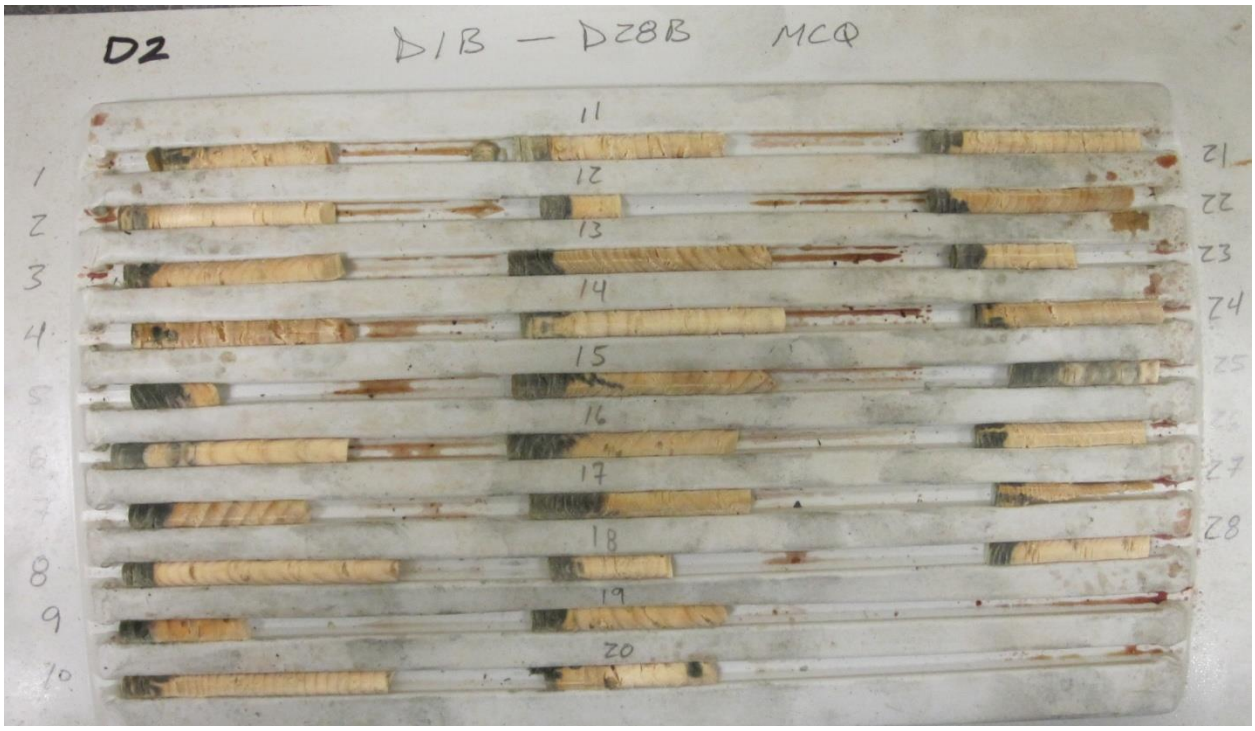

Figure 4 - MCQ Boring Penetration Results for Charge D1B

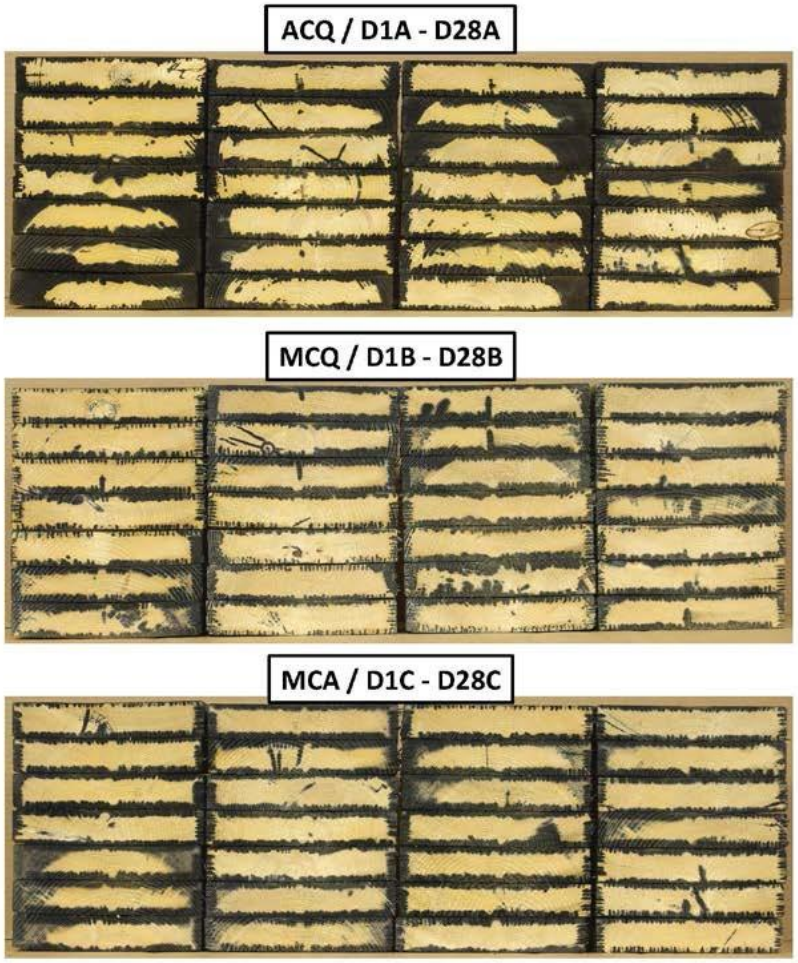

Figure 5- Cross-section comparison of ACQ, MCQ, and MCA for Charge D1

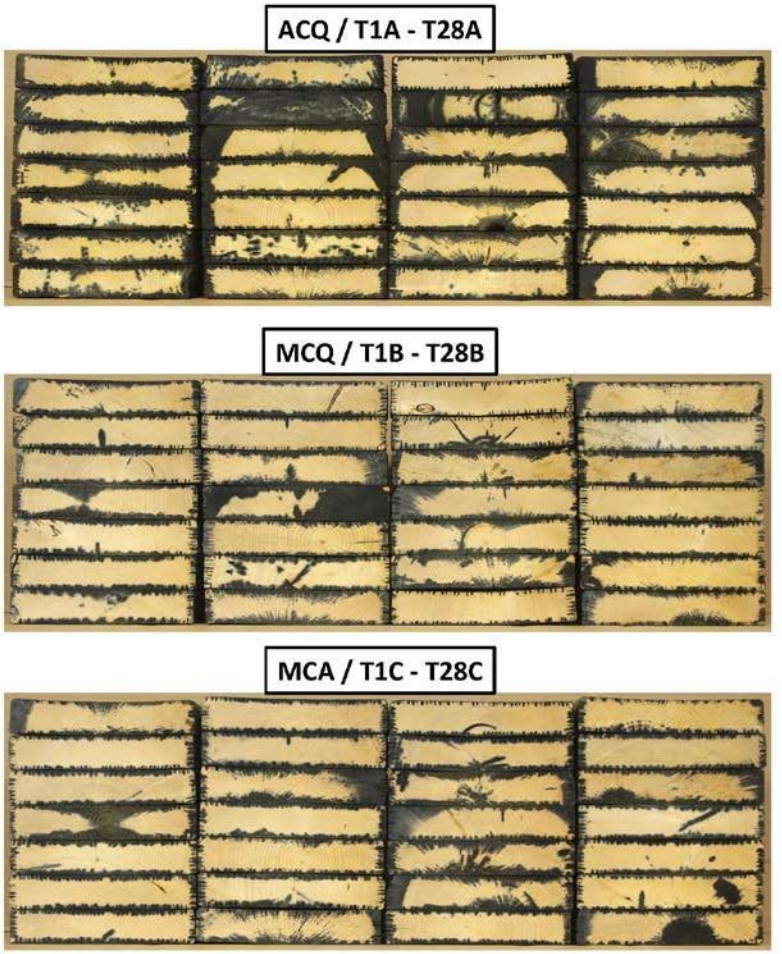

Figure 6 – Cross-Section comparison for ACQ, MCQ and MCA treatments Charge D2