

Summary LIFE Forms Review

Wood-Based Composites Center

Oregon State University - May 9th, 2022

New Proposals: Level of Interest

TITLE	VERY INTERESTED	INTERESTED	INTERESTED W/CHANGE	NOT INTERESTED	ABSTAIN
(001) N-04-PR: Effectively Incorporating Pr ... - Gerald Presley and Matthew Konkler (Oregon State University)	3	2	0	1	0

Project Updates: Progress Ratings

TITLE	GREAT PROGRESS	ON COURSE	NEEDS CHANGE	OFF COURSE	ABSTAIN
(002) K-04-SI: Elucidating the Mechanism of ... - John Simonsen (Oregon State University)	5	2	0	0	0
(003) J-01-SIN: Understanding elevated temp ... - Arijit Sinha (Oregon State University)	3	4	0	0	0
(004) K-02-CA: Bench-scale screening test f ... - Scott Case and Brian Lattimer (Virginia Tech)	6	0	0	0	0
(005) I-28-FR: Wood thermochemistry - Chip Frazier (Virginia Tech)	3	2	0	0	2
(006) M-05-NE: Improving Durability of Wood ... - Mojgan Nejad (Michigan State University)	2	2	0	0	1
(007) M-02-PR: In-depth Characterization of ... - Gerald Presley and Jed Capellazzi (Oregon State University)	1	4	0	0	0
(008) SWEETWATER-21: Investigating Lignin C ... - Mojgan Nejad (Michigan State University)	1	3	0	0	2
(009) I-29-FR: Fundamentals of resole formu ... - Chip Frazier (Virginia Tech)	1	4	0	0	1
(010) M-01-KA: Repeatable Measurement Metho ... - Fred Kamke & Lech Muszynski (Oregon State University)	2	4	0	0	0
(011) I-10-FR: Carbon Isotope Ratios, novel ... - Chip Frazier (Virginia Tech)	1	5	0	0	1
(012) M-04-FR: Wax Migration - Chip Frazier (Virginia Tech)	1	4	0	0	1
(013) M-03-PR: Preliminary Investigation of ... - Gerald Presley and Fred Kamke (Oregon State University)	0	5	0	0	1

LIFE Forms Review

Project: (001) N-04-PR: Effectively Incorporating Pressure-Treated Fire Retardant Lumber into Mass Timber Panels

Project Phase: New Proposal

Project PI: Gerald Presley and Matthew Konkler (Oregon State University)

Level of Interest

Very Interested - 3

Interested - 2

Interested with Change - 0

Not Interested - 1

Abstain - 0

Summary of Responses to IAB Comments

Questions

- How will you apply the adhesives, through an extrusion system?
- How will you separate the effect of planing from the effect of borate reduction on the bond quality? You could get an improvement in bond quality simply by removing surface roughness.

Suggestions

- For a fundamental study of adhesion, use a different bond performance metric. No need to have cross lamination. Recommend Mode-I fracture. Now that you are controlling the adhesion, then you can design in a controlled study to evaluate adhesive penetration. Perhaps consider. I know this was a challenge with the preservative work because the bonding parameters were so different.
- I would like you to make a comparison between softwood and hardwood lumber
- Would suggest also including delam testing.
- Please incorporate preliminary testing. A suggestion could be based on glulam adhesion testing, which is industry standard and can also add a bonus of adapting them into a bench-scale test.

Comments

- Want a strong literature review. Lean heavily on the analytical data (DSC and DMA). Planing can be a confirmation, but the fundamental side should be on what is the minimal concentration for good adhesive cure.
- Do you have a history of the advantages and disadvantages of both adhesives?
- The project has been improved, but a call with the industry advisory board is highly recommended

LIFE Forms Review

Project: (002) K-04-SI: Elucidating the Mechanism of CNF reinforcement in wood adhesives and composites

Project Phase: Project Update

Project PI: John Simonsen (Oregon State University)

Progress Ratings

Great Progress - 5

On Course - 2

Needs Change - 0

Off Course - 0

Abstain - 0

Summary of Responses to IAB Comments

Questions

- Is it more reactive because the CNF? or because the resin itself was less advanced? Was UF solids normalized in the panel process (65 vs. 44.5% solids)? For your mechanical results was density controlled?
- Why do you think the resin is more reactive with the CNF

Suggestions

Comments

- The DSC data needs more evaluation and thought on the interpretation.
- Great project and good results. Good work.
- Good overall progress. There was not much context for the material cooked in, the results seem to focus on the back add approach. Perhaps it was the time limitation but more a comparison would have been helpful. The cooks parameters were not clear. The reference to cook time is insufficient to characterize the cook.

LIFE Forms Review

Project: (003) J-01-SIN: Understanding elevated temperature performance of wood composites

Project Phase: Project Update

Project PI: Arijit Sinha (Oregon State University)

Progress Ratings

Great Progress - 3

On Course - 4

Needs Change - 0

Off Course - 0

Abstain - 0

Summary of Responses to IAB Comments

Questions

- Were you surprised by the poor performance of the PUR glues at temperature? even after having this been a hot topic for a long time related to PUR vs. MF?

Response 1: The result for PUR (1st generation) was expected since it has some troubles initially. The comparison of performance was conducted at face value without singling out any adhesive for their resistance or lack of performance. -Arijit

- What is the basis for the 120 minute time for Ijoists?

Response 1: The basis for 120 minute time exposure was to be consistent with a 2 hour fire rating for an assembly. -Arijit

- Did you determine if the elevated temperatures would affect the testing machine? Would suggest you make sure your determination is included in your final report.

Response 1: Yes, several weeks were dedicated to make sure there are minimal influence of apparatus and other ancillaries at higher temperature on the data. Care was taken to isolate critical testing parts and keep them outside of the chamber. The design of apparatus was not presented due to time constraints, but will be included in the final report. -Arijit

Suggestions

Comments

- Interesting results. This is a good baseline for elucidating the behavior of heat and wood composites. It will be interesting to see the potential follow-up projects of fire and heat as high priority topics.

Response 1: Thank you for the encouragement. On basis of this result, other follow up projects will be proposed. -Arijit

- went through data too quickly; it was hard to interpret what we were seeing

Response 1: Given the time constraints (10-12 min) for final presentation, it was hard to compile everything in 10 min. Will have more details in the final report. -Arijit

LIFE Forms Review

Project: (004) 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

Great Progress - 6

On Course - 0

Needs Change - 0

Off Course - 0

Abstain - 0

Summary of Responses to IAB Comments

Questions

- What was the effect of fasteners on the test?

Suggestions

- Could you make idealized plywood with 0-90-0-90... etc to have a better comparison between 14 and 12 scale?

Comments

- Excellent Work!
- The project is highly relevant and the results are interesting. I hope there is a follow-up to widen the data for different composites such a OSB
- Great job with a difficult task.
- Nice work and good presentation.

LIFE Forms Review

Project: (005) I-28-FR: Wood thermochemistry

Project Phase: Project Update

Project PI: Chip Frazier (Virginia Tech)

Progress Ratings

Great Progress - 3

On Course - 2

Needs Change - 0

Off Course - 0

Abstain - 2

Summary of Responses to IAB Comments

Questions

- Curious in the literature has there been a controlled study of bond performance between Radiata and Loblolly? Is the excess HCHO generated in Radiata able to in anyway contribute to the resin crosslinking? Mode I fracture?
- I recall that there were interesting results that warrant further study. Can you give a brief description?

Suggestions

- Please try to communicate your results in a clear and short manner for the next update

Comments

- The project has good progress.
- Try to avoid flashing through slides with information during the presentation. The audience will always want time to read and understand results. Might be better not to show those if time constraints are in place, and focus on higher level conclusions and reasonings. It was a good presentation for a longer time slot.

LIFE Forms Review

Project: (006) 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

Great Progress - 2

On Course - 2

Needs Change - 0

Off Course - 0

Abstain - 1

Summary of Responses to IAB Comments

Questions

- In the HNTs encapsulated with lignin, is the HNT providing stability of the lignin? IS there a way of direct incorporation of lignin?

Response 1: Yes, since HNT is nano-clay also acts as nano-pigment in addition to lignin carrier. Addition of either lignin or HNT individually was not as effective as as addition of encapsulated HNT with lignin (reducing UV-degradation of resins). -Mojgan Nejad

Response 2: Yes, since HNT is nano-clay also acts as nano-pigment in addition to lignin carrier. Addition of either lignin or HNT individually was not as effective as as addition of encapsulated HNT with lignin (reducing UV-degradation of resins). -Mojgan Nejad

- What is the target numbers of hours in the Q-UV? Is there a plan to have samples in natural weathering?

Response 1: The plan is to continue the QUV test for up to 2000 hrs, this was the results only after 300 hours. We also analyzed the samples with DSC and FTIR before and plan to do so again after 2000 hrs. No, there is no plan to perform natural weathering for this project, but we are open to propose that as future project if WBC members are interested. -Mojgan Nejad

Suggestions

Comments

- The progress is good and the results are interesting

Response 1: Thanks -Mojgan Nejad

LIFE Forms Review

Project: (007) M-02-PR: In-depth Characterization 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

Great Progress - 1

On Course - 4

Needs Change - 0

Off Course - 0

Abstain - 0

Summary of Responses to IAB Comments

CodyWainscott's Response: This research project has made progress in determining adhesive interaction with (full organic, full borates, and mix of both) treatments. More dynamic mechanical analysis (DMA) tests are needed to come to a more decisive conclusion.

Questions

- Ensure your modulus data has the same total active MF content, Normalize. Your conditions have 5% less MF than the control. What are the base resin characteristics? Please provide viscosity profiles.
- The green treatment did better than the controls. How many specimens were tested?

Response 1: For shear and wood failure I had 24 samples and 12 samples for delamination. -Cody Wainscott

- What evidence did you see that lumens were blocked and reduced adhesive penetration? Could the reduction have been due to a change in adhesive cure?

Response 1: Results are assumed from delamination, shear strength, wood failure tests and research papers on the topic which are limited. The dynamic mechanical analysis tests I did so far do show a negative reaction when mixed, both in cure strength and slower cure time. When adhesive penetrates into the wood and makes contact with the preservatives it may cause change in curing, example precure or blockage. In the microtome slides there is evidence of holes in the bondline for some treatments which could be do to adhesive interaction with the preservative. -Cody Wainscott

Suggestions

Comments

- DMA = Dynamic Mechanical Analysis Please provide Standard deviations! Earlywood vs. latewood in Comparing penetration data. Need to normalize; is cell depth the best comparison when the size of cells is so different? Please look into other adhesive penetration studies.

Response 1: Cell depth penetration was normalized by the number of cell rows in the slide. Other papers read have only provided cell adhesive counts where a "good" bond is anywhere from 2 to 7 cells deep for strong mechanical strength. This was backed by shear and wood failure tests. In many cases, articles only provided wood failure results. -Cody Wainscott

- The research is interesting. it will be good to see more results in the next meeting.

Response 1: Thank you very much. This research will provide a good backbone for a more in depth follow up project. -Cody Wainscott

Technical Lead Statement

All reviews were either; on-course or great progress. Two questions were related to the performance of the resin verses the control. One suggested to make sure the amount of solids were the same and the second commented that the green treatment did better than the controls and wanted to be sure enough samples were use to ensure good statistical analysis. A third question was based on how they can be sure the difference in performance was due to pure penetration issues and not complicated by cure. On the penetration measurements make sure not to be looking at differences between early and late wood and confusing that with the resin having difference in penetration.

General Comment to all groups: Make sure you put in standard deviation and use proper statistical approaches to define differences.

LIFE Forms Review

Project: (008) SWEETWATER-21: Investigating Lignin Consistency from Batch-to-Batch

Project Phase: Project Update

Project PI: Mojgan Nejad (Michigan State University)

Progress Ratings

Great Progress - 1

On Course - 3

Needs Change - 0

Off Course - 0

Abstain - 2

Summary of Responses to IAB Comments

MojganNejad's Response: The goal is to evaluate the consistency of lignin properties from multiple biomass sources throughout the year using the same isolation parameters. If the results show lignins have consistent properties, then it would answer the concern raised by many lignin end-users of lignin (e.g., resin and panel producers). We hypothesized that the variation in biomass (different batches) could be minimized if lignin producers used the same isolation parameters. These results will also help determine which lignin property is more sensitive to biomass variations and should be measured for each batch before using lignin for product developments.

Questions

- Is the SW-10 a hardwood or softwood source? Are you surprised that there are such broad differences between the hardwood and softwood samples?

Response 1: The SW-10 is also hardwood produced in Sweetwater partner plant in Europe. No, we were expecting to see major differences between softwood and hardwood lignins, but we are happy to see that hardwood lignins had relatively similar properties when isolated using the same isolation parameters. -Mojgan Nejad

- What is the batch-to-batch variation between batches on elemental analysis?

Response 1: We only had one batch samples, so far. Sweetwater is going to send us more samples and we can report the elemental analysis and other results in the Fall meeting. -Mojgan Nejad

Suggestions

- Include range on GPC information. Data seemed to show lignin type to lignin type comparison only. Would suggest adding variation testing within each type while you wait for additional lignin batch samples.

Response 1: Sure we will run three replicates for GPC too. -Mojgan Nejad

Comments

- Great progress. It is good to learn more about the differences in lignin between different species. I look forward for more updates

Response 1: Thanks a lot. -Mojgan Nejad

LIFE Forms Review

Project: (009) I-29-FR: Fundamentals of resole formulation

Project Phase: Project Update

Project PI: Chip Frazier (Virginia Tech)

Progress Ratings

Great Progress - 1

On Course - 4

Needs Change - 0

Off Course - 0

Abstain - 1

Summary of Responses to IAB Comments

Questions

- Were you able to confirm that the solids did not change with spraying?

Suggestions

Comments

- Good progress and presentation.
- Good job on the presentation.
- Good presentation.

LIFE Forms Review

Project: (010) 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

Great Progress - 2

On Course - 4

Needs Change - 0

Off Course - 0

Abstain - 0

Summary of Responses to IAB Comments

Questions

- How do the differences in the color of wood effect the results? Examples would be earlywood/latewood, and sapwood/heartwood.

Response 1: I have noticed that brighter specimens with more sapwood seem to fluoresce at a greater intensity, which may contribute to some prediction error. Although any adhesive present on the surface lowers that intensity and helps to further quantify the value. -Talbot B. Rueppel

Suggestions

Comments

- Good work, it will be interesting to see the final conclusions of this research

Response 1: Thank you, we are excited and working towards our goals. -Talbot B. Rueppel

- It would be interesting to look at images of the wood failure surfaces for the outliers. Is there a reason why these points aren't well predicted by the technique?

Response 1: This may be due to surface topography reflecting the light differently. I will make sure to take a deeper look into those outliers. -Talbot B. Rueppel

LIFE Forms Review

Project: (011) I-10-FR: Carbon Isotope Ratios, novel view of CH₂O emissions

Project Phase: Project Update

Project PI: Chip Frazier (Virginia Tech)

Progress Ratings

Great Progress - 1

On Course - 5

Needs Change - 0

Off Course - 0

Abstain - 1

Summary of Responses to IAB Comments

Questions

- Can you reach out to other departments on campus to determine if there are any LC methods for IRMS?

Suggestions

- An industry team should host you to make the tagged resin!
- Be sure to take an exhaustive look at LC techniques that would help quantify the mass ratio of the bisulfite adduct with HCHO.

Comments

- Good presentation. it will be interesting to see the results with the isotope

LIFE Forms Review

Project: (012) M-04-FR: Wax Migration

Project Phase: Project Update

Project PI: Chip Frazier (Virginia Tech)

Progress Ratings

Great Progress - 1

On Course - 4

Needs Change - 0

Off Course - 0

Abstain - 1

Summary of Responses to IAB Comments

Questions

Suggestions

Comments

- Awesome; excited to see some data!
- Good advance in the review and good work presenting. Will look forward for the fall update
- Good job so far.

Technical Lead Summary

This was the first update on this project. There were only 5 responses, with 3 On Progress and 1 great progress, with 1 abstain. The comments were all focused on excitement to see the data starting to come in, and on the Student's good presentation. Good luck; we are all looking forward to the next steps.

LIFE Forms Review

Project: (013) M-03-PR: Preliminary Investigation of DMDHEU-Treated Strand Board

Project Phase: Project Update

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

Progress Ratings

Great Progress - 0

On Course - 5

Needs Change - 0

Off Course - 0

Abstain - 1

Summary of Responses to IAB Comments

Questions

- Can you also do some DSC DMA to confirm resin cure in presence of this treatment? Are these retentions in % chemical weight vs. % wood weight? That seems high!

Response 1: This preliminary project will not address resin cure using DSC or DMA. Recall this was designed as a 9-month undergraduate project. If results are promising, perhaps a follow-up project could look at chemical interactions. % weight gain is based on dry weight of wood. Yes, the 20% level is high. Perhaps the 10% and 5% levels will be useful. -Fred Kamke

Suggestions

- I hope that Shane can present his results during the fall meeting

Response 1: Shane has agreed to present the final report at the Fall Meeting. -Fred Kamke

- Glad you are showing mechanical data alongside the durability. Definitely want to confirm you achieved a similar adhesive performance and that durability is truly due to the positive impact of the treatment and not a negative impact of compromised adhesive cure penetration.

Response 1: IB, bending, and thickness swell tests are pending. Then we'll conclude with the fungal durability test over the summer. It looks like we may receive some additional chemical from Hexion. We will follow-up with Peter DeJong about synthesizing some MeDMDHEU for us. -Fred Kamke

Comments

- The road blocks have been significant for this project and it is great that it has started to move forward, we look for the results as they can be industry relevant

Response 1: So do we. Shane Johnson has committed to working with us over the summer, so we expect a final report to be made by Shane at the Fall Meeting. Hexion may be willing to synthesize some methylated DMDHEU for us and solve the raw material issue. -Fred Kamke