Summary

LIFE Forms Review

Project Updates: Progress Ratings

TITLE	VI	I	I W/ C	NI	A
(R001) K-05-KA (Final Report): Analysis of ... - Fred Kamke & John Nairn (OSU)	2	2	0	0	2
(R002) I-29-FR: Fundamentals of resole form ... - Chip Frazier (VT)	2	2	0	0	2
(***R003) K-04-SI: Elucidating the mechanism o ...*** - John Simonsen and John Nairn (OSU)	3	1	0	1	1
(R004) I-10-FR: Carbon Isotope Ratios, nove ... - Chip Frazier (Virginia Tech)	5	1	0	0	0
(R005) M-05-NE: Improving Durability of Woo ... - Mojgan Nejad (MSU)	2	4	0	1	0
(R006) M-02-PR: In-depth Charactherization ... - Gerald Presley and Jed Capellazzi (OSU)	0	2	2	1	1
(R007) M-03-PR: Preliminary Investigation o ... - Fred Kamke & Gerald Presley (OSU)	1	2	0	0	1
(R008) SWEETWATER-20 (Final Report): Evalua ... - Mojgan Nejad (MSU)	1	2	0	0	2
(R009) I-28-FR: Wood thermochemistry - Chip Frazier (Virginia Tech)	1	3	0	0	1
(R010) K-02-CA: Bench-scale screening test ... - Scott Case and Brian Lattimer (VT)	1	1	0	1	1
(R011) J-01-SIN: Understanding elevated tem ... - Arijit Sinha (OSU)	2	2	0	1	0
(R012) M-01-KA: Repeatable Measurement Meth ... - Fred Kamke & Lech Muszynski (OSU)	2	3	0	0	0
(R013) POSTER: Isolation and Characterizati ... - Chip Frazier (VT)	0	2	0	0	1

Project: (R001) K-05-KA: Analysis of adhesive atomization on composite bond performance

Project Phase: Final Report

Project PI: Fred Kamke & John Nairn (OSU)

Progress Ratings:

Very Interested - 2
Interested - 2
Interested with Change - 0
Not Interested - 0
Abstain - 2

Summary of Responses to IAB Comments

Questions

- A little confused if why the data seems to show a correlation between maximum area coverage and lower bond performance... do we think this is real? What can explain this?

  Response 1: I assume the comment is about IB performance and the resin coverage data from the blender strands. Best IB was at the highest atomizer RPM. There was no statistical significance for resin viscosity. In regard to resin coverage, there was no statistical significance due to atomizer RPM, but resin viscosity was significant - lowest viscosity had more coverage. If you plot IB versus resin coverage for aspen and southern pine combined, there is no correlation. A linear line has a positive slope, but R-squared is only 0.0075. Aspen by itself is slightly better, but still very poor at R-squared of 0.0339. Southern pine by itself did show a positive linear relationship, with R-squared of 0.5684. Continued..... -Fred Kamke
  Response 2: IB is inherently variable due to between-strand resin coverage variability and variability in mat formation. After analyzing the density of the IB specimens we found that 25% of the variation is accounted for by density. Any effect of resin coverage in the study was not great enough to consistently pick-out in the IB results. What we can say is that increasing RPM from 7000 to 13000 improved IB across the board. The effect of resin viscosity was not significant on IB, but increase of resin viscosity reduced coverage. The other factor to consider is the size of the resin spots. Unfortunately, spot size and coverage are correlated. Increasing spot size increased coverage. For aspen, increased spot size decreased IB (R-square = 0.188). For SYP there was no correlation between spot size and IB. -Fred Kamke
  Response 3: It should be remembered that resin spots on the strand surface are not just discrete droplets. Many droplets overlap on the surface of the strand, so multiple droplets can often be counted as one large resin spot. -Fred Kamke

- How is resin applied in real-world OSB manufacturing, and do you expect the same trends observed in your work? Why do you think you saw an interaction on SYP and not on Aspen when looking at the lap shear data presented?

  Response 1: You must be looking at slides 11 and 12 in the final report. The first thing to note is that shear strength is reported as maximum load per milligram of resin applied to the lap joint. Dylan had to normalize based on the amount of resin because the atomizer spray pattern in the blender apparently shifts when we change RPM. The spinning disk creates a cone of resin. The angle of the cone likely changes with RPM. The highest RPM produced the lowest mass of resin on the lap-shear strands. Increasing the resin viscosity increased mass of resin on the lap-shear strands. We also noted a bimodal distribution of spot size for the lap-shear strands. The lap shear strands are stationary inside the blender when they are exposed to the spray. Spinning disk atomization can create "ligaments" of resin at the rim of the disk, and then the ligaments may break up into smaller droplets. We can easily observe the bimodal distribution with a microscope. Continued..... -Fred Kamke
  Response 2: For strands in a rotating blender, the strands rub together and spread the resin from strand to strand. In a rotating blender the strands move randomly inside the drum and get exposed to different regions of the spray pattern. With both southern pine and aspen there was a huge influence of RPM. Increasing RPM reduced the mass of resin on the strands. I notice that the vertical axes for specific shear strength were not the same between aspen and southern pine. Perhaps this gave the impression of more interaction with southern pine than aspen. If you just looked at the 13,000 RPM & medium viscosity resin, aspen had average specific shear strength of 782 and southern pine had 675 N/mg. The corresponding COV for aspen and southern pine were 54% and 44%. If you compared the failure load, without normalizing for mass of resin, increasing RPM reduces failure load. -Fred Kamke

Suggestions

- Still interested in one day seeing if the same relationships hold up for pMDI resins.

  Response 1: pMDI appears very different on an OSB strand. Resin spots are finer. pMDI penetrates completely though the thickness of the strand. Because of the strong affinity of pMDI to wood, the spots appear as a thin coating, with essential zero contact angle. Most of the PF resins I've looked at have a well defined contact angle, which is difficult to estimate, but my guess is about 10 to 50 degrees. If we repeated this study, pMDI could be included but we likely would not have a simple option for changing viscosity. I would also modify the lap-shear resination method to yield a consistent amount of resin application per strand. Time in the spray pattern could be calibrated to mass of resin applied for each resin type and atomizer speed. -Fred Kamke

Comments

- Great work.

Summary Statement – TC Lead Jesse Paris

Project: (R002) I-29-FR: Fundamentals of resole formulation

Project Phase: Project Update

Project PI: Chip Frazier (Virginia Tech)

Progress Ratings:

Very Interested - 2
Interested - 2
Interested with Change - 0
Not Interested - 0
Abstain - 2

Summary of Responses to IAB Comments

ChipFrazier's Response: Thanks for the feedback. We certainly need to take this effort to the performance side.

Questions

- Is your sprayed material the same solids content? The increase in viscosity is more dramatic than we would expect. Your fillers will still bring in air, simply in the voids between your fillers. If your cowels mixing is correct, air should only be from wetting out fillers. You should not be slurping air during mixing (slow down vortex if blade is exposed and air is coming in. With the FlackTek mixer are you making any adjustments for resin drops? or all components in mix at the same time? The benefit of a step by step mix procedure is to have tight mix upfront to develop wheat before letting down with additional resin.

  Response 1: For the sprayed materials, I have only measured the slight difference in density that occurs after spraying. I can look at this more thoroughly with the moisture content analyzer to better understand if there is a solids content change. There is never a large enough vortex where the blade is exposed during mixing. All the components are mixed at the same time for the FlackTek mixer. It might be possible to develop a multistep method for the FlackTek mixer sample after comparing samples for the almond and walnut shell formulations. Thanks for the questions. -Ryan Gray

- What is your hypothesis on why you saw differences between the fillers (ie-Why did you see gel formation on CCR only?)

  Response 1: The CCR is the only filler that has been chemically altered. We believe that the CCR alteration process has given it the unique capability to gel under these conditions. -Ryan Gray

Suggestions

- Between FlackTek and the CCR (and quite frankly between Filler A... B... C...) how can you confirm that the wheat flour is developed to the same degree between mixes? We believe different fillers have a different effect on developing the wheat flour given all other mix steps and components are the same. This wheat development would affect all the subsequent rheological studies.

  Response 1: Currently, we make the FlackTek samples in one step and wouldn't be able to determine this. Possibly, a multistep FlackTek sample mix can be developed that reflects the mixing times of the regular mixing method. Thank you. -Ryan Gray

- Take learning from this project and explore implications on adhesive performance.

  Response 1: Thank you, and we will take the steps needed, to observe possible changes in adhesive performance as a result of the observations made in this project. -Ryan Gray

Comments

Summary Statement – TC Lead Todd Miller

Project: (R003) 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 (Oregon State University)

Progress Ratings:

Very Interested - 3
Interested - 1
Interested with Change - 0
Not Interested - 1
Abstain - 1

Summary of Responses to IAB Comments

Questions

- Your optical microscopy is cool and agree this does not show agglomerations... is this done for all samples with increasing CNF concentration? Is there a quantitative evaluation planned?

  Response 1: Yes, it is done for all samples with increasing CNF. if I found agglomeration I had planned to measure and quantify it, but since I did not find it I have no quantitative evaluation plan -Maria Munoz

Suggestions

- We would suggest that you do not use density as a covariant in the analysis since density can be effected by cure. You could use weight instead.

  Response 1: Hi, thanks for your suggestion. Could you develop more your idea about how the density can be affected by cure. I want to state that when I did PB samples, all of them follow the same procedure, same quantity of adhesive, catalyst, particles, water, press time, etc. There is a density variation between samples just because they were made at lab scale. And, as density is an important factor because the mechanical properties are highly depended on density, not weight of the sample, so we decided include density as a covariant. To use weight as a covariant one assumes the dimensions are the same between samples. This is not the case for us. There is significant size variation given the equipment and protocols that we have available, even though we tried our best to keep things consistent. -Maria Munoz

- Very curious about the DSC data not showing the cure peak. We should check the method and pan type. It looks like you are having a major loss of water. Perhaps a high-vol pan

  Response 1: Hi, last week I repeated the experiment (only for UF control and UF+1.4% CNF) in Hexion facilities and I was able to find the cure peak. You are right, the pan type that we have available in the university wasn't the correct one for this experiment. I would like to show my results in today's meeting. -Maria Munoz

- The project is progressing well and perhaps needs further statistical interpretations of the results. This could allow replicating the best tests by adjusting the density of the boards to validate the results.

  Response 1: The results for internal bond, MOR and MOE have been categorized as a function of density. Upon comparing density normalized properties we see that the addition of CNF significantly improves the properties of the PB samples. -Maria Munoz

Comments

- Good Progress. Great data with increasing mechanical properties with increasing CNF content (after accounting for density). Eager to see the fracture test data - Will this also be on particleboard samples? or simple DCB specimens?

  Response 1: Hi, thanks for your comment. Two weeks ago I finished the fracture mechanics test and I am still processing the images and data. To perform this test I used particle board samples. -Maria Munoz

Summary Statement – TC Lead

Project: (R004) I-10-FR: Carbon Isotope Ratios, novel view of CH2O emissions

Project Phase: Project Update

Project PI: Chip Frazier (Virginia Tech)

Progress Ratings:

Very Interested - 5
Interested - 1
Interested with Change - 0
Not Interested - 0
Abstain - 0

Summary of Responses to IAB Comments

ChipFrazier's Response: Thanks for the feedback. Frankly, I am uncertain if the platen closing speed should be increased or decreased; it seems fast now but that's not a careful observation.

Questions

- Just curious, how were you assessing 'tack' (by feel or are you measuring in some way) Are you pressing to stops? If your density is low, is that because of Mass or Thickness?

  Response 1: I am simply assessing tack by feel - at least enough resin content that the resonated furnish is able to be pre-formed into a greenbody that doesn't crumble during pressing but a low enough resin/moisture content to avoid blows. Adjustments made within this range are generally geared towards achieving the desired panel density and thickness. The density is low due to issues achieving the desired thickness. Generally 0.5" stops are used during pressing but press cycles have been performed without the use of any stops and the target thickness is still not achieved. -Mark

Suggestions

Comments

- It looks like the problem of producing the proper panel thickness and density. Suggestions have been made on forming. I would suggest developing a press schedule where the pressure changes during the entire press cycle. I have not pressed particleboard since graduate school. If memory serves me correctly, the press schedule will affect the density profile. Put the new hot press at Va Tech to work!

Response 1: Great suggestion! Adjusting pressure during the press cycle, adjusting pressing speed, and looking into cold-pressing prior to hot-pressing are all things we are considering and will be investigating moving forward to try to attain the target panel thickness. -Mark

- Glad to hear your particleboard process has shown real improvements! Great work.

  Response 1: Thank you! We appreciate the kind words along with the advice WBC members have been providing us throughout the process! -Mark

Summary Statement – TC Lead Todd Miller

Project: (R005) M-05-NE: Improving Durability of Wood Products by Reducing Lignin Degradation

Project Phase: Project Update

Project PI: Mojgan Nejad (Michigan State University)

Progress Ratings:

Very Interested - 2
Interested - 4
Interested with Change - 0
Not Interested - 1
Abstain - 0

Summary of Responses to IAB Comments

Questions

- Can you please explain your before and after images as regards to your measurements on slide 8? None of the pairs is of the same sample.

  Response 1: This is an excellent question. Unfortunately, the quality of photos taken from the same set before exposure was not good (taken with a phone). The images shown in slide 8 are taken from one replicate from each set that was kept in the dark place as a control, along with the other replicate from the same set exposed to 35 days of UV exposure (taken with a high-quality camera). Sorry, that is why they are not matched. -Mojgan Nejad

- What were your coating thickness and curing conditions?

  Response 1: The wet film thickness of all resins were 8 mils (0.2mm). The coated wood samples were left in a dark place for one week to air dry before UV- test. These were waterborne resins. -Mojgan Nejad

Suggestions

- We would suggest that you investigate the coating itself before moving on to adding the coating to plywood.

  Response 1: This is an excellent question. Unfortunately, the quality of photos taken from the same set before exposure was not good (taken with a phone). The images shown in slide 8 are taken from one

replicate from each set that was kept in the dark place as a control, along with the other replicate from the same set exposed to 35 days of UV exposure (taken with a high-quality camera). Sorry, that is why they are not matched. -Mojgan Nejad
Response 2: Please ignore the above comment. It was in response to the previous question. This is an excellent suggestion. I think we might have measured them before. If not, we can prepare another set of samples with pure resins and a mixture of each resin with different additives and evaluate them before and after 35 days of UV exposure. -Mojgan Nejad

- In regards to the Acrylic resin, we were curious about your film thickness? and how you were drying the coatings on the boards? We observed with thick films and higher drying temps similar cracking occurs. with thinner films (~10 mil wet) and dried at ambient conditions we don't see cracking. Perhaps this cracking lead to the odd UV results. We observe the adhesion to wood should is still good, but the cracking is through the coating thickness.

  Response 1: We were also surprised to see that acrylic resins did not perform better than alkyd and PUD. The wet film thickness of all resins were 8 mils and samples were air-dried. We might need to consider using different acrylic resin for next step weathering test. -Mojgan Nejad

- It was surprising to see that the acrylic didn't perform as well. Perhaps the film thickness was higher to have uniform drying and thereby causing cracks. We would suggest a multi-application strategy, where two thinner coatings were applied with drying in between. This should eliminate the cracking and result in a more predictable performance from the acrylic.

Comments

Summary Statement – TC Lead Sudip Chowdhury

Project: (R006) M-02-PR: In-depth Charactherization of Bondlines in CLT made with Preservative-Treated Lumber

Project Phase: Project Update

Project PI: Gerald Presley and Jed Capellazzi (Oregon State University)

Progress Ratings:

Very Interested - 0
Interested - 2
Interested with Change - 2
Not Interested - 1
Abstain - 1

Summary of Responses to IAB Comments

CodyWainscott's Response: Data and images will be reworked to fix confusion which was a common question and an easy fix. CLT panels were 3 ply and glued with MF and PUR resins. From these resins, each got a preservative treatment. Lamellas were planed before CLT panels were created while post layup CLT panels were created first and treated afterwards. The overall investigation of whether preservatives inhibit penetration is being done now, and more data will be out in the future. Micrograph of the penetration will be analyzed by counting cell depth across 160 images. More penetration images can be created but will required more time to accomplish data collection.
CodyWainscott's Response: More literature of the resins types will be reviewed. There are plans to have the preservatives and resins shipped to us and mixed in order to perform a DMA test and investigate if the preservatives inhibit the curing process.

Questions

- Did you test treated CLT? It looks like the student only tested the control samples. The coding was confusing. It looks like the panel was assigned a code based upon the treatment. The control was a C9. The origin panels was divided into 9 sectors in which C2 and C9 were tested. Were the lamellas planed after treatment? What is the mechanism causing problems with bonding?

  Response 1: There were a total of 9 treatments and one control. Cody is going to fix labeling moving forward so the slides are more understandable. The treatments are as follows: All wood is Douglas-fir Panel A and B- untreated wood manufactured into3-ply panels using melamine formaldehyde resin and 18 x 30 inch subsections of each panel panels were then pressure treated with one of three preservatives. Panel C- untreated control with MF resin Panel D- 2x6 lumber pressure treated with low borate product containing organic compounds as actives Panel E- 2x6 lumber pressure treated with borates to formosan termite

retentions were used to make CLT panels with MF resin Panel F- 2x6 lumber dip treated in a borate solution that contained organic actives as well, MF resin Panel G-same as D with PUR resin Panel H- Same as E with PUR resin Panel J- Same as F with PUR resin all treated lumber was planed after treatment which caused about 30-70% loss of borates in the borate-based treatments -Gerald Presley
Response 2: The mechanisms are likely a combination of borates acting as surfactants and inhibiting the curing process and borates taking up space in cell lumens and preventing resin penetration. This work is really only looking into the latter and Cody will have some data on that in the near future. -Gerald Presley
Response 3: As Gerald Presley answered. We did analyze different CLT panels with MF and PUR resins and the three different preservative treatments. I will rework how the data is presented next time. -Cody Wainscott

- Did you look at depth of penetration versus strength to see interactions? How do test 1 and test 2 differ?

  Response 1: Cody is working on that now. He is analyzing micrographs and will be counting cells to measure depth of penetration over ~160 images. -Gerald Presley
  Response 2: The penetration analysis is in data collection right now. More micrographs will be created the further along we get. The presented method of analyzing penetration depth using Image J has be suspended due to conflicting issues and instead we will be counting the cell penetration by hand. -Cody Wainscott

- Can you get access to the adhesives and preservatives for more controlled fundamental studies of adhesive interactions in presence of preservative "X"? For all proposed fundamental testing (and with your current testing), controls without preservatives are necessary. Need a lot more information around your shear block adhesive image data... how was this collected? what is the sensitivity to differentiate adhesive vs. wood? why is this relevant? how do you intend to use it?

  Response 1: We have asked for the preservatives and adhesives which should arrive to us soon. We will mix these at different ratios and do a DMA test with Hexion to determine how the curing process could change. This should tell us if the preservatives inhibiting curing vs the control resins. The wood failure images where taken under a UV light. These pictures where then analyzed using Image J where the picture was turned black and white to differentiate wood from adhesive. A percentage of the wood vs adhesive was found using Image J to find wood failure. This data will tell us the performance of the bondline strength and if the adhesive properly bonded with the wood cells or pre-cured without much penetration. This along with delamination analysis, the DMA test stated above and penetration micrographs should tell a story if preservatives inhibit bondline penetration or not. These panels were not made by us so this limits us to which test we can do to determine performance. -Cody Wainscott

Suggestions

- Focus on the chemistry and the bond line images to determine what can be done to improve performance of adhesives when gluing treated lamellas.

  Response 1: Cody is currently analyzing the micrographs and will be quantifying average resin penetration in each field of view by counting number of cells impregnated with resin over the whole field. We realize this is a relatively small sample due to the small size of each field of view but are limited by time investment. In total Cody is going to analyze just over 160 images over 9 different treatments and one control. -Gerald Presley

- More fundamental interaction analyses are absolutely necessary: - DSC for impacts on resin cure in presence of adhesives - Surface energy evaluations to help explain differences in resin penetrating and wetting - better controlled adhesive penetration data (it was clear in one image that the pure adhesive layer was significantly thicker and contained voids than the other... this must have an effect on bond performance, but without control of the panel lay-up one can't say if this is due to a process issue such as different board thicknesses or bond pressures? or due to preservative treatments affecting the resin penetration)... If you are going to show these images, there should be a greater discussion about how that data adds to your ability to answer the hypothesis, and what the potential limitations are.) The standard is PRG320 not PGR. When presenting anything with condition codes, please include a key on the slide, or better labeling. It is hard as an audience member to follow what code is what. There were references made to different adhesion performance observed between the MF and PUR adhesive for a given preservative system, but no discussion of WHY? this goes directly to the need for more fundamental background understanding (literature and analytical data about the differences between the interactions with each resinpreservative). Also, a control comparison without preservative would be helpful. For one of your conditions there was mention that there was questions about that panel's formation process. If this is the case, it should not be included. Or at least, all observations drawn from that panel should be looked at in context of all of the other fundamental test methods that will hopefully be added to this work (i.e. DSC, surface tension, controlled bonding for penetration evaluations, etc...)

  Response 1: The micrograph images shown where to explain how the Image J analysis of penetration which has since been scrapped for counting cells instead. You do have a point though and we could use these images to explain why some data was better than others. We will wait until we finish our DMA test first though. More literature into the adhesives types will be also be reviewed in the future. -Cody Wainscott

Comments

- Not enough testing to justify the conclusion that the treatment affects glue bond strength. Do not use trade names when describing resin and treatments. PRG-320 may not be the appropriate standard to evaluate the effects of treatment on the glue bond. By the way, you referred to it as PGR-320. I can understand this

Response 1: Do you have another suggestion for a standard we can use in the future to look at bondline impacts? -Gerald Presley

- If you want to answer your hypothesis, you NEED to do more analytical testing than simply post-mortem evaluations of panels you had no control in laying-up. More fundamental chemical analytical testing is necessary. If there are time resource limitations to completing all this proposed fundamental testing, then there should at least be an acknowledgement upfront of the limitations from only looking at these older panels. AND the report should include a heavy literature review focusing on other fundamental tests that can help address the proposed hypothesis. Highly caution drawing any conclusions from the mechanical and adhesive penetration data of these specific panels without more subsequent and supporting fundamental analyses.

  Response 1: Yes, there is time element to this project and not much else can be done without more resources. With that said, we are currently waiting on getting the preservatives and mixing them with the resins at different ratios. These mixtures will then be sent to a DMA machine to find the elastics modulus vs temperature which should tell us how the curing process will change. -Cody Wainscott

Summary Statement – TC Lead Bob Breyer

Project: (R007) M-03-PR: Preliminary Investigation of DMDHEU-Treated Strand Board (new)

Project Phase: Project Update

Project PI: Fred Kamke & Gerald Presley (Oregon State University)

Progress Ratings:

Very Interested - 1
Interested - 2
Interested with Change - 0
Not Interested - 0
Abstain - 1

Summary of Responses to IAB Comments

Questions

- Would be interested in seeing a TGA of the solution and the resulting impregnated strands.

  Response 1: We have noticed some volatility of the DMDHEU after impregnation. This has been a challenge as we have adapted the treatment from published lumber treatment methods to treatment of wood strands. So far percent weight retention has been lower than expected. -Fred Kamke

Suggestions

- If sourcing the DMDHEU is a challenge, we can assist in preparing the material in the lab.

Comments

- Very interesting concept.

Summary Statement – TC Lead Sarath Vega

Project: (R008) SWEETWATER-20 (Final Report): Evaluating Suitability of Steam-Explosion Lignin for Different Polymeric Resin Applications

Project Phase: Project Update

Project PI: Mojgan Nejad (Michigan State University)

Progress Ratings:

Very Interested - 1
Interested - 2
Interested with Change - 0
Not Interested - 0
Abstain - 2

Summary of Responses to IAB Comments

Questions

- What is the internal variance for Lignin versus what the variance is between lignins?

  Response 1: We had three replicates for some of the measured lignin properties. They standard deviations were very low and reported for those measured properties in the report. The two lignin samples evaluated in this study were prepared from the same biomass source (hardwood) but were isolated through two-step pH drop (lignin-1) and one-step pH drop (lignin-2). As shown in lignin properties data, using even different method to drop the pH to precipitate lignin from liquor significantly impacted lignin properties, thus their reactivities toward formaldehyde, epichlorohydrin and Isocyanate. Hope that answered your question. -Mojgan Nejad

Suggestions

- Keep units consistent (eg- slide 5). Suggest you compare the adhesive performance against a comparable PH.

  Response 1: Sure, we will fix the slide. The two lignin-based phenolic adhesives had very similar pH of 12.9±0.1 and 13.3±0.1. Do you think even these slight differences in pH can impact adhesive performance? Thanks, we will definitely investigate the effect of pH in our future formulations. -Mojgan Nejad

Comments

Summary Statement – TC Lead Scott Tudman

Project: (R009) I-28-FR: Wood thermochemistry

Project Phase: Project Update

Project PI: Chip Frazier (Virginia Tech)

Progress Ratings:

Very Interested - 1
Interested - 3
Interested with Change - 0
Not Interested - 0
Abstain - 1

Summary of Responses to IAB Comments

Questions

- Why did the glass transition temperature go up with DSC but down with DMA? Have you done any work to understand the variation within the methodology to be able to comment on the significant differences within the NMR data, specifically the C5 aromatic shift?

  Response 1: I love these questions and I'm eager to see how Sara answers them! -ChipFrazier
  Response 2: Thank you for your question. In DMA, we did the experiment for whole wood tissues and therefore other wood components like cellulose and hemicellulose are present. We believe that polysaccharide degradation upon the treatments is the reason behind the decreasing trend of the glass transition temperature. However, for DSC tests isolated lignins were used and we could see the effect of treatments solely on lignin glass transition temperature. -Sara Yazdi
  Response 3: Thank you for your question. In DMA, we did the experiment for whole wood tissues and therefore other wood components like cellulose and hemicellulose are present. We believe that polysaccharide degradation upon the treatments is the reason behind the decreasing trend of the glass transition temperature. However, for DSC tests isolated lignins were used and we could see the effect of treatments solely on lignin glass transition temperature. -Sara Yazdi
  Response 4: I haven't done any work to understand the variation within the methodology to be able to comment on the significant differences in NMR data yet. But, I will be doing statistical analysis to determine the significant difference between the data -Sara Yazdi

Suggestions

Comments

- Great presentation and Awesome data! Great use of different analytical techniques!

Summary Statement – TC Lead Darren Riedlinger

Project: (R010) K-02-CA: Bench-scale screening test for ASTM E119

Project Phase: Project Update

Project PI: Scott Case and Brian Lattimer (Virginia Tech)

Progress Ratings:

Very Interested - 1
Interested - 1
Interested with Change - 0
Not Interested - 1
Abstain - 1

Summary of Responses to IAB Comments

Questions

- Have you looked at the width of the flame versus the width of the sample? Could there be a flame edge effect that is impacting the char?

  Response 1: We had not looked at this before because the flames are not in direct contact with the sample in this current furnace setup. Instead, the burners were heating the test specimens indirectly. The heat transfer in the specimen comes from the hot gases inside the furnace, the hot furnace walls, and when the wood ignites heat from the burning wood. The indirect heating from this furnace resulted in a very even char depth across the width of the sample. We have proposed a new furnace setup where the burners are directly impinging on the sample. In this case, the flame width may impact the charring, but we still saw a very even distribution of char through the sample in the initial tests. -Michael Gangi

Suggestions

Comments

- Did the glue meet the requirements of ASTM D2559 or ASTM 7247? Did you see char fall off in any of the tests?

  Response 1: The glue we used was to build up sections was Titebond III wood glue. The Titebond III meets the requirements of ASTM D-905 (Strength Properties of Adhesive Bonds in Shear by Compression Loading), but not ASTM D-2559 (Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure

Conditions) nor ASTM 7247 (Shear Strength of Adhesive Bonds in Laminated Wood Products at Elevated Temperatures). In addition, we are unsure of the glue used to create the plywood laminates themselves. Yes, we did see char fall off in the plywood tests at 1/2-scale and full-scale due to cracking of the char at longer exposure times. However, the char fall-off did not initiate at the interfaces of the built-up layers where our glue would be in question. Instead, the cracks propagated vertically from the surface through the plywood layers. It was brought up in the Q+A session that the plywood used may not have been structural plywood, which we will look into for the next set of tests. -Michael Gangi

Summary Statement – TC Lead Jim Ni

Project: (R011) J-01-SIN: Understanding elevated temperature performance of wood composites

Project Phase: Project Update

Project PI: Arijit Sinha (Oregon State University)

Progress Ratings:

Very Interested - 2
Interested - 2
Interested with Change - 0
Not Interested - 1
Abstain - 0

Summary of Responses to IAB Comments

Questions

Suggestions

- Consider the impact of the dart ablation temperature on the results.

Comments

Summary Statement – TC Lead Patrick Farrell

Project: (R012) M-01-KA: Repeatable Measurement Method for Percent Wood Failure

Project Phase: Project Update

Project PI: Fred Kamke & Lech Muszynski (Oregon State University)

Progress Ratings:

Very Interested - 2
Interested - 3
Interested with Change - 0
Not Interested - 0
Abstain - 0

Summary of Responses to IAB Comments

Questions

- How much will the results be impacted by earlywoodlatewood, or heartwoodsapwood?

  Response 1: As long as the adhesive has a different chemical signature in the UV-vis range, earlywood/latewood and heart/sap will not matter. This is the beauty of spectroscopy - you are not limited by color contrast to the human eye. -Fred Kamke
  Response 2: Ideally we will attain one or more principal components (PCs) to rely upon which will differentiate the innate wood vs adhesive chemical structure. In short, a PC is a linear combination of columns (variables) within an n x p data matrix which provides the most variance (largest eigenvalue corresponding to a linearly transposed eigenvector). -Talbot B. Rueppel
  Response 3: For example, Ding et al. (2020) found that the characteristic peak of cellulose is 574 nm due to the glycosidic bonds within. The researchers reported that this peak was independent of lignin content. Although, Malachowska et al. (2020) found that lignin content does affect the broadness of the "shoulder" thereafter, it does not alter or mask the characteristic peak of the cellulose glycosidic bonds which are absent in the resins. This will be further clarified in the literature review. -Talbot B. Rueppel

- Are there plans to evaluate wood failure from other types of test specimens (i.e. block shear)? Did Roseburg identify read the wood failure? Would a goal be to develop a new ASTM standard?

  Response 1: We have existing block shear specimens for which PWF has already been determined (Matthias Wind project from last year) and Lech Muszynski have a couple of sets from some previous CLT studies. I don't think we need them to prove the concept. To use the larger block shear specimens a larger probe must be built. RFP did provide the PF bonded plywood specimens with PWF already determined. Frankly, I don't

agree with the values. Talbot will perform his own PWF evaluation after the UV-vis scans. This other method will follow ASTM D2525, but he will use digital images and a superimposed grid system to evaluate both halves of the broken specimen. He will also use a digital image analysis technique. So there will be several measures of PWF for each test set. If successful, I would propose further refinement for adoption as an ASTM standard. -Fred Kamke

Response 2: The existing block shear specimens would be beneficial because they are true shear (no peeling), represent lumber-based structural composites, and are MF-bonded Douglas fir. MF exhibited a very distinctive spectral profile and characteristic peak in preliminary trials, which could be exploited well with MVDA techniques. Although, most (not all) of the specimens were high percentage wood failure and were stained. There are many more samples of the same species and adhesive combination, but they have not been tested under ASTM D5266 and are low-contrast, which is why Matthias had to stain them. ASTM D5266 certainly needs amended due to its subjectivity. -Talbot B. Rueppel

*Response 3: Addition: There are many more *unstained* MF-bonded Doug fir block shear samples left Further, there are approximately 80 additional PF-bonded Doug fir lap shear specimens which were tested dry and evaluated with the grid system. -Talbot B. Rueppel*

Suggestions

- Agree with the assessment that going forward elimination of the corners of specimens due to the probe holder will not be a problem (% is %). However, there will likely be challenges in correlating your values to the conventional subjective assessments of the matched specimens.

  Response 1: This may be an issue that we can account for with the digital image analysis techniques, especially the grid overlay technique. Missing corners could end up lowering the resulting correlation coefficient (r^2) values, but not substantially. -Talbot B. Rueppel

Comments

- Given enough wood failure specimens evaluated, missing the corners should not affect the results the amount of wood failure at the corners should be random. The Columbia Falls specimens are fine. If you need any other specimens, please let the member know. I am concerned about the % on the plywood chips. It does not lend itself to blinding the study. Next time, identify the specimen and have the separate spreadsheet with the wood failures.

  Response 1: Thus far you have only seen preliminary tests. We recognize the importance of eliminating bias in the test results. The PF bonded test specimens have the % wood failure written on each specimen, but we could cover that up with tape. The other test set of specimens have not been broken. The spectra are not really revealing to the naked eye. There are hundreds of peaks and data from several peaks will likely be

included in the model. I don't think a human could look at a failed surface and a pre-evaluated PWF and then manipulate the spectra to bias the results. It really is a black box until the model is applied. If this process works, at some point software will be created to provide an immediate readout of PWF. We will not have that. The digital spectra must be stored and then input to a multivariate model using separate software. -Fred Kamke

Response 2: We do understand your concern with the blinding issue. However, now that we have a probe holder which maintains a fixed probe distance from the specimen, regardless of its thickness, the only source of possible bias is eliminated because the probe itself will not have to be constantly adjusted due to the varying specimen thicknesses. That too, was not able to alter the obtained spectral profile from a sample scan, only the intensity. The 2" fixed probe distance and acquisition area eliminates this issue. Please let us know if we have misinterpreted this concern. -Talbot B. Rueppel

- Great presentation. We see no problem with moving forward with the plywood samples from Columbia. Really like the fact you shared the literature review outline. We don't see this often, but it is excellent. It allows the IAB to see greater depth into how the project and student plans to progress. Very cool advancement with the probe holder.

  Response 1: Thank you for the kind words. Unfortunately, I was not able to finish the literature review and send it out to everyone before this meeting, but I've been working diligently on it, and you all will receive the completed document next week. At that point, please feel free to send any critiques you have. Fred did a great job making the probe holder. It keeps the probe very secure and mitigates the probe distance issue we had. -Talbot B. Rueppel

Summary Statement – TC Lead Sarath Vega

Project: (R013) POSTER: Isolation and Characterization of *Cannabis* pectins

Project Phase: Project Update

Project PI: Chip Frazier (Virginia Tech)

Progress Ratings:

Very Interested - 0
Interested - 2
Interested with Change - 0
Not Interested - 0
Abstain - 1

Summary of Responses to IAB Comments

Questions

Suggestions

- It would be helpful to understand the commercial viability of the material. How much is available in a geographic area and what price point?

Comments
