Summary

LIFE Forms Review

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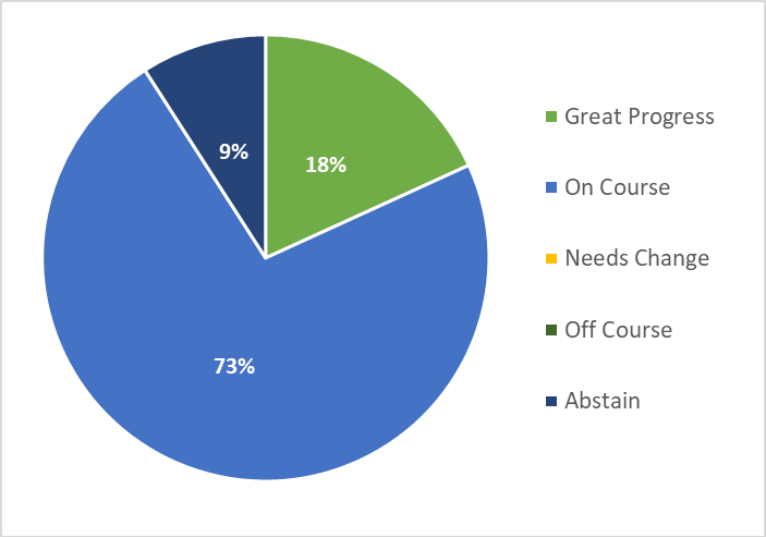
Project Updates: Progress Ratings

TITLE	GREAT PROGRESS	ON COURSE	NEEDS CHANGE	OFF COURSE	ABSTAIN	TOTAL
(001) K-05-KA: Analysis of adhesive atomiza ... - Fred Kamke & John Nairn (OSU)	2	8	0	0	1	11
(002) J-02-HA: Geometry and mechanics of pa ... - James Hanna and Joseph Loferski (VT)	6	4	1	0	0	11
(003) M-01-KA: Repeatable Measurement Metho ... - Fred Kamke and Lech Muszynski (OSU)	3	7	0	0	0	10
(004) M-05-NE: Improving Durability of Wood ... - Mojgan Nejad (MSU)	1	7	0	0	2	10
(005) M-02-PR: In-depth Characterization of ... - Gerald Presley and Jed Capellazzi (OSU)	0	8	0	0	1	9
(006) SWEETWATER-20: Evaluating Suitability ... - Mojgan Nejad (MSU)	2	6	0	0	1	9
(007) Freres-19: Mass plywood panels: Perf ... - Fred Kamke and Arijit Sinha (OSU)	5	6	0	0	1	12
(008) I-29-FR: Fundamentals of resole formu ... - Chip Frazier (VT)	3	5	1	0	1	10
(009) K-04-SI: Elucidating the mechanism of ... - John Simonsen and John Nairn (OSU)	0	4	0	1	2	7
(010) K-02-CA: Bench-scale screening test f ... - Scott Case and Brian Lattimer (VT)	5	4	0	0	0	9
(011) I-28-FR: Wood thermochemistry - Chip Frazier (VT)	3	5	0	0	2	10
(012) J-01-SIN: Understanding elevated temp ... - Arijit Sinha (OSU)	1	9	0	0	0	10
(013) I-10-FR: Carbon Isotope Ratios, novel ... - Chip Frazier (VT)	1	6	0	1	0	8

Project: (001) K-05-KA: Analysis of adhesive atomization on composite bond performance
Project Phase: Project Update
Project PI: Fred Kamke & John Nairn (OSU)

Progress Ratings:

Progress Ratings
Great Progress - 2
On Course - 8
Needs Change - 0
Off Course - 0
Abstain - 1



Summary of Responses to IAB Comments

Questions

1) Do you think some of the variation obtained is the result of lab fabrication of strand boards? Did you conclude anything about the lap shear strength COV and its dependency on rpm? Do you believe any of your results could be extrapolated to MDF and Particle Board?

Response 1: Lab fabrication of strand mats is always an important step. Dylan is the only person doing the forming and he strives to be consistent. Several practice panels were made and evaluated for density variation prior to manufacturing the test panels. Even with precautions, forming is a source of variability. Variability will likely prevent strong conclusions about lap-shear strength. Resin 3 results are still pending. We should know more when the resin distribution results are reviewed. We did not anticipate that the direction of spray pattern from the spinning disk would change with either MW or RPM changes, but it appears that it did. Consequently, placement of the lap-shear strands in the blender may not be optimum for all treatments. We can check this by examining the resin distribution of the bulk strands. MDF and particleboard use very different resin application methods than OSB. I believe atomization is less important for MDF and particleboard. -Fred Kamke

Response 2: 1.) Yes. I practiced making multiple panels before making the panels that were used in the project, but it is difficult to spread a perfect distribution by hand. Having said that, I am confident that the quality of the panels used in this project are as unbiased and uniform as they can be. 2.) We have not drawn

any conclusions on the strength performance of the lap shear test based on atomizer spray pattern, but I suspect it will be more likely influenced by the estimated weight of adhesive on the strand. 3.) I would not compare this project to MDF or particleboard, because this project focuses around using a spinning disk atomizer for adhesive application, which MDF and particleboard does not. -Dylan Willard

2) Could you be working in too narrow of a range on atomization speed (RPM)? This may be influencing the differentiation, or lack of, seen in the data.

   Response 1: Based on preliminary studies and further results in this project, there appears to be a significant difference in resin area coverage and strength performance of strand board. So I do believe that atomizer RPM is influencing the data of this project. -Dylan Willard

3) What sort of statistical analyses are going to be used pull out main effects? Will any analysis of the interaction between variables be included?

   Response 1: Variability is a killer for resin distribution statistical analysis. There will be a pairwise comparison of means and regression analysis. The experiment included a full factorial design, so interactions may be detected between MW, viscosity, and disk rpm. -Fred Kamke

4) Do you see if the wood anatomy affects some of the adhesive properties?
   Response 1: Anatomy differences may come into play. The resin spot size may be very different due to disk speed or MW. The aspen has a lot of vessel cells, which have larger diameter lumens (60 - 80 micron) than southern pine tracheid lumens (20 - 40 micron). Theoretically, small resin droplets will fall into large lumens and not be able to participate in bonding. -Fred Kamke

5) Besides image J, have you tried to do any fluorescence microscopy to confirm the dispersion of the adhesive on the strands?

Suggestions

- We would suggest spending additional time with the statistical analysis of the data to understand what is a true difference in the results.

  Response 1: I agree, we plan to do an in-depth statistical analysis. -Dylan Willard

Comments

- Have you looked into the correlation (or corrected for) density with your lab osb panel mechanical results? We are very much looking forward to the fundamental relationship discussions correlations between MW and spray behaviors... Less so into the specific species comparisons.

  Response 1: We have not yet discussed the statistical analysis of the mechanical test results, but we will look at the variability of density and make a linear adjustment if necessary. An adjustment based on density would be fair in this case, since press schedule and mat MC are the same for all panels. -Fred Kamke

Response 2: We have not done corrections for the density of the strand board. The mass of the IB specimens was not recorded for the first two molecular weights of resin, but we will do it for the third so we can get an idea of the density variability. -Dylan Willard

- Good job orienting the audience in your first slides.

  Response 1: Thank you! -Dylan Willard

- Looking forward to the imaging work, which should give insight into how droplet size ties in with resin efficiency.

  Response 1: Us as well. We have made much more progress on the image analysis since the time that the presentation was recorded, which I will share during the Q&A session. -Dylan Willard

- Interested in seeing the statistical analysis between resin MW, viscosity, and atomizer RPM on board properties.

- Good work.

- It would be helpful to focus the efforts on the resin distribution analysis to better understand the effect on the performance of wood composites.

  Response 1: This is the stage of the project that Dylan is currently working on. Resin distribution is inherently variable. However, we expect to see a moderate correlation between IB and resin coverage, and maybe IB and resin spot size. -Fred Kamke

- Good progress.

Summary Statement – TC Lead Jesse Paris

Great progress since the fall. There were 11 total ratings; 8 "on course", 2 "great progress" and only 1 "abstain".

There has been a lot of work done with different resins and species to quantify droplet size, distribution and performance effects. A large portion of the questions and discussions focused on moving toward the statistical evaluation of results. The researchers have said they do plan to do this statistical work.

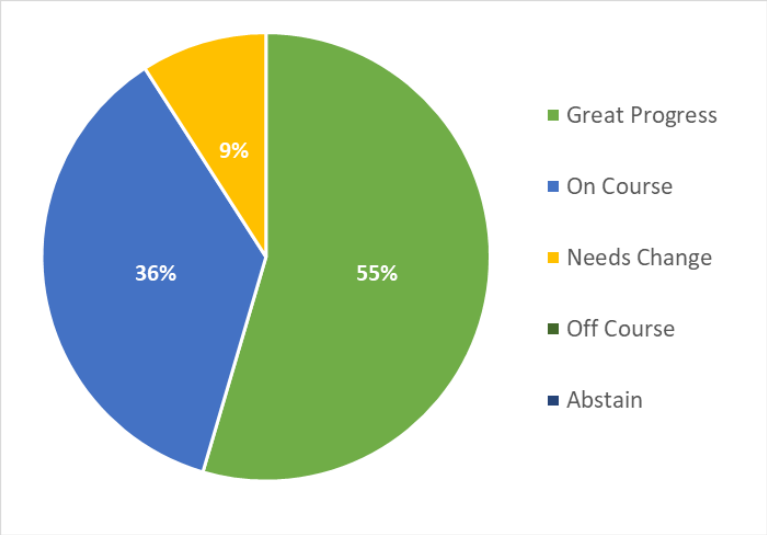
There is clearly a lot of data (3 resins, 2 wood species, 3 atomizer speeds, and multiple evaluation techniques). A point was raised that the evaluation / presentation of that data and the general project summary should look at the fundamental characteristics that affect performance and distribution. That is to say how do molecular weight, viscosity and surface tension influence distribution and performance? This is a target for the statistical evaluations.

It appears a lot of Resin 2 work is in progress and Resin 3 work still upcoming, as well as the data analysis and reporting. Best of luck to finishing everything in time.

Project: (002) J-02-HA: Geometry and mechanics of panel warpage
Project Phase: Final Report
Project PI: James Hanna and Joseph Loferski (VT)

Progress Ratings

Great Progress - 6
On Course - 4
Needs Change - 1
Off Course - 0
Abstain - 0



Summary of Responses to IAB Comments

Joseph Loferski's Response: We completed developing the experimental methods to induce and measure controlled moisture warp-shape changes. The project objective was changed early on to focus on developing the experimental methods based on the results from Phase 1. The natural variability of wood causes challenges in knowing the exact material properties on a point-wise basis. Therefore, we focused on comparing the qualitative response to the model predictions. Future research can use the results from both Phases for future model validation.

Questions

1) Will there be an analysis comparing the experimental warpage to model results from Phase 1?

   Response 1: Yes, a comparison of the qualitative model predictions will be made to experimental results. - Joseph Loferski

2) What was the size of your veneer samples and is the veneer sample size compared to the size of the scanner important in terms of properly characterizing warpage? The colored lines in the veneer on slide 7 represent the type of moisture induction method correct? What do the closeness of the lines represent (degree of

moisture gradient)? Surface Markers: Would these be necessary in industry application? If so that is not practical *Do you believe your conclusions can be extrapolated to full size sheets of veneer? What sort of project would be the next logical project to understand multiple ply engineered wood? When can expect something of relevance to industry? I look forward to the final paper to understand the objectives of the project. To date there has been a lot of time devote to moisture induction methods and characterizing degree of warp. Did the objectives of this project ever change? My recollection was that this project was going to try validating the computer modeling results. Will you truly be able to do that before the completion of the project?

Response 1: 1) Samples are 7.5 by 15 inches. Yes, the scanner size and the sample size must be compatible to pick-up the data. 2) The colored lines represent the moisture induction method. The closeness of the lines represents the area of the moisture concentration. Smaller closer, spaced lines represent an area of higher localized moisture concentration and farther spaced lines represent a larger area of moisture across the surface of the panel. 3) The scanner used in this project was designed for three-D objects and it has difficulty measuring flat, feature-less surfaces. Therefore, the surface markers were required. Other scanners with larger scale capabilities are available that are even capable of scanning entire buildings. 4) The variability of wood makes it difficult. But the intent of the project is to create methods in a laboratory setting and determine if controlled warpage can be quantified and measured based on manipulations of the moisture gradient. 5) A model needs to be developed -Joseph Loferski

3) Did you use rotary peeled or sliced veneer? If you used rotary peeled which side of the veneer did you apply the moisture to?

Response 1: We used rotary peeled veneer. The moisture induction methods are applied to both sides of the panel's surface to ensure a consistent through-thickness moisture gradient. -Kerrigan Strong

Suggestions

- Usefulness to members will be in the ability to troubleshoot warp by understanding the impact of different variables (e.g. moisture)- not so much as being able to accurately measure warpage of individual panels. A summarized sensitivity analysis showing the magnitude of each variable or different moisture distributions would be most useful for troubleshooting in the manufacturing environment

  Response 1: We will attempt to conduct the sensitivity analysis. -Joseph Loferski

- Tie it back to the model if possible. Define possible next projects.

  Response 1: Will do. -Joseph Loferski

- Consider adding a more in-depth discussion of how this body of work applies or can be applied in the real world.

Comments

- It is apparent that the level of effort was there but it seems that the original goal of the project, which was to validate the numerical model, was not achieved. Is it the lack of time preventing this comparison or are there additional steps that must be taken to get to this comparison?

  Response 1: The Phase 1 results showed the feasibility of predicting warped geometries using realistic but arbitrary input material properties. Additional steps are needed to validate the model. First, because of the natural variability of wood and the difficulty of knowing the exact material properties on a point-wise basis predicting the warpage of individual veneers was not attempted. A another step needed for validation was developing methods to induce controlled moisture content changes and measuring the resulting deformed shapes for comparison to the models. The objective was changed to focus the experimental methods on quantifying moisture induced deformation to simulate the theoretical model predictions. Using the results from both phases, future research can focus on validating the models with experimental results. -Joseph Loferski

- Very good work.

  Response 1: Thanks! -Joseph Loferski

- Good progress on moisture induction methods and scanning.

  Response 1: Thanks, work is continuing -Joseph Loferski

- Very nice presentation.
- Good work.
- Good work on the project. The results are interesting and has showed that having further validation of computer modeling is important.

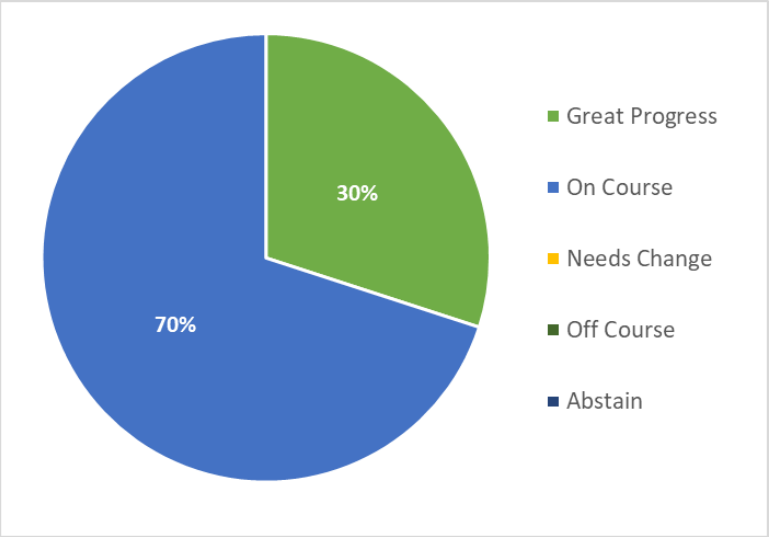
Summary Statement – TC Lead David Ruth

1. *There still will be an analysis comparing the quantitative results from this project to the modeling results from the initial project.*
    a. *Any ideas for next project to continue this line of research?*
2. *Several questions to understand the veneer type, dimensions, scanner operation, etc.*
3. *A sensitivity analysis was proposed to understand the impact of different variables. They will attempt to perform this analysis.*
4. *Needs Change is not defined in suggestions or comments. In addition, this is the final report, so the project is basically complete.*

Project: (003) M-01-KA: Repeatable Measurement Method for Percent Wood Failure (new)
Project Phase: Project Update
Project PI: Fred Kamke and Lech Muszynski (OSU)

Progress Ratings

Great Progress - 3
On Course - 7
Needs Change - 0
Off Course - 0
Abstain - 0



Summary of Responses to IAB Comments

Questions

1) What gives you confidence that this is a viable technique when some of your graphs seem to indicate that different WCs are intermixed. - Can you confirm that the test method specified which half of the sample to be measured...and is there good correlation between the two halves? - Can you elaborate on the use of stains in both the reference sets and possibly in a final application?

Response 1: UV-vis spectra are complex and there is general overlap of data between wood and resin. Most of the same chemical bonds are present in each material. However, certain wavelengths will be more prevalent in wood than resin, and visa-versa. The use of a principle component analysis (PCA) will consider all combinations wavelength in a multiple variable correlation. Previous work by others on different, but similar materials has been successful. -Fred Kamke

Response 2: Ideally, half of the failed specimen should be mirror images, but not in all cases. If there is no adhesive transfer, there will be no wood failure, but one side will have 100% wood and the other half will be

100% adhesive. Together this would be 50% wood failure, which is obviously wrong. We don't know what the data will look like in this situation since we have not yet encountered a specimen like this. If the data was separate for each half, a comparison would show a discrepancy. Stains would be applied after specimen is broken to improve color contrast. This would only be used to create the ASTM reference data. UV-vis spectroscopy doesn't require staining. -Fred Kamke

Response 3: Response 2: The use of the complimentary information from two halves (e.g. 100% adhesive on one and 100% wood on the other for spots with an adhesion failure) may be addressed by refining the software application used to handle the image analysis based on the x-y position of scans on either side of the failed specimen. The spectral analysis does not differentiate the x-y position. (Lech) -Lech

Response 4: One way of addressing the adhesion failure using spectral analysis would be by identifying the discrepancy between the left and right side (quantitatively, the difference between %WF identified on either side) as a mark of an adhesive failure (a contribution of 100% wood on one side and 0% wood on the other side to the total %WF). We should see if a suitable algorithm to that effect would be effective in realistic assessment of reference specimens with independently measured areas of adhesion failure. -Lech

Response 5: We will first develop multivariate models to characterize each species and adhesive, then we will develop models to differentiate and quantify their relative percentages. We are evaluating the half of the shear in which the adhesive is applied, that way we have a good measure of the amount of wood detached from that side. Stains will be used for ASTM D5266 calibration and Digital Image Analysis on weak-contrast specimens. -Talbot B. Rueppel

2) Are the graphed lines summations of multiple scans across the entire surface or one scan? Have you scanned a 100% wood failure sample and 0% wood failure sample to calibrate the system? Are you correlating back to APA reference chips? Given that you are measuring intensity, are you measuring wood fiber pull or the depth of the fiber pull? We can see that groupings are present in the intensity wavelength graph but are unsure if this will hold up as a true correlation as you had several lower %WF lines show above the 95% WF lines. Could some of the discrepancies on the graphs be related to areas of large earlywood or latewood bands?

Response 1: Talbot will have to answer about multiple scans in the examples provided. The apparatus allows for as many scans as you desire to be averaged. You can also setup bins to combine a range of wavelength (ie. +/- 5nm) into an average intensity at the midpoint of the range. Correlation is to APA reference sets and % wood failure determined by industry professionals. In addition, Talbot will evaluate % wood failure using an image analysis technique, and the conventional ASTM method for another basis of comparison. -Fred Kamke

Response 2: We don't know if light fiber pull will create a different spectra than deep fiber pull. The technique is sensitive to the exposed surface. Nevertheless, if your eye can see PF resin below a thin layer of wood cells, then that light will be part of the captured spectra. We expect the intensity at key wavelengths will be different. Our technique does not differentiate spatially (x-y coordinates), so shallow failure data is lumped together with deep failure data. The position of the spectra on the graphs shown is not a direct indication of high or low wood failure. The relative intensity of key wavelength is the important measure. Earlywood and latewood may provide different spectra. Past research indicates the relative amounts of cellulose, hemicellulose, and lignin varies between earlywood and latewood. We can test this. -Fred Kamke

Response 3: Response 3: The analysis includes reference specimens: one with raw/clean wood surface for given species (100% wood failure) and one "painted" with the test adhesive (0% wood failure). –Lech

Response 4: With UV-vis the detector is not necessarily dominated by the same color and intensity features that we observe with the human eye. Yes, some wavelengths probably penetrate through the thin fiber layer, and some light from beneath the thin layer of cells makes it way back to the detector. But will it be the enough intensity to be significant or will some other wavelength dominate the response? We don't know, so we have to select some specimens that exhibit this visual characteristic and see what happens. -Fred Kamke

Response 5: With UV-vis the detector is not necessarily dominated by the same color and intensity features that we observe with the human eye. Yes, some wavelengths probably penetrate through the thin fiber layer, and some light from beneath the thin layer of cells makes it way back to the detector. But will it be the enough intensity to be significant or will some other wavelength dominate the response? We don't know, so we have to select some specimens that exhibit this visual characteristic and see what happens. -Fred Kamke

*Response 6: Our goal is to have an adequate acquisition region at a high enough intensity that just one scan will cover the entire surface of the shear specimen. Thus, we do not want to have to scan the surface multiple times. The surfaces being scanned are either 1”x1” (lap shear) or 1”x2” (block shear). Our goal is to have a large enough acquisition region to only need to scan each specimen *once*, therefore, I am working on making a 1”x1” and a 1”x2” black frame to reduce background noise and concentrate as much light as possible within the acquisition regions. The frames are expected to increase the intensity at a further probe distance and larger acquisition region. So, technically, each sample is scanned multiple times (depending on the acquisition parameters), but we want the scan to cover the entire surface of the specimen so we do not have to move the specimen around for multiple other scans. I have also made a "dome" using a 6x6x6" box painted black on the inside. This will help greatly. -Talbot B. Rueppel*

3) Why did you choose MUF rather than MF?

Response 1: Both are light colored adhesives, which is what we wanted for at least one set of specimens. We MUF because it was available. We will have some soy resin on yellow-poplar to evaluate in the future. The intent is to demonstrate the technique against some extreme combinations of light and dark adhesive and wood combinations. -Fred Kamke

4) Does specimen age since breaking change the reflectance spectra? Is it necessary to analyze freshly-fractured specimen.

Response 1: On a long term, when specimens are exposed to light, we do see wood darkening some. It is possible that something also happens to the adhesives in the specimens. As of now, we do not know if/how it affects the spectra. On the other hand, most of our specimens are being stored in a darkroom and/or in closed boxes to limit light exposure. –Lech

Response 2: We would like to evaluate freshly fractured specimens, especially to develop initial models. We expect that weathered specimens will require additional models in the future. For consistency, we want to evaluate and develop models for the same set of specimens, i.e. we do not want to mix a set of treated vs untreated specimens or weathered vs unweathered specimens until we have developed models for untreated, unweathered samples first. -Talbot B. Rueppel

Suggestions

- We would suggest adding the design of experiments (eg- scanning pattern) to the presentation. This would clarify several questions listed above. An interpretation of how adhesive peppering could impact the results would also be a good addition.

  Response 1: Someone must explain to me what is adhesive "peppering". We don't have a design of experiment yet. Until we obtain all of the test specimens, we can only create a rough design of experiments. We are not even sure of the level of variability, so we can estimate the number of replications. We do know that we will include light and dark adhesives, and light and dark wood. Then we will need to consider if earlywood and latewood should be separated and if heartwood and sapwood should be separated. -Fred Kamke

  Response 2: Response 2: Our preliminary tests include specimens darkened by a proprietary preservative treatment. Including treated specimens in the experimental design matrix is still subject for discussion and will be decided once we are clear on all other variables to be included in the project. –Lech

  Response 3: I will make sure to explain the design of experiments and specifically the scanning patterns used. -Talbot B. Rueppel

- Any chance of working with WISC center and their VSC, or using other multispectral imaging systems and image analysis? Or alternatively using the VSC as a lab control reference?

  Response 1: We do collaborate with the WISC center and use their VSC equipment for preliminary assessment of our specimens. –Lech

  Response 2: Yes, we believe that the VSC and the Mass Mountaineer data analysis package will be useful in helping to develop initial PCA models. Cady introduced me to this instrument and we evaluated the stain penetration for a few lap-shear samples from a previous resource project. This instrument has exceptional 3D imaging capabilities that help differentiate between materials at certain wavelengths. It adequately reveals the natural fluorescence of wood as an organic material, compared to the synthetic adhesives. This will be beneficial for PWF evaluation purposes. -Talbot B. Rueppel

  Response 3: I think the point here is that the VSC can be used as a control reference and to pinpoint the best light source. One objective of the project is to develop a method using equipment in a practical price range. Our UV-vis system is inexpensive, and could be even cheaper if we could use a laser light source. Currently, we have a dual broadband light source, which gives us the option of broad spectra of excitation light, but sacrifices light intensity at any given wavelength. -Fred Kamke

Comments

- Good work so far. Good luck, it is a difficult challenge. Agree with limiting scope. Get a good method, and then check its robustness and adjust as needed for other conditions treatments.

  Response 1: Thanks for the comment! Yes, this is our planned path forward. –Lech

Response 2: Thank you for the support. There are a lot of variables to consider, which means a lot of models must be developed. We hope that the initial models will serve as templates for further models. -Talbot B. Rueppel

- Great quick start!

  Response 1: Thank you! –Lech

  Response 2: Thank you! -Talbot B. Rueppel

- Good project with relevance to the industry.
  Response 1: Thank you! –Lech
  Response 2: Thank you! The fact that it is well-proven in other industries is also promising. -Talbot B. Rueppel

- Please contact us if we can provide any material for support.

  Response 1: We will, though it is hard to follow up on an invitation sent through an anonymous form. ;7) We do our best to keep all interested parties involved. –Lech

  Response 2: That would be much appreciated. If you could email me at rueppelt@oregonstate.edu I would like to get in touch. -Talbot B. Rueppel

- Let us know if we can provide any material andor support for your project.

  Response 1: We will be contacting all our partners and interested parties with specific requests for tested and evaluated QA specimens to support this project. -Lech

  Response 2: That would be much appreciated. If you could email me at rueppelt@oregonstate.edu I would like to get in touch. -Talbot B. Rueppel

- Reducing the entire failure specimen to an average absorption spectrum certainly simplifies the analysis if can be done effectively. If this doesn't work, will you be exploring performing more detailed image analysis methods (retaining the individual pixel information)?

  Response 1: At current stage, we are exploring both methods in parallel: the absorption spectrum and image analysis of scans of the failure planes in fluorescent light boosting the contrast between wood and the adhesive. -Lech

- It is necessary to validate the use of the UV-VIS Spectroscope by analyzing the percentage of wood failure and the spectra. A calibrated model is to be expected.

  Response 1: Yes, a calibration model will be necessary for each product application. We expect that Doug-fir plywood and PF resin will be consistent across manufacturers, for example. -Fred Kamke

  Good advance

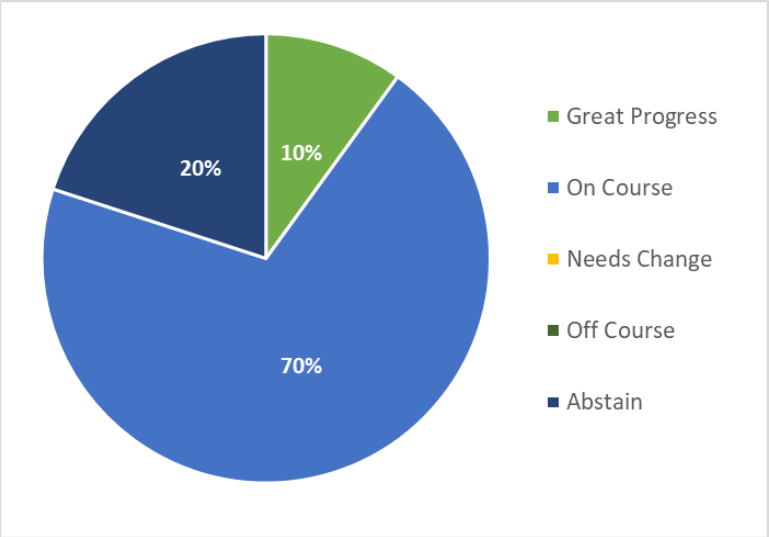
Summary Statement – TC Lead Sarath Vega

The feedback is positive, with 3 "great progress" and 7 "on course". The main questions are related to the adhesive and adhesive markers, as well as the calibration necessary for imaging the failures. The suggestions were focused on including the experimental design in the presentation to give more context, also to try to use a multispectral imaging system. All the questions and suggestions have been answered by Talbot and the advisors.

Project: (004) M-05-NE: Improving Durability of Wood Products by Reducing Lignin Degradation
Project Phase: Project Update
Project PI: Mojgan Nejad (MSU)

Progress Ratings

Great Progress - 1
On Course - 7
Needs Change - 0
Off Course - 0
Abstain - 2



Summary of Responses to IAB Comments

Questions

1) Why is it going only up to 2000h when 5000h would give a better idea of the long-term degradation? Are you going to use the ASTM G154 cycle 7 standard?

Suggestions

- We would suggest adding a control of untreated plywood to show the base change due to UV exposure.

  Response 1: Great point. Yes, we do have control samples, a set of uncoated plywood samples, and also a set of coated plywood samples with pure resins but without any additives. -Mojgan Nejad

- It will be interesting to add a mold test to the samples exposed to UV light. As it can be a good indicator of micro fissures in the wood cells (which is where fungal colonization can start)

Comments

- Sounds like a good plan. Looks like it is just getting going!

  Response 1: Thanks, we got the samples a bit late, but we have everything now and will present the UV-degradation results in the next WBC meeting. -Mojgan Nejad

Summary Statement – TC Lead Simon Pardo

Overall good and great progress, with 2 abstains.

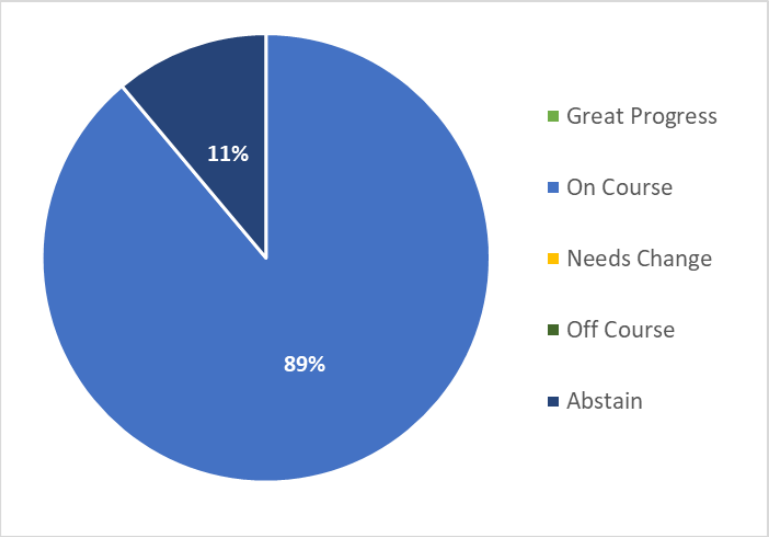
Technical committee recommends that the project focus towards fundamental (pre-competitive) evaluation of lignin and other polymeric structural changes and not on developing a product.

One question was regarding the time of weathering; whether to extend the weathering time to 5000h and no answer was provided. A suggestion was made to add untreated plywood as control and PI agreed that would be done. Another suggestion was to add biological degradation as one of the treatments, and no answer was provided by the PI.

Project: (005) *M-02-PR: In-depth Characterization of Bondlines in CLT made with Preservative-Treated Lumber (new)*
Project Phase: Project Update
Project PI: Gerald Presley and Jed Capellazzi (OSU)

Progress Ratings

Great Progress - 0
On Course - 8
Needs Change - 0
Off Course - 0
Abstain - 1



Summary of Responses to IAB Comments

GeraldPresley's Response: We experienced some delays in getting the materials we will be characterizing and as of mid March 2021 we have all of the panels we will be testing and examining under the microscope. Our current progress outline in the recording only includes training and microscopy exercises using test materials, but we are now on track to test all of the proposed treatments.

Questions

1) I didn't understand the basis for your hypothesis that preservative treatment of CLT Lamellae would NOT significantly impact bond strength or resin penetration. Can you say more about this or explain it in a different way? * Can you remind us why these three preservatives were chosen and do each of them have different application niches.

   Response 1: Part of the basis of the hypothesis is that treated lamellae are planed prior to layup and some of the preservative that may impede resin impregnation into the wood cells is removed. There is still quite a bit of chemical left in the wood, but the highest concentrations on the outer surface are removed. We also have some confidence in the resin systems being used here as at least PUR (Purebond) is used in a commercial CLT

product by XLam Australia/NZ that incorporated treated lamellae. I am not sure what the treatment is for that one so it may be a bit of a stretch to say PUR should work with other systems, but there is at least one example. We also have some post layup pressure treated panels that were pressure treated with one of the three treatments we have here. Visually most of the pressure treatments caused some problems on the panels by warping the edges, which suggests that our post layup treatments are likely to perform worse. -Gerald Presley

Response 2: The three treatments were selected because they each have different properties. All are used as anti-termite treatments, and particularly the borates are commonly used in Hawaii for structural lumber. We are also interested in durability performance and wanted to cover a range of available treatments. -HIBor is a pressure treatment with sodium octaborate tetrahydrate, so there are borates deeply impregnated into the lumber. This means there are charged functional groups in this preservative that may interact with resin components. -Preserve tech contains borates and organics (propiconazole, tebuconazole and imidacloprid). However this is only a dip treatment so the penetration is not as deep as the pressure treatments. -KlearGuard is a pressure treatment with organics only, propiconazole, tebuconazole, imidacloprid and permethrin. You eliminate the borates with this one, but we still donâ€™t know how these organics are going to interact with the resins. -Gerald Presley

Suggestions

- The DOE outlines two different treatment methods times to be tested. Consider how these differ and might impact the hypothesis.

  Response 1: I've highlighted some of the differences in the preservative systems in the answer to the previous question. -Gerald Presley

- It would be interesting to see if besides fluorescence microscopy you can use confocal, as it can give you images of of a thicker section. this can allow you to have a thicker wood section while reducing the noise from the microtome.

Comments

- Seems like a good start.

  Response 1: Since this presentation was made, we now have the panels we will be testing and Cody has started delamination and block shear tests. He will be continuing the bondline characterization with the "real" samples throughout the spring and summer. -Gerald Presley

  Response 2: Yes, so far I have done the delamination tests and have begun preparing for the shear test. -Cody Wainscott

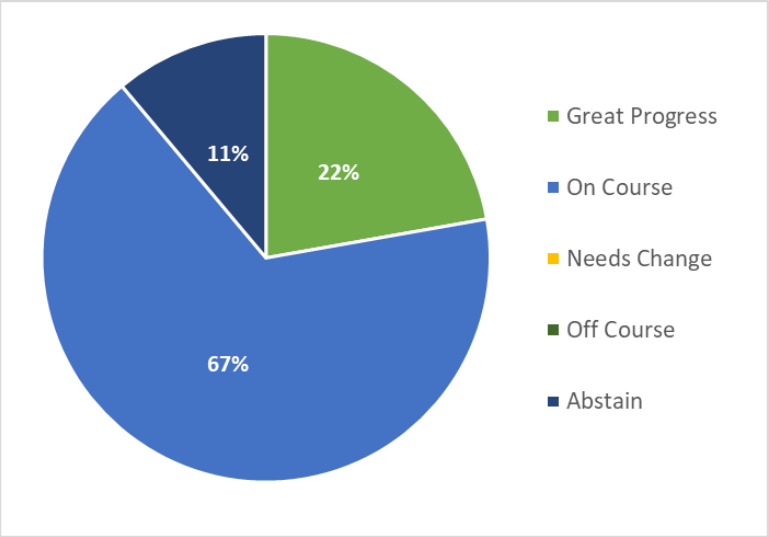
Summary Statement – TC Lead Bob Breyer

Overall, the progress rating was on course with only one abstain. One issue was that all the responses to the questions and suggestions were given by Gerald not the student. The main question was based on the statement that the tested systems should not affect bonding. The response was that the surface is sanded so should reduce the effect. A suggestion was made to use confocal microscope so that they could evaluate a thicker section.

Project: (006) SWEETWATER-20: Evaluating Suitability of Steam-Explosion Lignin for Different Polymeric Resin Applications
Project Phase: Project Update
Project PI: Mojgan Nejad (MSU)

Progress Ratings

Great Progress - 2
On Course - 6
Needs Change - 0
Off Course - 0
Abstain - 1



Summary of Responses to IAB Comments

Questions

1) What is the biodiversity of the different lignin samples tested and how do you plan to account for this in the analysis? What application area is applicable to the portion of the project looking to displace bis-phenol-A?

Response 1: We tested 9 other lignins in phenolic, 20 other lignins for polyurethane, and 16 other lignins for epoxy in previous studies from a wide range of biomass sources (hardwood, softwood, and annual crops) and extraction processes (kraft, soda, organosolv, and sulfite). In the epoxy project, we can replace 100% of bisphenol-A with lignin and use biobased epichlorohydrin and biobased curing agent to formulate 100% biobased epoxy resins. The biobased epoxy resin can be used for formulating epoxy coatings, adhesives, and biocomposites (along with other natural fibers for automotive and other applications). -Mojgan Nejad

Suggestions

Comments

- Good work

Summary Statement – TC Lead Scott Tudman

The ratings were: great progress, good progress, one abstain. This is a yearlong process. It has four stages; three of them have been completed. The project is on course, finishing the fourth stageearly. Overall, the progress is really good.

The main focus was to look at Sweetwater lignin, based on a wood-acidic explosion, and see how can it may perform in the polyurethane adhesives, urethane coating, and phenolic resins. Both the polyurethane adhesives and urethane coating screening are completed, and determined the lignin performs very well, compared with other types of lignin.

Two questions were about the variability of lignin or lignin samples tested. The response to that is that it is outside this specific work. There have been several other lignins tested from different wood sources like hardwood, softwood, annual crops, derived lignin, and different extraction processes. There is a good baseline to evaluate this lignin versus other sources of lignin out there.

There is a question about which applications are looking into displacing bisphenol-A (BPA). We found that MSU has a methodology to replace 100% of the BPA with lignin and they use that in a fully bio-based epoxy resin solution. That is the direction the project is heading to.

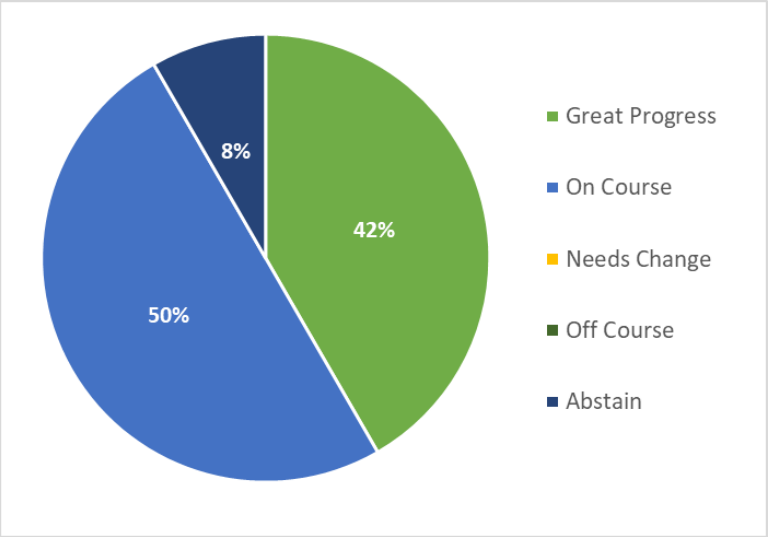
One comment was good work.

In the discussion after the presentation, there were a couple of questions about wood species and details on the thermographic analysis (TGA). I spoke with Dr. Nejad, she mentioned that they reheated the lignin sample and cooled it. They did find there were two transition temperatures. This element looked odd for hardwood lignin, that there were two separate TGs. They confirmed that afterward.

Project: (007) Freres-19: Mass plywood panels: Performance, design and application
Project Phase: Project Update
Project PI: Fred Kamke and Arijit Sinha (OSU)

Progress Ratings

Great Progress - 5
On Course - 6
Needs Change - 0
Off Course - 0
Abstain - 1



Summary of Responses to IAB Comments

FredKamke's Response: Part 2 of this project is well on its way to completion by the end of June. This is the part of greatest interest to the WBC, and this is the part that is being done by Matthias Wind. Part 1 covers the structural design and use guide for MPP, which is the work funded by the TallWood Design Institute, and has specific interest to Freres Lumber. Part 1 is almost done, but there is one more series of mechanical tests to be completed this summer. Part 2 evaluated the MF bond between the lamellae in regard to substrate MC and temperature in this cold-pressing operation. This mill has very good temperature control, but relative humidity varies from day to day and season to season. The substrate MC does change, but not much.

FredKamke's Response: The MF bond performed very well. Accelerated weathering test revealed high wood failure and only modest strength loss with time or repeated boil/dry cycles. In the large specimen, short span shear tests, the most common mode of failure was rolling shear in the adjacent cross-ply of the PF-bonded lamellae. Some statistical differences were detected due to MC and temperature treatment, but not much. This adhesive system appears to be performing well within its operating window.

Questions

1) Where does the "design and application" portion of the title of this project tie in? I can see that the performance has been very well executed but not sure if we can make the connection with design and application in the scope presented

Response 1: The project has been funded in two parts. Part 1 was about the design and application. Part 1 was funded by the TallWood Design Institute. Freres has been closely involved in the testing for Part 1. Those results will be shared with all WBC members. Part 2 focused on the adhesive bond performance, as well as the influence of mill conditions on temperature and MC of the wood surfaces that are bonded. WBC reporting has been mostly about Part 2. The technical advisors have been updated about both Parts 1 and 2. -Fred Kamke

Suggestions

- Consider the influence of running all samples of one set in the same soak tank. Could a fluctuation in tank conditions have biased the results? Usually better to randomize samples between tanks. Please clarify your statements on failures within the PF bond-lines. Many times these failures are due to artifacts in the wood (eg-knots) and not to weak points in the cured adhesive.

  Response 1: PF failure in the large short-span shear tests were rolling shear failures perpendicular to grain. PF failure in the compression shear-block specimens were rare, but happened occasionally. Matthias will have to confirm if any knots, or other abnormal artifacts were included. I think those specimens were omitted if they were found. -Fred Kamke

  Response 2: At the time of the test run, the originally planned soak tanks were not available. For the actual test 4 ident soak tanks (12 specimens each) were used and specimens were randomly assigned to the different soaking tanks. Only the soak tank for the 8-week soaking time was slightly different in size, but no difference between these two types in is expected. It is possible that specimens, which are located at the bottom of the tank, could experience higher water pressure, but the depth of the tanks was just 1 ft. If there was any sign for failure due to knots in the adjacent PF bondline, the specimen was omitted as suggested in ASTM D905. Some delaminations we saw during the VPS test happened due to knots as mentioned but there were some specimens, which failed at PF bondlines due to bad bonding at that exact spot, which can happen during manufacturing. Most of these delaminations did not hinder the test of the MF bondline, which was the main goal. -Matthias Wind

Comments

- What were the effects on the treatments on the MF bondline?

  Response 1: The different manufacturing conditions showed only a few differences in terms on the performance of the MF bondline performance, but the statistical analysis is not fully finished. If the question refers to the certain performed test: Soaking on bending specimens: Decrease in shear strength only due to change in MC and wood properties due to the main failure type of rolling shear at the cross bands. Therefore, no effect of the soaking on the MF bondline can be evaluated through this test. VPS: bond performance was slightly decreased Overall, the MF showed very satisfying results. -Matthias Wind

Summary Statement – TC Lead Patrick Farrell

- *Two-part project*
  - *Part 2 is the WBC focus and is Matthias Wind's thesis.*
    - *The MF bond performed well.*
    - *The mill has very good temperature control.*
    - *Relative humidity varies from day to day.*
    - *Moisture content does change but not much.*
  - *Part 1 is funded by the TallWood Design Institute.*

Questions

- *Where does the "design and application" portion of the title of this project tie in? I can see that the performance has been very well executed but not sure if we can make the connection with the design value and application in the scope presented.*
  - *Fred Kamke responded*
  - *Two-Part project. Part one deals with the design and was funded by the TallWood Design Institute.*
  - *Freres has received updates on both parts of the project.*
  - *Part 1 results will be shared with WBC members.*
- *What were the effects on the treatments on the MF bondline?*
  - *Statistical analysis not finished.*
  - *Manufacturing conditions showed few differences in terms of the MF bondline performance.*
  - *Soaking of bending specimens showed a decrease in strength due to changes in moisture content affecting rolling shear a the cross bands. No effect on the MF line can be evaluated.*
  - *VPS bond performance was slightly decreased.*
  - *MF bond showed very satisfying results.*

Suggestions

- *Consider the influence of running all samples of one set in the same soak tank. Could a fluctuation in tank conditions have biased the results? Usually better to randomize samples between tanks. Please clarify your*

statements on failures within the PF bond-lines. Many times, these failures are due to artifacts in the wood (eg-knots) and not to weak points in the cured adhesive.

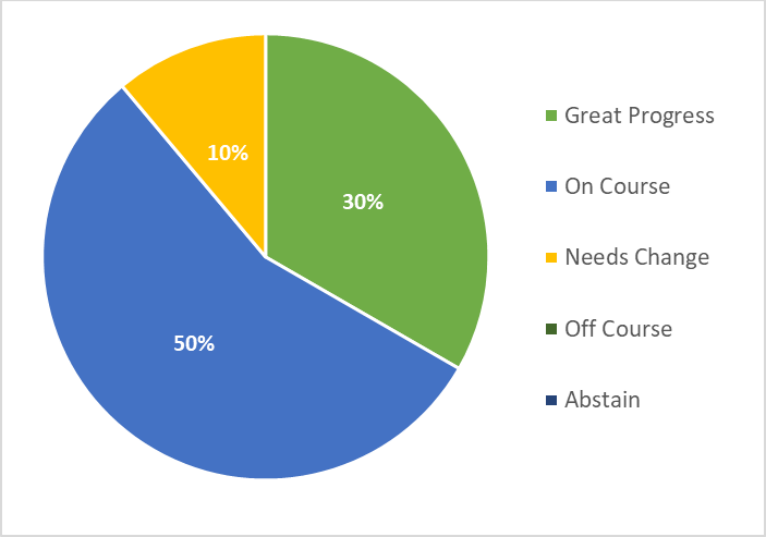
- *Failure mode in large, short-span shear test were rolling shear perpendicular to grain.*
- *PF failures in block shear were rare.*
- *Knots were omitted as suggested by ASTM D905.*
- *Some failed on the PF bond line due poor bonding at the spot of the test but did not hinder the tests of the MF bond line.*

Freres Lumber Co., Inc would like to thank the WBC and wish Matthias Wind good luck with his future endeavors. We appreciate his patience with our production schedule and his efforts to fit the checks in with his schedule. Matthias always addressed comments and answered on L.I.F.E forms.

Project: (008) I-29-FR: Fundamentals of resole formulation
Project Phase: Project Update
Project PI: Chip Frazier (VT)

Progress Ratings

Great Progress - 3
On Course - 5
Needs Change - 1
Off Course - 0
Abstain - 1



Summary of Responses to IAB Comments

Frazier's Response: One member indicated the need for change, please we need to hear any and all concerns in the final Technical Committee (TC) summary. Ryan is aware of my feelings, that this project is not where it needs to be. There is a smattering of activity here and there, and no single subtopic has been thoroughly developed and concluded. I'm reminding the TC about the balance struck between good progress and training independent scientists. I don't always wish to tell the students precisely what to do; of course I often do. In Ryan I am observing the progress we desire; everyone has different rates and progression profiles. I don't graduate anyone based upon time served; it's based upon productivity and maturation.

Questions

1) It was mentioned during the presentation that densities were different at different time after mixing. However the data wasn't supporting that; we saw only 0.01 point change in the density after spraying. Could you please clarify?

Response 1: I believe you are referring to the comment I made at "10 min 48 sec," in which I stated, "...we haven't seen great changes" about the density changes. I acknowledge that my pronunciation may not have been clear. I apologize for any confusion this might have caused. -Ryan Gray

Response 2: Yes, more density measurements are required. The data shown suggests that spraying the resin has little or no effect on density- but we need many more data points. -Frazier

2) How do you plan to relate these resole formulations back to delamination?

Response 1: We would measure delam resistance as a function of formulation variables. Please clarify- it seems I'm not on point here. -Frazier

3) Please define creep and how you measure this. Creep has a specific test meaning to board manufacturers. Thanks.

Response 1: Thanks yes this needs clarification. It's a classic creep experiment: apply a fixed stress to the liquid adhesive and measure strain over time and under linear response conditions. -Frazier

4) I don't recall the project's scope, we're there plans to investigate other fillers besides CCR?

Response 1: Yes, we are going to investigate other fillers. Typically, we start our experiments with CCR because those formulations have shown the most network development. Thank you! -Ryan Gray

Suggestions

- As a preliminary study, please check the achievable "shift" during the TTS study. If the material is not going through significant change during the temperature window, the achievable TTS shift will perhaps be very small and the purpose of the TTS will be lost.

  Response 1: Thank you; agreed -Frazier

  Response 2: Thank you, and we will make sure we do this. -Ryan Gray

- Please make sure at the conclusion of the project to leave us with some practical manufacturing suggestions andor suggest next logical project to get us there.

  Response 1: We will do our best- we still need to make significant progress. -Frazier

  Response 2: Thank you, and we will make an effort to do this. -Ryan Gray

- Is the tack portion of this work part of the original scope? Tack has multiple factors such as water loss over time which heavily influence tack development. Should the investigation of tack be considered for an alternate project due to the complexity of the subject?

  Response 1: Agreed, many variables affect tack, and we are trying to make fundamental improvements under carefully controlled conditions. We have experience is tack, so in my mind this builds upon past work. The original scope was never well defined- so the answer is no. -Frazier

Comments

- Good progress on this project.

  Response 1: Thank You! -Ryan Gray

Summary Statement – TC Lead Todd Miller

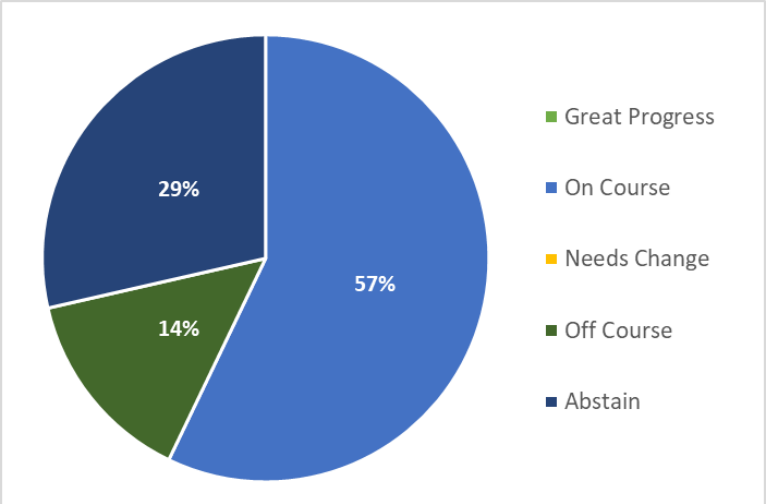
Most all thought the project was on course or was making great progress with one indicating the project needs change.

There were questions asking to define creep measurements for the liquid adhesive and if fillers other than CCR would be investigated. One had a suggestion to check the achievable shift during the TTS study and to be that it includes practical manufacturing parameters. One question was about tack measurements being in the original scope of the project. It was not in the original scope but will enable the project to build on past work and make fundamental improvements under controlled conditions. There was also a request to include a short summary in the presentation to remind people what the project goals are.

Project: (009) K-04-SI: Elucidating the mechanism of CNF reinforcement in wood adhesives and composites
Project Phase: Project Update
Project PI: John Simonsen and John Nairn (OSU)

Progress Ratings

Great Progress - 0
On Course - 4
Needs Change - 0
Off Course - 1
Abstain - 2



Summary of Responses to IAB Comments

Questions

1) Do have ballpark costs for CNF's purchased on an industrial scale?

Response 1: my apologies but I do not have that information. -Maria Munoz

Suggestions

Comments

- Off Course? Is this project behind schedule? Do we need to prioritize the objectives?

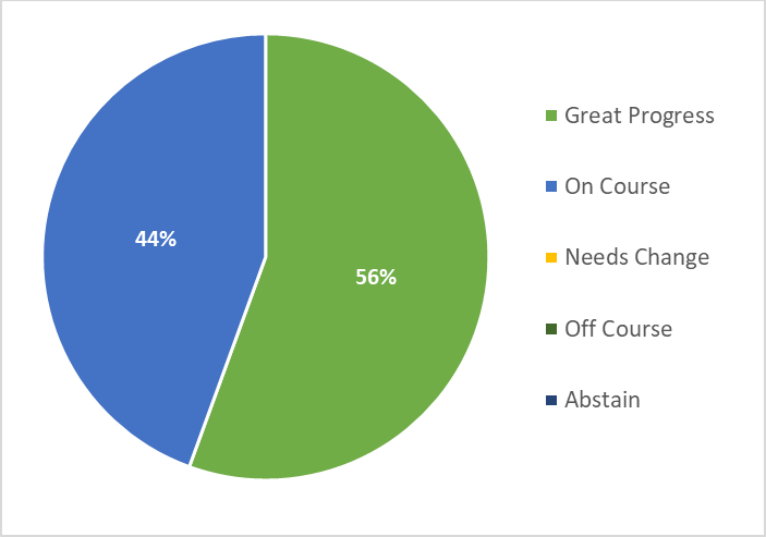
Summary Statement – TC Lead Daniel Way

This project had mixed reviews with four members voting on course, one member voting off course, and two members abstaining. One question was asked about the cost of CNFs purchased on an industrial scale in which the student answered that they did not have that information. One comment was provided asking if the project was off course, behind schedule and if the objectives need to be prioritized – but no specific feedback was provided. The TC would like to encourage the PI and student to reach out for help if guidance is needed.

Project: (010) K-02-CA: Bench-scale screening test for ASTM E119
Project Phase: Project Update
Project PI: Scott Case and Brian Lattimer (VT)

Progress Ratings

Great Progress - 5
On Course - 4
Needs Change - 0
Off Course - 0
Abstain - 0



Summary of Responses to IAB Comments

Questions

1) Large scale tests can have wind applied which blows the char layer off during testing. Have you considered this in the modeling?

   Response 1: Our modeling is able to capture both the charring of the wood and char oxidation at the surface. We can change the char oxidation rate by changing wind speed at the surface. Currently, we are using a generally accepted wind speed and a furnace oxygen concentration to predict the char oxidation rate. In the model, the reduction in thickness associated with the char oxidation is accounted for. -Michael Gangi

Suggestions

- I'm looking forward to a bit more conversation about the char oxidation and ablation percentages. I didn't quite follow all of the presented conclusions.

  Response 1: Specimens at both scales have the same char oxidation rate (~0.005 mm/s). For the two-hour test, 1.3â€œ of the 6â€œ is removed. For the bench-scale 200 second test, 0.05â€œ of the 1â€œ is removed.

We are not sure how this difference will affect the ability of the bench-scale test to capture the temperature gradients of the full-scale test. If needed, we can increase the velocity of the gas on the specimen surface to increase the char oxidation in the bench-scale test. -Michael Gangi

Comments

- In one of the conference calls for this project, it was brought up that the target temperature was difficult to achieve and Bob Breyer mentioned that you may want to reduce the size of the exhaust. Was that done? Were you able to achieve desired temperatures?

  Response 1: We were able to fine-tune the heat release rate of the furnace to get the time-temperature curve to be within 1.82% error of ASTM E119 curve, much better than the requirement of 7.5%. We have a damper on the exhaust duct if we need to adjust to meet the target temperature but havenâ€™t need to do that thus far. -Michael Gangi

- Excellent work!

  Response 1: Thank you very much! -Michael Gangi

- I appreciated the good orientation to the project (orig goals and timeline and industrial relevance)

  Response 1: Thank you for your kind comment. I made it a point to reset the project in case it is the first time you are hearing about it. -Michael Gangi

- Good job, the results are interesting

  Response 1: I appreciate that, thank you! -Michael Gangi

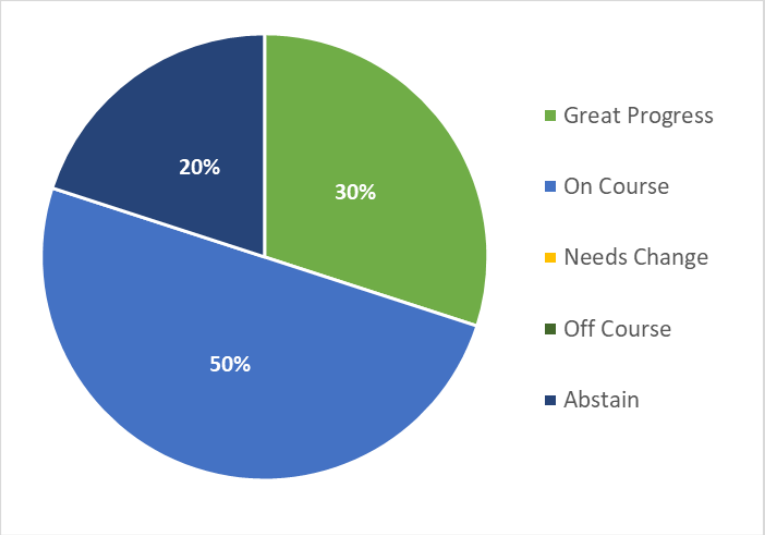
Summary Statement – TC Lead Jim Ni

The feedback is positive, with 5 “great progress” and 4 “on course”. One question is if the modeling has included the effect wind in large scale tests, which may blow the char layer off during testing. Michael responded that wind speed is accounted in the model. One suggestion is to have more discussions about the char oxidation and ablation percentages. Michael provided some additional information in his response. Michael also confirmed that the furnace can control the time-temperature curve to be within 1.82% error of ASTM E119 curve, much better than the requirement of 7.5%. Overall, Michael did an excellent job.

Project: (011) I-28-FR: Wood thermochemistry
Project Phase: Project Update
Project PI: Chip Frazier (VT)

Progress Ratings

Great Progress - 3
On Course - 5
Needs Change - 0
Off Course - 0
Abstain - 2



Summary of Responses to IAB Comments

Frazier's Response: Sara struggled early- I gave her a long leash to develop a novel lignin isolation; she was determined but ultimately unsuccessful. Once she adopted the milled wood lignin isolation, she flew past that critical milestone. She is progressing well on the required analytical techniques- these are all new to her; her current emphasis is data quality and reproducibility. Areas for improvement: Sara needs to strengthen her understanding of the analytical methods, knowing the pros/cons of the methods and moving beyond the black-box effect, accepting results without questioning. She needs to begin interpreting her data and synthesizing a novel scientific framework. This project is moving well; it could be better, and it will be.

Questions

1) Why the choice of 80 mesh? What conditions did you use to relate it back to industry press conditions.

   Response 1: Thank you for the questions. We want the sawdust particles to be small enough so we can subject them to solvent extraction for extractives removal. We chose the temperature of 200 C together with

a significant steam pressure during the 10-minutes acid-catalyzed thermal treatment to simulate the industry hotpress conditions. -Sara Yazdi

Response 2: Particle size effects require the use of a fixed size; that's standard approach for wood chemicals analysis. Actually, the thermal conditions are not so reflective of actual hot-press conditions. But we are still developing methods and we need to use an extreme treatment to insure that our procedures are effective. More realistic heating conditions will be used later. -Frazier

2) How did you confirm the change in GPC was due to a change in molecular weight versus a change in tertiary structure? The hydrodynamic volume controls the results on a GPC.

Response 1: That's a great question; you could be right. But practically speaking, what effect would cause such a big change in hydrodynamic volume? I believe crosslinking and molecular weight gain would be that effect. Also, and I could be mistaken, but I think light scattering would be most sensitive to changes in hydrodynamic volume- but the light scattering trace showed little effect- again I'm not sure about this. But the general knowledge of lignin acidolysis is that the first step involves chain cleavage, followed by repolymerization. So currently we are suggesting that the GPC observation is consistent with the general understanding of lignin acidolysis. Nevertheless, this question is so good that we must follow up on it- thanks. –Frazier

Response 2: Thank you for your question. I haven't been concerned with the possible change in the tertiary structure of lignin because haven't seen any discussion about this phenomenon in literature. But yes, the hydrodynamic volume of lignin macromulecular chains controls the elution time and thus the GPC results. We will follow up on this to see how likely the change in GPC data could be reflective of the changes in the tertiary structure of lignin. -Sara Yazdi

Response 3: I will add that the GPC of lignin is known to be complicated by molecular association. So in general this is a sticky topic that requires careful consideration. -Frazier

Suggestions

- The GPC chromatograms presented don't seem to support a 30% increase in Mw in the treated wood. Were these results replicated? All other optical constants being equal (which I assume would be the case for treated vs untreated lignin), the area of the scattering intensity should be directly proportional to weight-average MW (so it should be 30% larger in the treated sample). I would review these results to understand this discrepancy. From experience, some GPC software isn't robust against small changes in baselineintegration limits over the low signal-to-noise region (e.g. the extreme tails of the distribution can get severely inflated, leading to incorrect overall Mw's).

Response 1: Thank you and I agree. The results have not been replicated. And I don't know if the dn/dc would be constant after this treatment. Not only is your comment pertinent, we also have the known effects of lignin association that always complicate GPC interpretation. –Frazier

Response 2: Thanks. No, these results haven't been replicated but will definitely be in the near future. I haven't thought about the discrepancy between the 30% increase in MW and the change in the area of the chromatogram peaks. Thanks for bringing this to my attention. I should review that and learn more about it. Thank you for your suggestion. -Sara Yazdi

Comments

- The joints were a problem in our full-scale test.. We thought there may an issue with the fasteners and additional charring. We used two joints in this test because we wanted to provide an option for our customers. We would recommend one joint type and the spacing would increase. Our recommendation is the spline because it uses less material than the lap joint.

  Response 1: This comment appears to be some malfunction -Frazier

- The work is really interesting, looking forward to the next update.

  Response 1: Thank you -Frazier

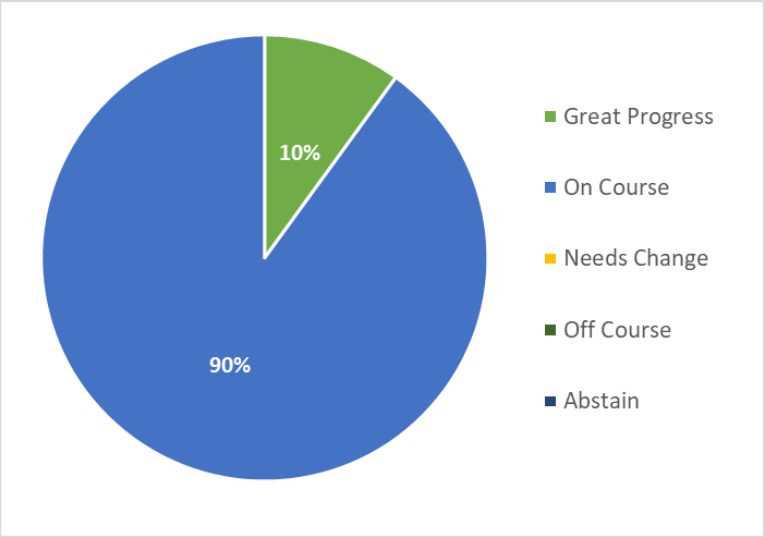
Summary Statement – TC Lead Darren Riedlinger

IAB is satisfied with the progress (5 on course, 3 great progress and 2 abstentions). Chip made some top-level comments about early delays as Sara unsuccessfully attempted to device a novel lignin isolation procedure, but that progress increased markedly after adopting standard milled wood lignin isolation. Two IAB comments expressed concern over the reported GPC results, and student and PI were receptive.

Project: (012) J-01-SIN: Understanding elevated temperature performance of wood composites
Project Phase: Project Update
Project PI: Arijit Sinha (OSU)

Progress Ratings

Great Progress - 1
On Course - 9
Needs Change - 0
Off Course - 0
Abstain - 0



Summary of Responses to IAB Comments

Questions

1) On the plywood graphs what do the three bar colors represent? Where you able to isolate the heat performance degradation to the components mentioned in the opening slides (wood, resin, or interaction of the two)? An early slide mentioned OSB. Was that or is that part of your testing plans now? What I heard in the presentation was mostly a discussion regarding plywood and LVL.

   Response 1: The three colors correlate with statistical significance of the different groups. Same colors imply that they are not different statistically, while different colors indicate a statistical significance between the groups. We haven't been able to isolate the driving characteristic for degradation yet. We have tried several chemical analysis and exploring a few more avenues to discern any interactions. OSB - was part of the first phase of the study conducted at FPL, Madison. The data for OSB had been presented in a previous update and will also be part of the publication being prepared. -Arijit Sinha

2) Was there any effect on the MF bondline?

3) What is the relevance of the temperature range and how it relates to the real world?

Response 1: The elevated temperatures were chosen to correspond to pre-charring temperatures that might occur in a protected light-frame structure based on previous work. -Arijit Sinha

Suggestions

- Slides could be more than just the data...have some explanations, commentary or conclusions on them.

  Response 1: Thanks for the feedback, we will take care of that in the future updates. -Arijit Sinha

Comments

- Good progress.
- Interested to see the DART-TOF results
- It will be interesting to see if the DART gives you the data needed for the chemical part.

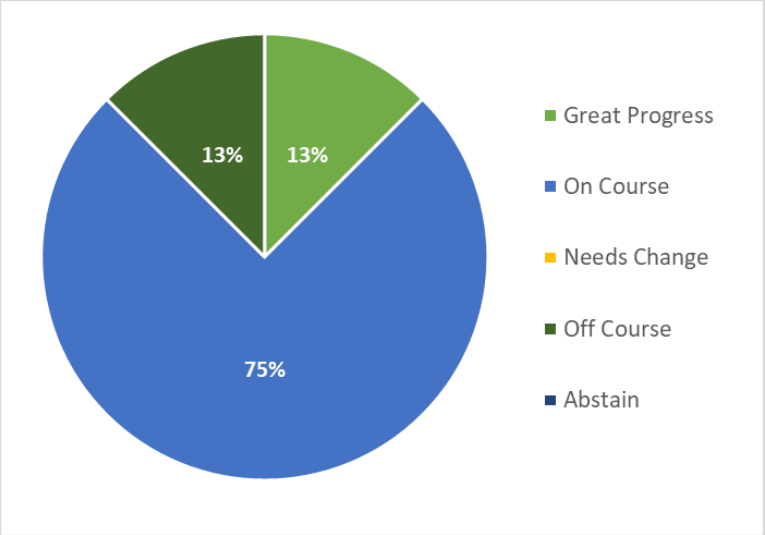
Summary Statement – TC Lead Daniel Way

Members were satisfied with the progress of this project with one member voting great progress and nine members voting on course. Three questions were asked in which the PI answered two of them. One member provided a suggestion on how to improve the presentation and two members commented that they are interested in the DART-TOF results

Project: (013) I-10-FR: Carbon Isotope Ratios, novel view of CH2O emissions
Project Phase: Project Update
Project PI: Chip Frazier (VT)

Progress Ratings

Great Progress - 1
On Course - 6
Needs Change - 0
Off Course - 1
Abstain - 0



Summary of Responses to IAB Comments

Frazier's Response: I am also unhappy with the current state of this project. Like Niloofar, Mark has struggled but in an entirely different fashion. Mark is bringing a much more thorough/rigorous approach. If anything, he can be too rigorous, sometimes getting bogged down in minutia. I hold equal blame- we assumed that weight loss in the cured UF resin was simple formaldehyde. It was not detectable formaldehyde, as discovered when we finally took the nmr. Mark questioned, reviewed, verified, and improved the procedure. Yes we have suffered a significant delay- we will get the job done. Still remaining is a great deal of methods development, once we start making panels. BTW, there was never any intention to study multiple panel types, or multiple wood species.

Questions

1) Will you have time to test enough wood samples? Is particleboard the only panel to be tested?

   Response 1: We have a goal; we will not let the setback deter us. We must take the time required to get the job done. Yes, particleboard is the only panel type we plan to use because quality, not quantity, is our goal; and we are having quality issue as shown. -Frazier

2) If you plan to abandon the measurement of isotope fractionation what is your plan to determine where the formaldehyde emissions originate (i.e.-wood or the adhesive)? This is critical, as the differentiation was the original goal of the project.

Response 1: Please recall that we elected to use labeled resin so that fractionation effects are insignificant. The measurement of isotope fractionation in the cured resin was theoretically fascinating- we had hoped to see this during our efforts to master the cartridge capture technique. But to our surprise, the cured UF resin produced hardly any formaldehyde! What's up with that? But it did release mass; but that mass did not detect as formaldehyde. In any case, measurement of fractionation in the resin is ancillary. We must move on to the ultimate goal. -Frazier

Suggestions

- Please relate this back to overall formaldehyde emissions and their source (wood vs resin).

  Response 1: Thanks for the reminder! –Frazier

  Response 2: This is still the primary objective! -Mark

- Regarding your imperfect mass balances even with paraformaldehyde: have you checked for adsorption losses within your transfer lines? From experience doing similar experiments, even traces of condensation in an unheated transfer line will sorb substantial amounts of formaldehyde (and depending on the material of the transfer line, the transfer line itself may be adsorbing and contributing to your losses).

  Response 1: Excellent point- thank you. I don't believe we have used a heated transfer line and we will follow up on this. -Frazier

  Response 2: This is a great point! As of yet, we have not been using a heated transfer line and condensation within the transfer line is observed during the course of the experiment. As we move forward we will be looking into heating the transfer line to minimize condensation within the line. We are currently employing silicone-based tubing for the transfer line, due to its high temperature stability and its flexibility, but we are also looking into high temperature fluoropolymer-based tubing for use as the transfer line in order to minimize formaldehyde adsorbing to the line itself as well. -Mark

Comments

- Good job exploring possible issues with detection process. Off Course? Is this project still behind schedule? Are all the original objectives still within the scope of remaining work?

  Response 1: We are behind; that's a simple fact. As Mark mentioned, measuring isotope fractionation in neat UF resin might not be achievable. But discriminating natural vs synthetic formaldehyde is achievable. -Frazier

- Good progress

Summary Statement – TC Lead Todd Miller

Feedback from members was 1 off course and 7 on course or great progress

In general, we are content with this project. There was a suggestion to use heated transfer lines to prevent formaldehyde from being trapped in condensation. There was concern about moving away from the original goal of isotope fractionation but the project will still be able to answer one of the fundamental questions of where formaldehyde emissions are coming from (resin vs. wood). Some had concerns about having enough time to test particleboard. There were also questions/concern about the shift away from measuring fractionation however; the use of ^{13}C in this study will enable the project to reach its fundamental goal of understanding where formaldehyde emissions are originating from.