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COMPUTER PROCESS CONTROL FOR NW100 PRESERVATIVE TREATMENT

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Summary

Computer control of the wood treating process has provided valuable data which allows treaters to closely monitor the treating process and improve upon treating times, closely manage chemical usage, and greatly improve upon quality control. In addition to computer control of the treating process, the data should also be analyzed to improve upon the treating process. Existing data has allowed treating plants to improve their treating process by shortening treating times or allowing the treating process to utilize net and gross retention rates as parameters for the treating process. Also, because computer control of the treating process monitors gauging and other input devices, cylinder pressure and tank volumes can be accurately monitored and recorded, chemical mixing can be more accurately metered, and safety devices can be monitored for quick response to unsafe conditions. There are several variables within the treating process that fall out of the realm of control of the treaters but with constant vigilance and recording of information, should allow for improved capabilities for treating. These variables include: mixed charges, solution concentration, mixed species (e.g.-SPF, Hem/Fir), moisture content, wood temperature, wood size, Heartwood/Sapwood ratio, and quality of incising. Again, monitoring and input of the variables into the treating program will allow for more accurate treating of materials. An additional concern for computer control of the treating process is the human interaction with the treating program. The old adage “garbage in – garbage out” has particular relevance to the system. The treaters must ensure the information provided to the treating program is accurate. Future changes to the treating program includes the possibility of more control and responsiveness of the treating process formulated, calculated, and presented to the treater as recommendations based on data collected from previous charges. With the data collected over time, analysis of the data will also provide for recommendations to changes and modifications to current standards that could possibly allow for reduction of sampling procedures which would allow man-hours to be better allocated to plant maintenance, packaging, or tagging.

Introduction

With the introduction of Computer Process Control Systems to the wood treatment industry, data collection has become a useful and necessary tool for analysis of the treating process. The data collected over time allows for the fine-tuning of the process to improve the time required to treat the material, injection rates, and chemical usage. By fine-tuning the process, treating plants are able to treat more charges, meet injection, penetration and retention requirements, and provide better quality control to prevent over-treatment, thus saving on chemical usage and cost.

Computer Process Control Systems generally consist of several components. One component is devices capable of measuring different stages of the process such as Cylinder Pressure, Solution Temperature, Flow Rates, and Injection Rates. Another important component is a device capable of optimizing the process. This component is generally the Treating Computer or Process Control System (PCS). Additionally, control of devices such as pumps, motors, valves, and switches must be regulated to optimize the process. Finally, reports should be generated from the data to provide production performance and product quality control. The Process Control Computer monitors all parameters that are required to control the process to predict product quality standards and is verified with the analysis provided by random sampling methods.

The Process Control Computer is capable of merging the data from the individual process controls much better than previous manual control methods, thus providing a higher level of performance. The computer is also able to detect process conditions, through the use of input devices, that may prove to be unsafe or harmful and provide a System or Safety Shutdown condition much faster than humans can. All these improvements over manual control of treating plants allows for the increase in productivity, efficiency, and safety of the treating process.

A highly automated production system is created through the use of the Computer Process Control System. Personnel operating the Process Control System at treating plants are able to input the charge material information into the system, ensure safety measures have been met, "start and forget" the treatment process, then sample and analyze the material prior to shipment to the consumer. Reports are also generated from the data to provide quality assurance information to inspectors to ensure that the treating plants are meeting or exceeding the requirements set forth in CSA O80.2 standard "Preservative Treatment of Lumber, Timber, Bridge Ties, and Mine Ties by Pressure Processes" and the CSA O80.36 standard "Preservative Treatment of Wood Products for Light-Duty Above-Ground Residential Uses by Pressure Processes". This report provides information to support Computer Process Control for NW100 preservative treatment.

Methodology

Treating records were collected from seven Canadian Wood Treatment Plants during 2003 and ten Canadian Wood Treatment Plants during 2004. In 2003, 7,598 charge reports were collected for commodities treated according to the NatureWood® standards set forth by Timber Specialties Co. Of these charges, only pure charges of fencing commodities (1x6 lumber), decking commodities (5/4x6, 2x4, and 2x6 lumber), wide commodities (2x8, 2x10, and 2x12 lumber), and square commodities (4x4 lumber and 6x6 timber) were used in an effort to predict the quality of treatment being done. The 2004 data resulted from 11,393 charge reports for the same commodities listed above. Again, only pure commodity charges were used to provide the analysis of the treating process.

Results and Discussion

The treating cycle parameters used in the treatment of fencing commodities were set for 30 minutes initial vacuum at 22 inHg, 15 minutes pressure at 150 psi, and 30 minutes final vacuum at 22 inHg. The treating parameters used in the treatment of the decking commodities were set for 30 minutes initial vacuum at 22 inHg, 60 minutes pressure at 150 psi, and 30 minutes final vacuum at 22 inHg.

Analysis of the data pertaining to the Gauge Retentions for fencing commodities is presented in **Figure 1**. Although the plants were not treating to the proposed CSA O80.36 standard, the results show that the majority of plants were able to meet the minimum gauge retention requirement of 0.125 pcf, with the best results coming from the 2004 data.

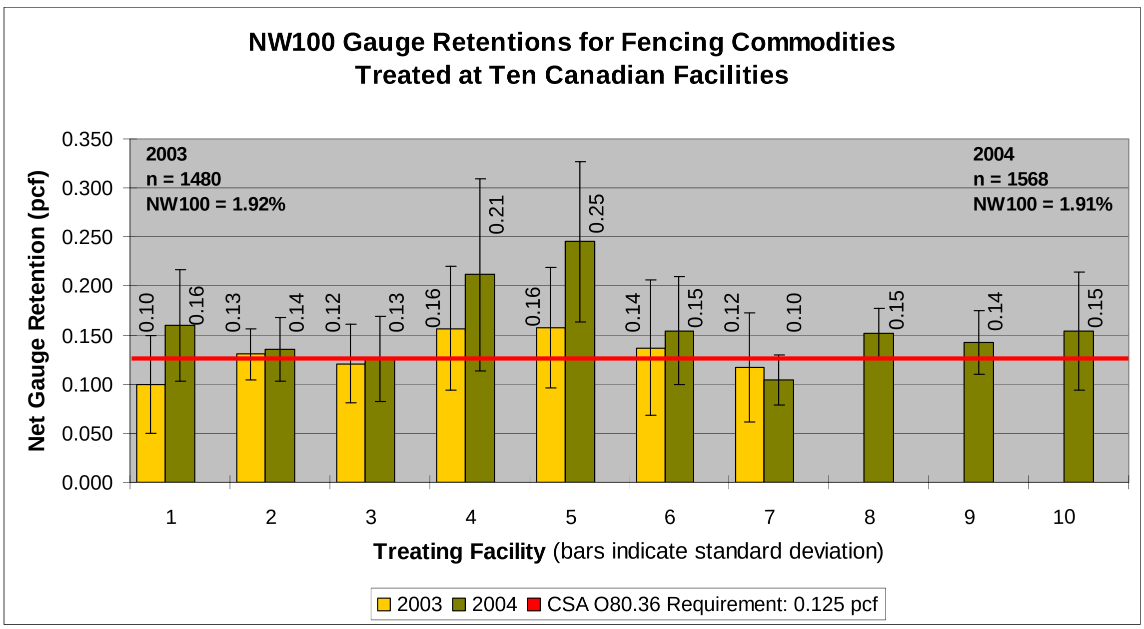

Figure 1

Analysis of the data pertaining to the Gauge Retentions for decking commodities produced the results shown in **Figure 2**. Although fewer plants exceeded the minimum gauge retention requirement of the CSA O80.36 standard, close inspection of the data shows that the average solution concentrations were reduced for the year 2004 data as compared to the year 2003 data.

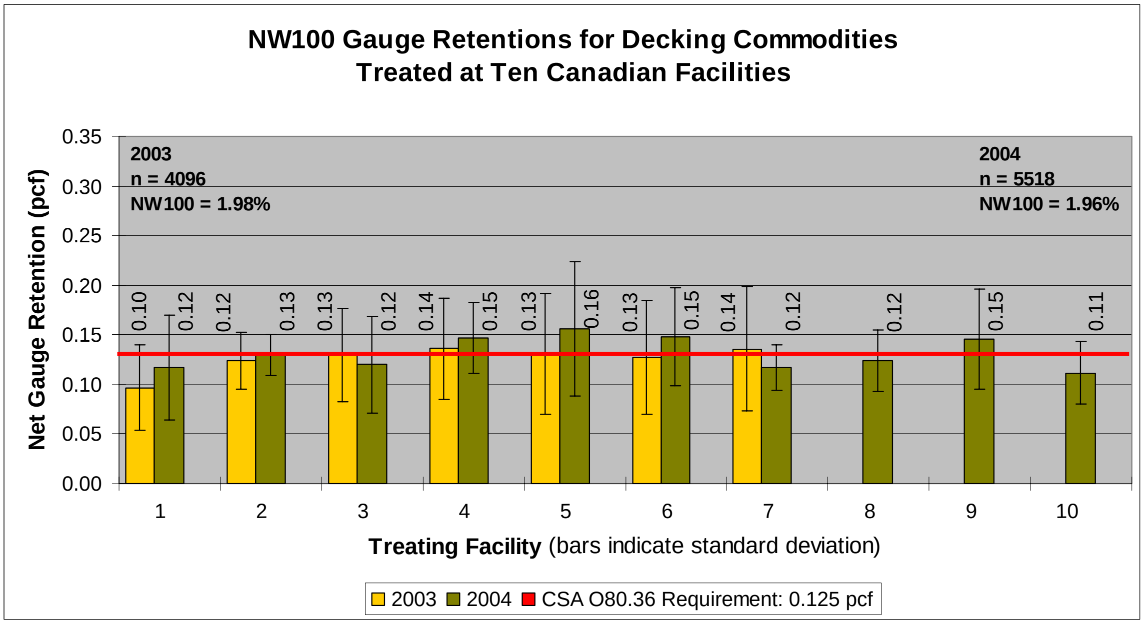

Figure 2

When applying statistical process control measures on the data, **Figure 3** shows a direct correlation between Actual Net Injection and Predicted Net Injection. Data was taken from one plant and analyzed to accurately predict injection rates required to meet the minimum gauge retention requirement of the CSA O80.36 standard. The data came from 195 pure charges of Fence Boards and shows the correlation between predictions based on Raise Pressure Injection and Pressure Injection and the Actual Net Injection provides an r^2 value of 78%. With this information, treating plants can modify their treating parameters by setting minimum values for time and/or injection rates, thereby defining the process requirements for the Pressure Step during treatment. By requiring minimum times and/or minimum injection values to be met before the charge is allowed to step to the next process, the treater is able to ensure the minimum injection and retention values are met that will allow each charge to successfully meet the gauge retention requirement of the CSA O80.36 standard.

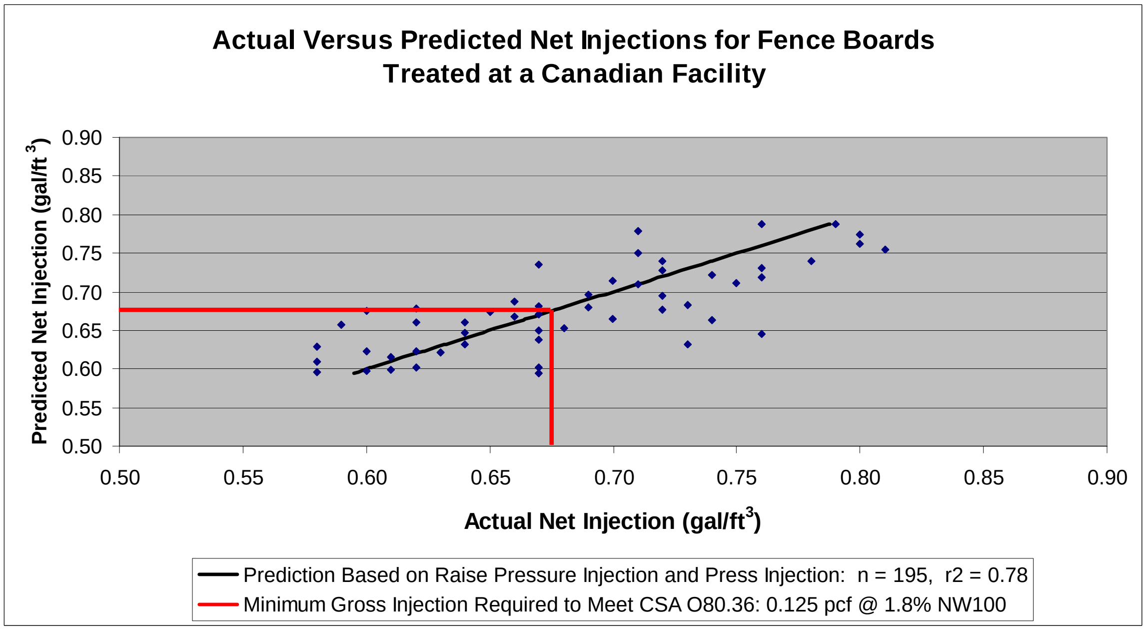

Figure 3

The same correlation holds true for decking commodities (5/4x6, 2x4, and 2x6 lumber), **Figure 4**. When comparisons are made between Actual Net Injection and the prediction based on Raise Pressure Injection and Pressure Injection, an r^2 value of 86% is achieved from 207 pure charges of 2x6 materials.

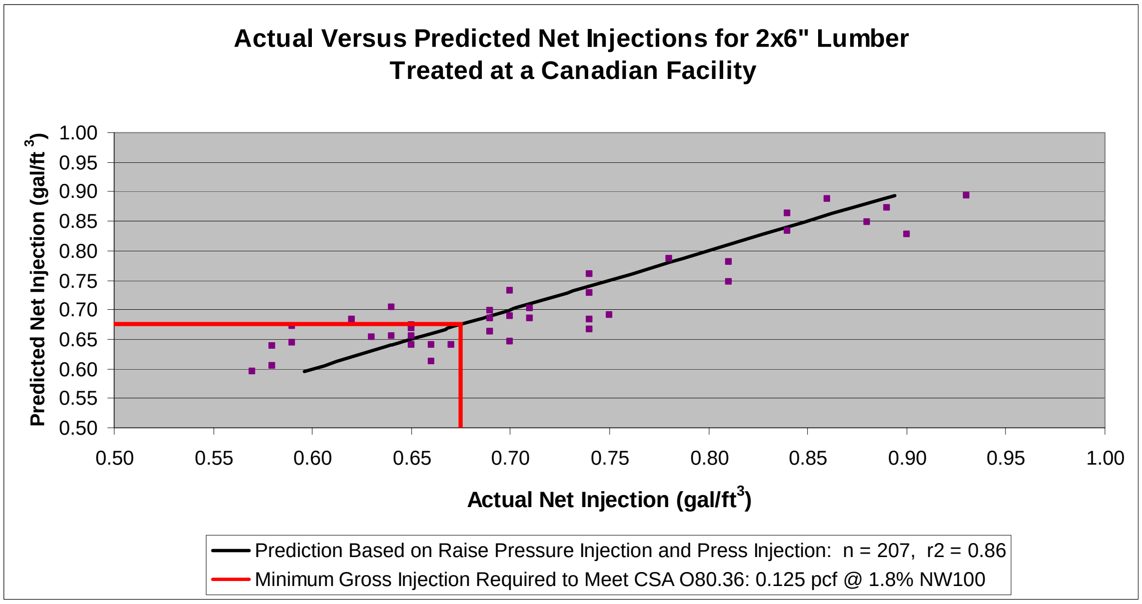

Figure 4

However, when comparisons are made between Actual Net Gauge Retention and Predicted Net Gauge Retention on wide commodities (2x8, 2x10, and 2x12 lumber), **Figure 5**, and square commodities (4x4 and 6x6 lumner), **Figure 6**, the correlation study shows poor correlations with r^2 values of only 12% and 18%, respectively. Therefore, accurate predictions cannot be made from this information.

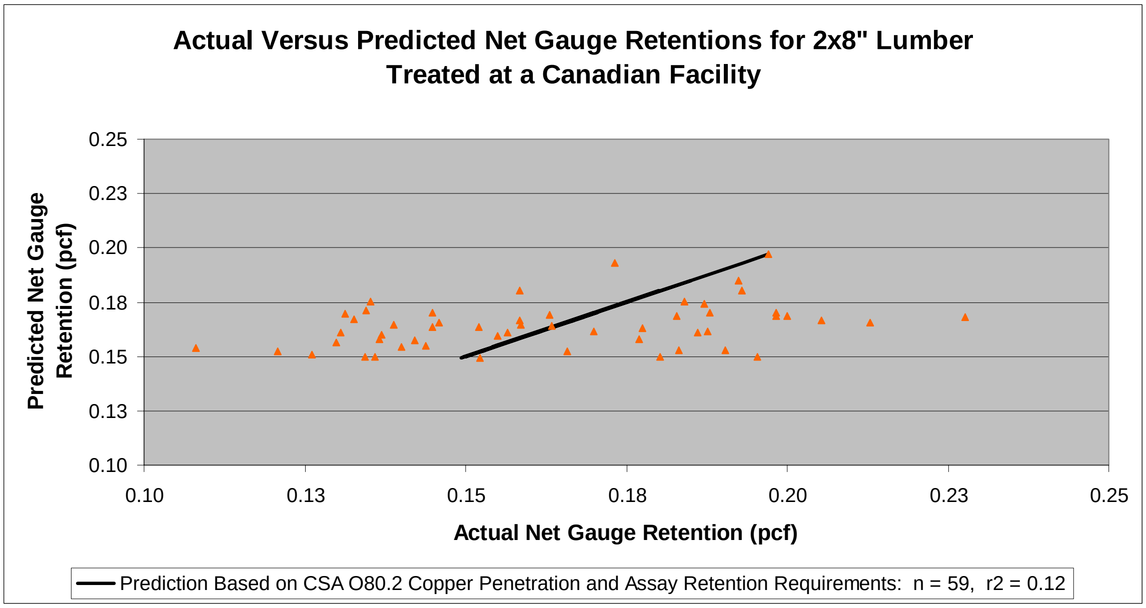

Figure 5

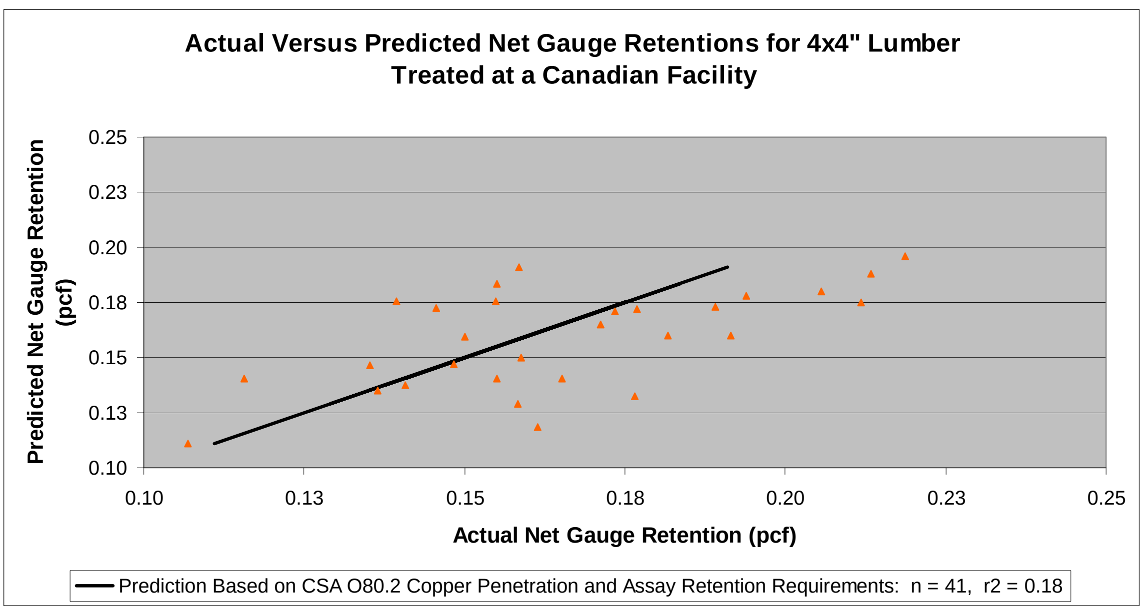

Figure 6

By comparing the Actual Injection and Predicted Net Injections for wide commodities, **Figure 7**, and square commodities, **Figure 8**, the r^2 values improves to 89% and 83%, respectively. Again, using the results from these studies allows the treater to fine-tune the treating process for the pressure and final vacuum cycles and ensures that a better quality products are treated while saving time and money.

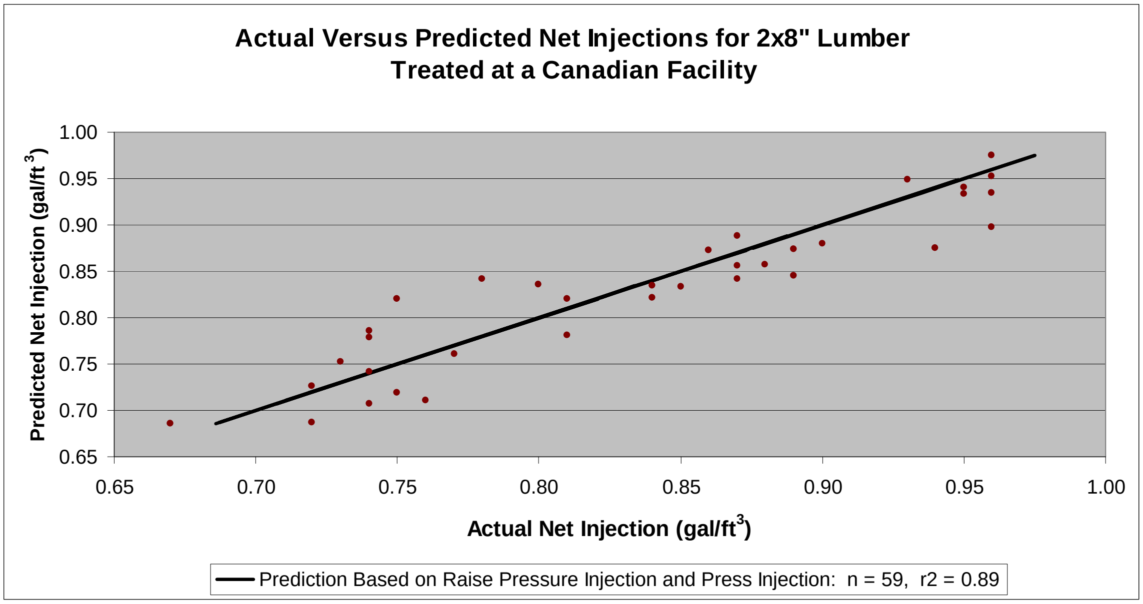

Figure 7

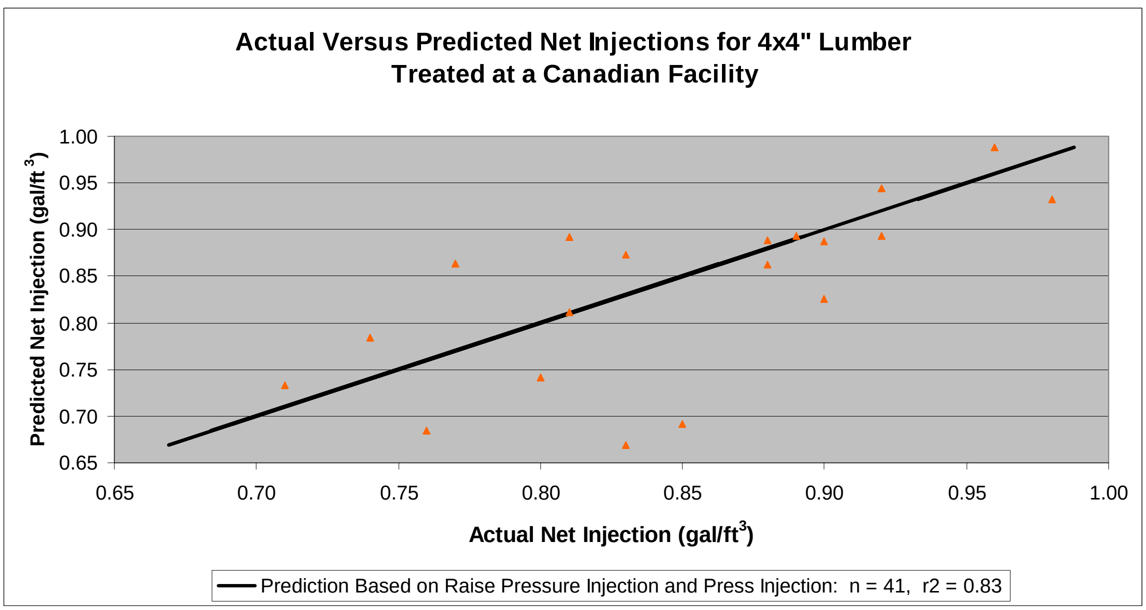

Figure 8

Conclusion

By analyzing the data collected from Computer Process Control Systems, steps can be taken to tighten the treating parameters to ensure commodities are thoroughly and accurately treated to meet the minimum requirements of the CSA O80.36 and the CSA O80.2 standards. Currently, an analyst is needed to collect, sort, and analyze the data, and then modify the treating recipes to restrict or narrow the treating process. **Figure 9** shows the original recipe parameter for the Pressure Step. Once the database is large enough to provide sufficient data to analyze, the analyst can take the original recipe which was active on time only, and make the necessary modifications to the Pressure Step that will help to improve the treating process.

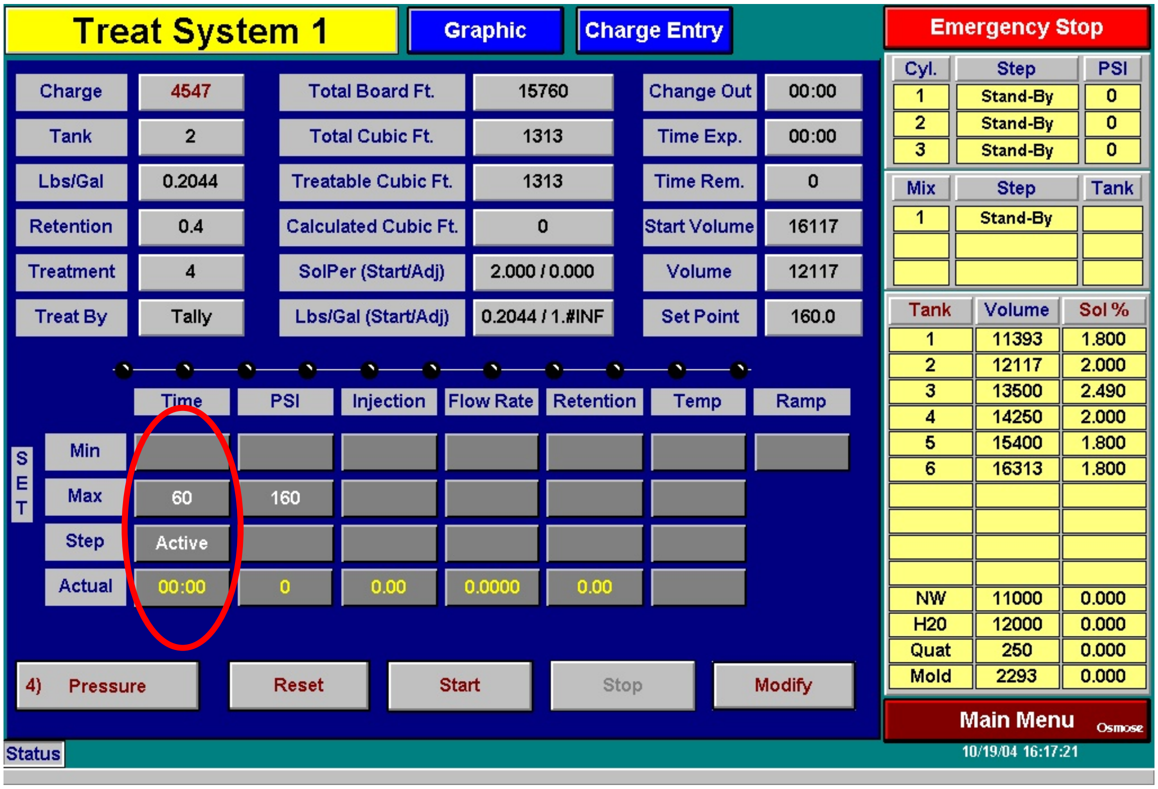

Figure 9

Figure 10 is a sample screen showing how minimum time and/or minimum injection rates in the Pressure Step can help to ensure better quality products are produced that will meet the minimum requirements of the standards. In this example, the analyst has determined that the minimum time required to treat this charge is 30 minutes with a maximum of 60 minutes and the minimum gross injection is set for 1.75 and a maximum of 2.0. By entering minimum values to the treating process, those values must be met before the maximum values are even assessed. In this way, the treater is ensuring that the minimum gross injection will be met for this product. The same procedure can be applied to the Final Vacuum Step to ensure that net injection minimum requirements are met.

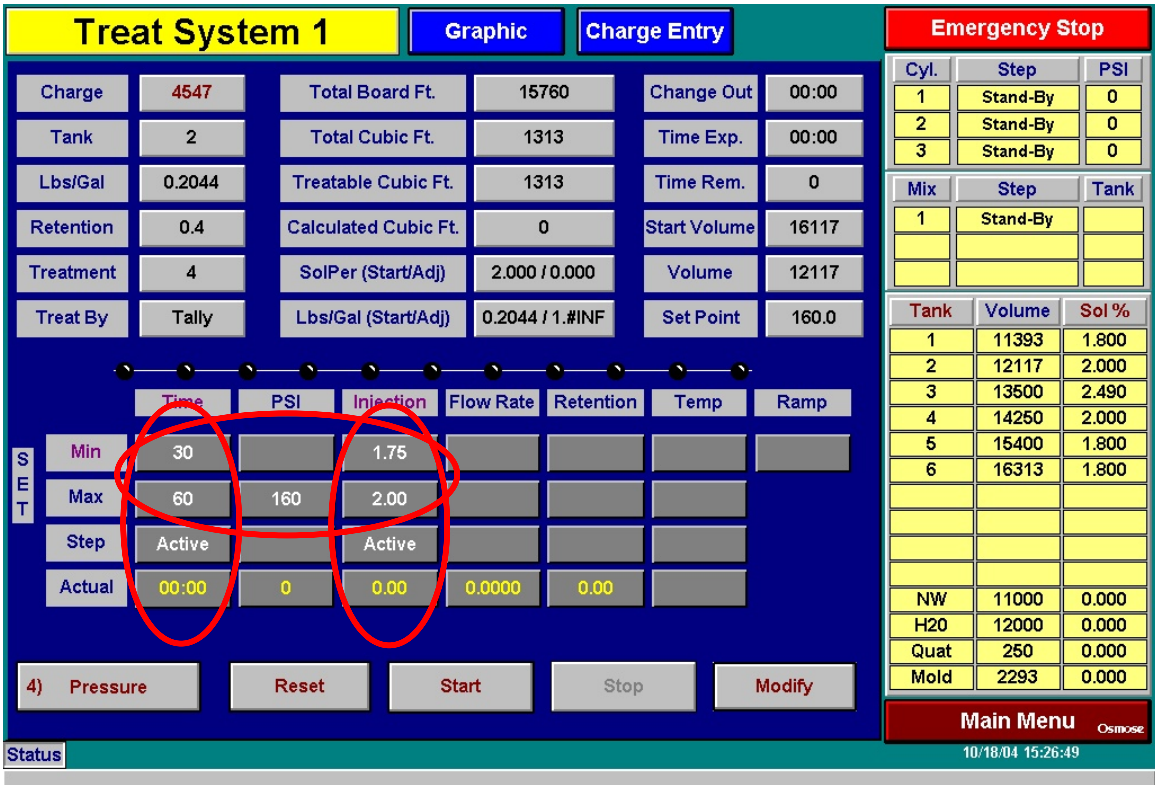

Figure 10

The drawback to this entire process is the human interaction required to gather, sort, and analyze the data, then make modifications to the Treatment Recipes for each plant. Future goals for the Computer Process Control System includes programming that is more intelligent and prompts the treater to make decisions based on analysis of the data previously recorded. The goal is to develop a program that can sort the data from the previous charges, exclude data that contains mixed charges, provide an analysis of the data, compare the results of the data to the recipe being used, and if modifications are apparent, prompt the treater with the ability to change the current recipe to reflect a better method of treating that particular charge. Some additional programming goals include better management for handling Sump Systems, as well as proper handling methods for dealing with rain water runoff and excess water due to drip pad wash down. These capabilities are available today but few plants have implemented adequate control for these conditions. Finally, as more Treating Plants migrate to business systems that include bar-coded products, the Computer Process Control System will be able to integrate with those systems to provide immediate feedback to the business system to update product status throughout the treating process. As with the Sump System Management issues, this capability is available today, however few plants have the robust business system in place with bar-coding capabilities.

Future Direction

Several challenges were recognized in regards to the Process Control Data. These challenges include: mixed charges, solution concentration, mixed species (e.g.-SPF, Hem/Fir), moisture content, wood temperature, wood size, Heartwood/Sapwood ratio, and quality of incising. Special consideration will have to be taken into account for these challenges. Another challenge to the process is wood sampling methods. This is a twofold issue. Most experienced treaters know which sections of the material will provide the best possibility for passing and failing the penetration and assay retention requirements. Therefore, the wood sampling method can be a biased sampling method. Secondly, when considering the sampling requirement of 20 wood borings from the charge, one has to ask, is this method statistically sound? For example, in comparing a charge of pure 2x4 materials and a charge of pure 6x6 material from a treating plant that has a 6'6"x82' cylinder, the quantity of boards in the 2x4x8 charge is 3072 pieces, whereas the quantity of timbers in a 6x6x8 charge is 512 pieces. With this in mind, the answer to the question of whether this sampling method is **statistically** sound is a resounding "NO". Finally, an additional challenge to the Computer Process Control System comes from the treaters. Many treaters display a hesitancy to change, especially to computer control of the wood treating process. Their attitudes and perception has to change to accept computers in general, and also, on acceptance of the computers, to allow the computer to run and control the treating process with the knowledge that they have the ability to structure, monitor, and maintain the computer system.

Literature

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