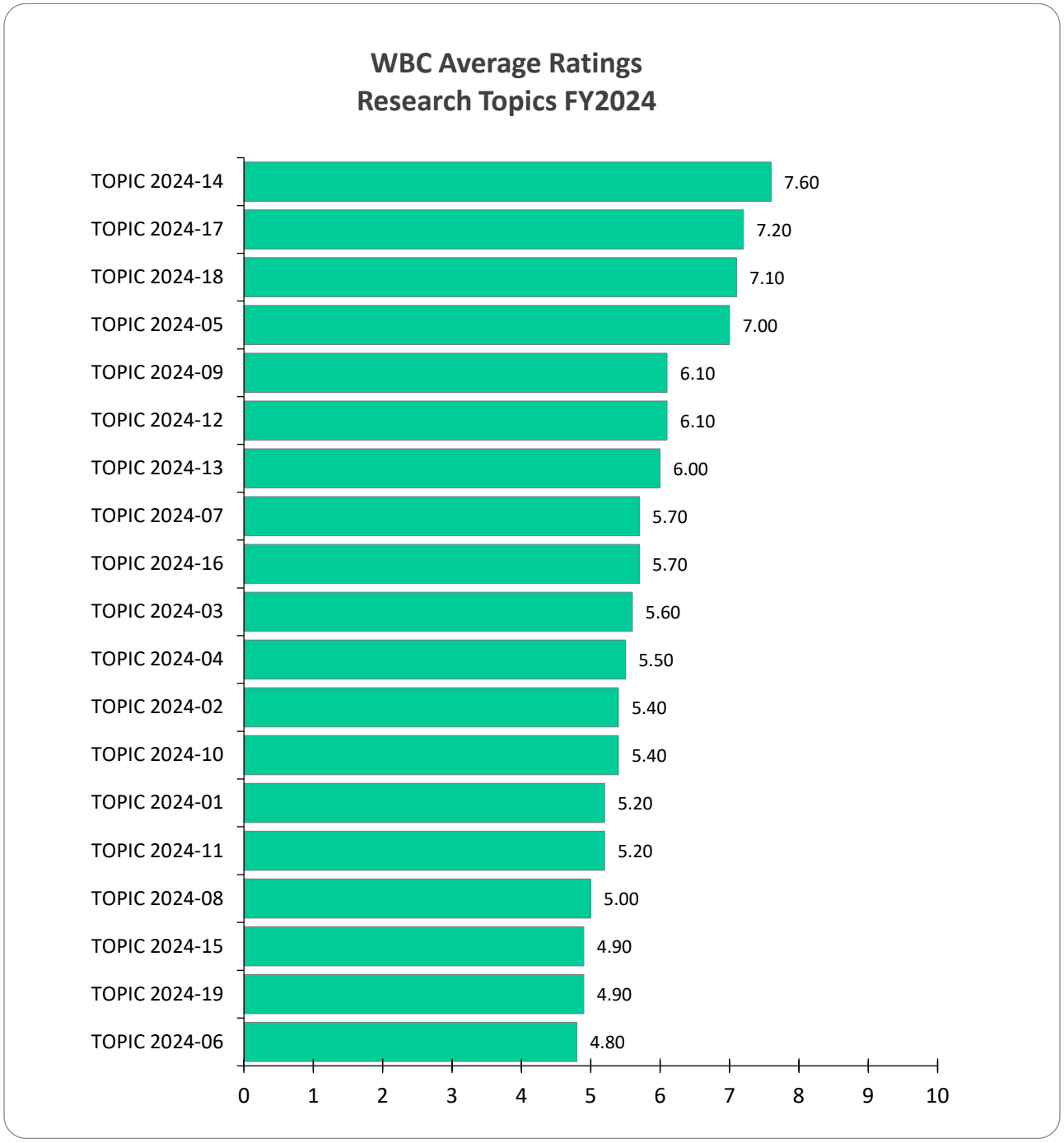
FY2024 WBC MEMBER-GENERATED RESEARCH TOPICS

MEMBER RATINGS SUMMARY

We have received eleven New Research TOPICS from **9/11** member companies (**82% response rate**). Rating feedback was returned by **9/11 members (82% response rate**). The topics were rated based on the company's interest on a scale of 0 to 10, **with 0 reflecting "no interest" and 10, "highest level of interest"**.

CODE	TITLE	Mean	SD
TOPIC 2024-14	*Investigate the process of adhesive penetration based on molecular size properties of the adhesive.*	**7.60**	2
TOPIC 2024-17	*Effect of phenol formaldehyde molecular weight on infiltration into wood cell wall nanostructure*	**7.20**	2
TOPIC 2024-18	*Method to accurately measure adhesive application rate using a smartphone or handheld device*	**7.10**	2
TOPIC 2024-05	*New or Modified Methods for characterization of wood-based composites fire performance*	**7.00**	3
TOPIC 2024-09	*Improved dimensional stability so that EWP can compete with non-wood options*	**6.10**	3
TOPIC 2024-12	*Evaluation of Mass Timber Products with transverse and/or longitudinal vibration techniques.*	**6.10**	3
TOPIC 2024-13	*Improved wood/overlay adhesion testing methods*	**6.00**	3
TOPIC 2024-07	*Improved fire resistance comparable to non-wood options for such end uses as wood decking and siding in wildfire-prone areas*	**5.70**	3
TOPIC 2024-16	*Find a microscopic solution for viewing amino and pMDI adhesives that do not require a secondary preparation such as a dye.*	**5.70**	2
TOPIC 2024-03	*Reduction in PB/MDF/OSB density while maintaining physical-mechanical properties.*	**5.60**	2
TOPIC 2024-04	*Use of biomaterials in resins for particle board and MDF*	**5.50**	3
TOPIC 2024-02	*Reduction of fiber raise on profiled MDF faces following machining and exposure to ambient conditions or incidental water contact prior to or after finishing*	**5.40**	2
TOPIC 2024-10	*Bond Strength Assessment across veneers (point and aggregate)*	**5.40**	4
TOPIC 2024-01	*Sustainable wood finishes: Characterization of Key Substrate Properties Related to Finishing Wood Composites*	**5.20**	3
TOPIC 2024-11	*System Effects in Mass Timber Products.*	**5.20**	3
TOPIC 2024-08	*Moisture-induced wood composite panel deformation*	**5.00**	3
TOPIC 2024-15	*Cure development of protein-based adhesives during pressing as a function of composition, time, temperature, and moisture content.*	**4.90**	3
TOPIC 2024-19	*Effectiveness of Citric Acid and Sorbitol as pesticide treatment in SYP and DF*	**4.90**	3
TOPIC 2024-06	*Using wood from burnt forests for plywood production*	**4.80**	4


WBC Average Ratings
Research Topics FY2024
TOPIC 2024-14
TOPIC 2024-17
TOPIC 2024-18
TOPIC 2024-05
TOPIC 2024-09
TOPIC 2024-12
TOPIC 2024-13
TOPIC 2024-07
TOPIC 2024-16
TOPIC 2024-03
TOPIC 2024-04
TOPIC 2024-02
TOPIC 2024-10
TOPIC 2024-01
TOPIC 2024-11
TOPIC 2024-08
TOPIC 2024-15
TOPIC 2024-19
TOPIC 2024-06
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5.40
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TOPIC 2024 – 1 RATING: 5.20

Sustainable wood finishes: Characterization of Key Substrate Properties Related to Finishing Wood Composites

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JUSTIFICATION

The current trend within the NA cabinetry market is the increased use of wood composites as the primary finished or wear surface (e.g. door substrate). Although double-refined MDF has been used for several years to replace maple, its use has generally required an additional finishing step (or two) to seal the machined/profiled areas to achieve the same film build experienced with non-machined areas or that seen with maple (historic industry standard species). The focus on increased sustainability and reduced finish process steps creates a need for an improved understanding of profiled surface structure and morphology/topography. Potential project outline:

- Develop procedure(s) for characterizing key substrate criterion for finishing success
  - Surface characterization
  - Board composition impact
- Align board variables to finish characteristics
  - Performance and aesthetics
- Identify board manufacturing and composition variables that can be optimized for finishing
  - Boards are not produced for finishing properties – what could be changed if they were produced for finishing?
- Machining for finish as opposed to machining for application
  - Current methods – began as whitewood methods then adopted to composite methods
  - Improvements – tooling geometries and speed; balanced with through put
  - Edge treatments – heat treatments for absorption and hydrophobicity (lignin flow) or other developed methods

COMMENTS TOPIC 2024 – 1

Comment 1-1. The described project has an immediate interest within secondary manufacturing (e.g. furniture, cabinetry, building products). The majority of secondary manufacturers use various grades and types of wood composites (e.g. MDF, double-refined MDF, particleboard, etc.). Although money is saved via the use of less expensive substrate (compared to solid wood), other production costs (e.g. costs associated with finishing) are increased. This includes finishing material and labor costs, as well as equipment maintenance. Identifying key substrate-related characteristics that impact finish process efficiency and effectiveness is beneficial to the manufacturer as well as the finish supplier, enabling both to tailor final products and process for improved sustainability (financial and environmental).

Comment 1-2. Potential to reduce cost of MDF in cabinetry.

Comment 1-3. As described our company rates this as a three. Our company is interested in finishes for veneer; therefore, if the focus were wood products we would have more interest. The justification indicates that there is potential for several projects.

Comment 1-4. Our rating is low only due to this not being a core subject for our company. It is undoubtedly important to those industries engaged in wood machining and finishing. However, it seems like is a well-researched subject with a large volume of published research available in the public domain. There are new, high dimensionally stable MDF products on the market. If these substrates were the focus of the machining studies, then we could rate this proposal higher.

Comment 1-5. The title of this proposal implies the focus of the research would be on the sustainability of the finishes themselves. Less VOC, etc. The description focuses on machinability or improving process of finishing. Shouldn't this be the title, to more efficiently use (any) finish? Expand study to HWPW, OSB, and MDF substrates vs. maple as part of this work would be good. How will this project advance the science around this subject?

Comment 1-6. This topic is interesting, as it can look into the substrate's paintability and/or machinability vs the finishing characteristics. As it is a rather broad topic, it will be good to see if it can get a better focus during the roundtable.

Directors' Comments

Sinha: This is an important topic that needs further investigation. It is of value to several of our members. Question remains on the "large volume of published data", which can be compiled and looked into with an initial literature search. If Azko Nobel is interested in this area, thich could be a good candidate for a new member special project.

Frazier: This is an exemplary project justification. Comment 1.1 provides an interesting perspective, and forward-thinking justification for this project. Comment 1-4 raises equally important questions with, "it seems like is a well-researched subject with a large volume of published research available in the public domain." Please help us obtain this information, and also info about the new dimensionally stable MDF products. We need this discussion, among all of us, to increase value for all members. I have been in communication with AkzoNobel on this idea, and I'm hoping to hire an MS student for this project. We have discussed a fundamental analysis of surface chem as a function of machining depth. There is also interest in using tomography to evaluate the degree of orientation in an MDF panel at different locations.

TOPIC 2024 – 2 RATING: 5.40

Reduction of fiber raise on profiled MDF faces following machining and exposure to ambient conditions or incidental water contact prior to or after finishing

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JUSTIFICATION

Increased use of MDF (single or double refined) as the predominant finished surface for interior furnishings (e.g. cabinets, furniture, etc.) has increased over the last 10 years. As opposed to being used in entry level applications, it is now used in higher end market segments which brings additional performance and aesthetic requirements. A continued problem with its use is the impact that incidental water exposure via liquid or vapor update has on performance, including in process (e.g. fiber raise after machining resulting in additional finishing steps) and in service (e.g. fiber raise or swelling in unfinished areas resulting in damage). A need exists to identify and develop an economical solution to reduce either. Experience has shown that increasing the resin or wax content of board furnish can improve its resistance to swell or fiber raise. However, it also increases the cost and can reduce the sustainability of the produced board. An alternate approach is needed. Ideally the approach would create a board with uniform density profile, machining characteristics as good as or better than controls, improved fiber raise after machining, and water resistance in service. The result would be a board with improved finishing characteristics and improved long-term performance in humid conditions.

COMMENTS TOPIC 2024 – 2

Comment 2-1. Use of wood composites for primary wear or show surfaces within cabinetry and areas of building products is growing. Given that the majority of surfaces are machined for aesthetic purposes (e.g. profiled with simple or complex shapes), managing the end result for optimal downstream processing is important. Additional machining or finishing processes are often employed to address surface changes after primary machining. Common defects, such as fiber raise, result from intermediate or extended storage in areas with limited environmental controls. Although “freshening” the surface via surface sanding can address most storage-related or machining defects, it is an additional step, or steps, in the manufacturing process. Modest changes to board composition, or changes to board production processes, may have a significant impact on surface changes after primary machining that help reduce downstream processing. Changes may provide a board manufacturer with an opportunity to provide a value added product for differentiation.

Comment 2-2. Great idea. Curious to see which potential alternative approaches are identified.

Comment 2-3. Important for high end MDF, solution would work its way down to commodity grades over time, improving MDF competition vs plastic. Seems to be a patentable/proprietary project. Improving moisture durability is a goal valuable to the entire industry.

Comment 2-4. This looks more like product development rather than fundamental research.

Comment 2-5. Our rating is low only due to this not being a core subject for our company. It is undoubtedly important to those industries engaged in wood machining and finishing. However, it seems like is a well-researched subject with a large volume of published research available in the public domain. There are new, high dimensionally stable MDF products on the market. If these substrates were the focus of the machining studies, then we could rate this proposal higher.

Comment 2-6. Care should be taken with project proposals to ensure they are pre-competitive in nature. The topic seems to have a wide scope. Are you looking for processing solutions, additive solutions or both?

Comment 2-7. There is interest in potential projects that could come from this topic, but further refinement is needed.

Directors' Comments

Sinha: The project has novelty and from the comments, it seems, members are interested. However, care needs to be taken to keep the scope pre-competitive in nature. The project results can lead to value-add in member's profile of products, however, a fundamental approach is warranted.

Frazier: Comment 2-4 is most noteworthy to me; I understand the product-development perspective, but for me the project justification raises entirely novel, high-risk, pre-competitive research. For some time now, I have been talking about controlling lignin chemistry in wood during hot-pressing. I've been talking about chemically intercepting lignin's natural reactivity, and promoting crosslinking; a thermoforming surface treatment is envisioned where a solution is sprayed on the surface and cured via hot-pressing and/or infrared. This is a lignin-specific reaction that we are currently studying via NSF funding. Emilie Kohler will present a poster in my absence. My vision of its application for this WBC project is far into the future. Nevertheless, I can claim that we are currently working on something that might play here. Maybe more important is that other faculty recognize their vision of precompetitive research. And by the way, the reminder about precompetitive research is always appropriate.

TOPIC 2024 – 3 RATING: 5.60

Reduction in PB/MDF/OSB density while maintaining physical-mechanical properties.

JUSTIFICATION

This topic was from 2023. We think this needs to remain an active roundtable discussion (not sure if there has been a project created from this or not). Increase in mill productivity, savings in the cost of raw materials (wood), and energy used in production processes such as drying. Consider different wood species, types of boards, levels of resin consumption, and types of resins to meet the quality requirements or CARB emission regulations. One key goal of the project could be matching Radiata strength at the same weight using DF or SYP.

COMMENTS TOPIC 2024 – 3

Comment 3-1. The proposed project sounds interesting and would have an impact on secondary manufacturing (e.g. cabinet doors, etc.) where weight of the machined substrate, as well as the final product, can impact handling within the plant and shipping costs. There could also be a positive impact on tool wear. Consideration of density profile is needed given that it can impact later processes depending on end market use. Additional consideration to impact on finishing should be considered if an additional process step is needed to finish lower density board.

Comment 3-2. Seems the solution for each product is specialized/niche. Not confident there is a global solution.

Comment 3-3. Where would the radiata pine be sourced from? Need more insight on how to evaluate.

Comment 3-4. The title starts with an end goal. What is the opportunity for fundamental research? Each of the products listed are a project by themselves. OSB must meet PS-2 requirements. Does a manufacturer overbuild to meet these requirements.

Comment 3-5. Topic of high interest. Review public literature and outline what specifically would be done that is novel and built upon previous learnings. Is this purely a different species or species mix play or would (should?) other additives be considered?

Comment 3-6. This topic has a lot of interest from the composites industry.

Comment 3-7. When discussing this topic, some potential points of interest could focus on researching the potential energy gains or losses associated with a reduced density, and how this could impact carbon

capture. Additionally, it may be important to consider how a reduction in density can be achieved in a production environment, as this may vary depending on the type of press used.

Directors' Comments

Frazier: This topic represents one of the most fundamental challenges in wood-based composite technology. It should be identified as the incredible, impossible goal that we must strive towards for reducing carbon emissions. Face it; we know very well that when reduced to smaller particle sizes, wood recombination can only regain good properties by increasing resin, orienting particles/flakes, and increasing density with density profile control. We have to consider entirely novel ways to produce a low-density core with high-density faces. Perhaps we should focus on truly high-density, stiff, thin layers bonded to a new core. It just seems like something entirely novel is required to meet this goal. This is a goal the Center should point to as stretgic for decarbonization.

Sinha: Dr. Frazier's comments summed it up well. Depending on the rating, we should keep this one active and perhaps have a discussion in one o the future roundtables.

TOPIC 2024 – 4 RATING: 5.50

Use of biomaterials in resins for particle board and MDF

JUSTIFICATION

The objective of this topic is to evaluate the incorporation of biomaterials in resins used to manufacture boards such as MDP and MDF, based on the guidelines that IKEA has proposed for 2030.
There is 40% of this type of material, complying with the physical-mechanical properties and formaldehyde emissions in accordance with current regulations.

COMMENTS TOPIC 2024 – 4

Comment 4-1. There is continued industrial interest in increasing the use of bio-based materials. It would be interesting to scope the project in such a way to provide use outside of primary PB and MDF manufacture. It would also be interesting to evaluate resins that expand during board manufacture that could potentially create a more uniform density profile or smoother surface when machined.

Comment 4-2. Topic appears to be product development.

Comment 4-3. Highly dependent on how the proposal comes out.

Comment 4-4. Is this close to NPD? Need more detail on what bio-materials to be considered.

Comment 4-5. New resin development is of interest for our company. Is potential project literature review? 40% is a fairly specific target; is that level obtainable with the state of the art? If so, what are we waiting for, if not what fundamental research is necessary to obtain the goal? What about resins that must meet ASTM D2559?

Comment 4-6. Some definitions of biomaterials would be helpful. What biomaterials would be considered? What is the sustainability focus here, lower VOC, reduction of carbon footprint, reduction in petrochemical raw materials? Some more details relating to prior research would be helpful to the justification. A higher rating is possible here if we just had more information to work with.

Comment 4-7. This topic has the potential to be not pre-competitive. May want to focus the topic on what properties are needed in the biomaterials of interest to successfully be incorporated into a product.

Comment 4-8. Several questions could be discussed in a roundtable for this topic: (1) What biomaterials are being considered for the resins?, (2) Is the drive to be formaldehyde-free?, (3) Is the topic limited to biomaterials?, (4) Can other composites be considered besides MDP and MDF?

Directors' Comments

Frazier: Again the concerns about product development are most noteworthy. Keep in mind that there has been nearly zero success in replacing petrochemical wood resins with renewable forms. What feedstocks? Well technical lignins have been worked on for years. But it does not matter; folks want to try anything. It's not easy. We have been trying for many years. We can make great glue at $1000/gram, and that is useless…**unless** it sparks ideas in our members. That is the merit in this goal. I agree that it looks like product development; but we are so far away from any feasible replacements that I still consider this fundamental research…but maybe we need some new approaches. As for comment 4-8, I believe that any biomaterials are candidates, IF they provide hope for reliable, large-scale supply. And yes, the drive is formaldehyde free, I believe, and any single new resin should, hopefully, have promise for application in all major composite products.

Sinha: No comments on this one. Concern about product development is noted!

TOPIC 2024 – 5 RATING: 7.00

New or Modified Methods for characterization of wood-based composites fire performance

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JUSTIFICATION

Understanding the fire resistance of systems involving wood in building codes revolve around E-84 and E-119. Both tests require significant amount of material to perform the test. Significant work has been performed by PIs Case and Lattimer (N-06-CA) to develop a bench-scale technique to scale the ASTM E119 furnace exposure. This work should be further explored in hopes of increasing speed of research and increase in consistency of measurement. The long-term ideal scenario is that a method can be developed and proposed as a standard. The suggestion would be to continue on from recommended next steps of N-06-CA

- Improve correlation between full-scale and ¼ scale
- Evaluate scaling methodology in other types of surface coatings
- Develop a scaling approach for adhesive joints

The work can perhaps begin with a literature review of fire testing and applications among ASTM, ICC, and UL and then a definition of the most relevant criteria (fire fuel, flame spread, fire stoppage etc) that leads to what small scale testing might best demonstrate the effectiveness of the materials.

COMMENTS TOPIC 2024 – 5

Comment 5-1. The most relevant criteria will be based on application (e.g. decorative wood ceiling panel vs. loaded glulam beam) so would suggest having members weigh in on what is most important to them during the round table.

Comment 5-2. Lots of companies already perform internal confidential bench-scale testing prior to going to an accredited full-scale test. However, even their internal tests with lots of full-scale data to compare against it cannot fully predict the full-scale performance. Details of the scaling are very important along with what the end goals are.

Comment 5-3. Need to understand how this expands on the work already done.

Comment 5-4. This a subject of importance for all types of EWPs, especially with pressure on performance in wildfire-prone areas (WUI).

Comment 5-5. This topic is very relevant to the current code changes. Also, as there is already a project that has been funded, the continuation to increase its viability for different materials is important.

Directors' Comments

Frazier: I hope that we can continue this work, continue to engage Case and Latimer. Currently, we have some administrative obstacles, and we should reach out to Case and Latimer to determine their interest. I suspect they remain highly motivated.

Sinha: The work has been started by a Center funded project at Vtech and we (the IAB) should make concerted effort to keep the PIs in the WBC fold and bring in more expertise as needed. There are different requirements for structural and non-structural products. The project discussion should revolve around how to incorporate different product tyoe in the mix. This project seems like a good candidate for a Systematic Literature Review followed by a Meta- Analysis to answer some of the questions raised within the justification. Will be great to have a discussion on this.

TOPIC 2024 – 6 RATING: 4.80

Using wood from burnt forests for plywood production

JUSTIFICATION

Wildfires are being more extensive every year. Wood processing facilities receive an important volume of burned logs for their processes. Burned logs might have different characteristics compared to regular logs such as lower moisture content, which should be well known to adjust all the following processes and products used in the production line. We propose to study the differences between regular and burned wood regarding quality compliance for plywood manufacturing.

COMMENTS TOPIC 2024 – 6

Comment 6-1. Sounds interesting. Would be interesting to expand beyond plywood into PB or MDF manufacture.

Comment 6-2. It would be helpful if a best practices for using burnt logs was developed.

Comment 6-3. Recommend that any proposal uses a large quantity of peeling data (mill data) to account for log variability.

Comment 6-4. Can we quantify (%) the volume of burned logs used? Do we know how it is being handled currently – in plywood or lumber? Is it plywood or lumber-specific? Could it be applied to other wood composites?

Comment 6-5. We deal with fire salvages already. We know there is reduced grade-yield. We need more specificity in the definition of regular wood and burnt wood. How long after the fire was the timber harvested? How severe was the fire damage? The project must narrow the scope. Suggestions would be to determine the effect on grade yield. The second phase could be to determine if there is a difference between the fire-damaged and regular wood in the strength properties from the same grade.

Comment 6-6. Is there a request from the plywood manufacturers to evaluate this issue? Are they struggling with raw material quality today and need guidance? Old logs from burned areas probably have insect damage and this would be covered in a raw material quality requirement document mill procurement uses.

Comment 6-7. Currently, plywood manufacturers already utilize wood from burned forests. It would be more interesting to evaluate the level of degradation of lignin and hemicelluloses in those veneers and see if they have additional properties (like thermally modified wood) or if there could be an impact on adhesion.

Directors' Comments

Frazier: This also seems like a high-profile objective for the industry, one that is very challenging but has potential reward for feedstock supply and demonstration of a new dimension of forest stewardship. The comments seem to suggest that a rapid whole-log evaluation would be fundamental.

Sinha: This is an important topic and lot of attentions is being given to this. We perhaps need to look beyond the center to follow the recent advancement in this area through US Wood Innovation Grant, The EDA grant at OSU, and others.

TOPIC 2024 – 7 RATING: 5.70

Improved fire resistance comparable to non-wood options for such end uses as wood decking and siding in wildfire-prone areas

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JUSTIFICATION

Regulations & codes continue to evolve with respect to the wildland-urban interface (WUI), resulting in criticism regarding wood products, including engineered wood products used as building materials. WUI regulations include performance standards for materials, such as ignition resistance, non-combustible materials, and flame spread. Continued investigation into novel processes and compositions for improved fire resistance of engineered wood-based composite products is critical if we are to preserve and expand the use of these building materials.

COMMENTS TOPIC 2024 – 7

Comment 7-1. Topic appears to be product development.

Comment 7-2. Very important long-term challenge for wood products.

Comment 7-3. Close to NPD? Is there an industry/consumer pull for this?

Comment 7-4. To broad in scope and it tends to be a product development issue.

Comment 7-5. Topic is impactful to many industries and is timely, considering expanding interest in WUI codes. Use of composite wood products in the areas impacted by fire is at risk of being excluded from building codes in both the US and Canada. Novel processes and compositions for improved fire resistance in engineered wood-based composites are critical to continued use in specification as qualified building materials.

Comment 7-6. The potential research of this topic has the potential to become patentable, and that might be out of the scope of the WBC.

Directors' Comments

Frazier: I have to repeat, with modification, my prior response because it fits here again: For some time now, I have been talking about controlling lignin chemistry in wood during hot-pressing. I've been talking about chemically intercepting lignin's natural reactivity, and promoting crosslinking. This could be used for an entirely novel way to increase fire performance. This is a lignin-specific reaction that we are currently studying via NSF funding. Emilie Kohler will present a poster in my absence. My vision of its application for fire performance is far into the future. Nevertheless, I can claim that we are currently working on something that might play here. And hopefully other faculty envision other precompetitive approaches to this idea.

Sinha: On the first glance, it seems new product development and perhaps outside the scope of WBC. However, there is potential to research some altered chemistry, which might fit in the WBC realm.

TOPIC 2024 – 8 RATING: 5.00

Moisture-induced wood composite panel deformation

JUSTIFICATION

Funding was previously provided for two MS projects involving moisture-induced warping in veneer-based panel products where a model and measurement method were developed. It would be good to finish out this work by combining the model and measurement method to investigate more complex warping situations.

COMMENTS TOPIC 2024 – 8

Comment 8-1. Topic is interesting regarding the impact on secondary manufacturing (e.g. interior entry or cabinet door construction). Is there data available regarding the cost to the industry for warped panel products used in cabinet door manufacture? Additionally, are other defects considered, such as veneer checking?

Comment 8-2. Interested. Need to know more about the recommendations from the previous research project.

Comment 8-3. Please provide more detail on what would be done to align model with experimental results. Please clarify if this is a new project to be funded or is there already an implied commitment by WBC to continue funding until completion (with new researcher)?

Comment 8-4. It will be interesting to continue the research for this topic as it had other two MS projects funded. Further studies can focus on how moisture affects different layups and different species, such as white-fir, sugar pine, etc.

Directors' Comments

Frazier: No comment on this topic.

Sinha: No Comments!

TOPIC 2024 – 9 RATING: 6.10

Improved dimensional stability so that EWP can compete with non-wood options

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JUSTIFICATION

Engineered Wood Composites with dimensional stability truly compete with non-wood options that are critically needed. While incremental improvements have been realized in recent years, there are still missed opportunities that could be addressed by significantly improving dimensional stability. Investigation into novel processes and compositions for improved dimensional stability of engineered wood products should be pursued to expand the specification and use of these products over non-wood alternatives.

COMMENTS TOPIC 2024 – 9

Comment 9-1. Product sounds interesting. Would recommend expanding scope to include secondary processing to improve dimensional stability. This can include surface or pressure treatments to improve dimensional stability via impregnation or other mechanism. A combination of approaches (primary and secondary processing) may be needed.

Comment 9-2. The entire composites industry would benefit from this. A difficult problem, quite possibly beyond the means of one student. Depends on implementation.

Comment 9-3. Are there specific non-wood alternatives that we're trying to compete with? Any specific thoughts on the process for improvement?

Comment 9-4. Need to identify a fundamental research angle to produce more interest.

Comment 9-5. Improved dimensional stability of EWP for better performance in applications vs. non-wood options is relevant to building products industries. It would be better to detail those novel processes and compositions to differentiate from the former solutions that have worked with respect to dimensional stability.

Comment 9-6. Design projects to focus on pre-competitive topics.

Comment 9-7. Projects from this topic might become patentable tech. Also, having a marketing focus on this would be more interesting.

Directors' Comments

Frazier: Like fire performance, increased hydrophobibity and dimensional stability is one of the big-vision goals for our industry. This should be a high priority for the Center. Again I have to repeat, we have an NSF project about chemically intercepting lignin's natural reactivity, and promoting crosslinking. This could be used for an entirely novel way to increase hydrophobicity. This is a lignin-specific reaction that we are currently studying via NSF funding. Emilie Kohler will present a poster in my absence. My vision of its application for hydrophobic modification is closer than for fire performance. Nevertheless, I can claim that we are currently working on something that might play here. And hopefully other faculty envision other precompetitive approaches to this idea.

Sinha: Dimensional stability and moisture induced durability is indeed, a big concern for EWPs and other wood-based materials. WBC has made inroads within this topic area and the work should continue. Investigation into new processes and formulation for improved dimensional stability of EWPs should be considered to expand the specification and use of these products over non-wood alternatives. We have the faculty expertise in this area and perhaps the roundtable can pique their interest.

TOPIC 2024 – 10 RATING: 5.40

Bond Strength Assessment across veneers (point and aggregate)

JUSTIFICATION

This topic has been highlighted in the past and we feel it should continue. It would be valuable for the industry to establish a quick, non-destructive, and accurate measurement of bond strength or immediately after production. This can be done with a mixture of point measurements using a hand-held device. This should be developed across several species and for veneers of varying thicknesses.

COMMENTS TOPIC 2024 – 10

Comment 10-1. Methods of generating accurate data quickly lead to better process control. This test (though delayed) could help with the plywood glue spread issue as well?

Comment 10-2. Interesting. Would an example be determining wood failure (%) in a plywood panel?

Comment 10-3. More specificity and fundamental research are necessary.

Comment 10-4. Rated "no interest" only because it is not applicable to our company. However, it does seem important to other related producers of EWP's. Isn't there some previous work in this area for OSB strands? If the justification would speak to prior research and indicate how this project will build upon that science, it would help sell the project for funding. Need a value statement, agree that it would be valuable to industry, but can you put some metrics behind this statement? Any manufacturer testimonials speaking to the need / value? This would all be helpful to the justification. This has potential, sell us on it.

Comment 10-5. It would be good to have more clarity on this topic. Additional information may raise the interest level of this topic.

Comment 10-6. It will be good to focus the conversation on potential projects related to the Wet SSS test for EWP. There is room to apply the work Talbot Rueppel made into tests that rely on operators (potential bias).

Directors' Comments

Frazier: This topic is critically important. Do we need a new approach? We made good progress with David Dillard's fracture approach.

Sinha: Interesting and important topic. We need to think beyond destructive approaches and pursue NDE techniques for this method to be rapidly deployable in the industry.

TOPIC 2024 – 11 RATING: 5.20

System Effects in Mass Timber Products.

JUSTIFICATION

The model inputs for mass timber products are the properties of the components. There is evidence that mass timber products perform differently than the components. Understanding these effects will provide a more accurate mechanical model.

COMMENTS TOPIC 2024 – 11

Comment 11-1. Part of the model discrepancy arises from the model being based on average or 5th percentile values of a component population. The empirical values fall somewhere within the population distribution and hence will influence the agreement between the model and test. Would suggest using actual test values (so much as possible) of the components when performing tests to understand system effects.

Comment 11-2. Useful for development of mass timber. Very vague.

Comment 11-3. Need a better understanding of what the output of the project would be.

Comment 11-4. Medium interest due to increased penetration of this product into the field of engineered wood composite construction. However, it is not specifically applicable to our company.

Comment 11-5. This topic is similar to topic 9, but will less detail.

Directors' Comments

Frazier: No comment here.

Sinha: There is a need in the industry to better predict the actual properties using base values for larger mass timber sizes. As we move more to performance-based design and capacity design our elements (such as beams, columns, etc.), this will be crucial.

TOPIC 2024 – 12 RATING: 6.10

Evaluation of Mass Timber Products with transverse and/or longitudinal vibration techniques.

JUSTIFICATION

Developing a technique to evaluate glulam, CLT, VLT or MPP products has the potential to:

1. Determine the system effects.
2. Reduce the testing during certification.
3. Evaluate finished products in quality control.
4. Test mass timber products in situ.

An example of test reduction is determining shear-free bending stiffness and shear modulus. Understanding system effects will refine mechanical models.

COMMENTS TOPIC 2024 – 12

Comment 12-1. Been doing transvers-longitudinal vibration since the 1980s. A pressing need for advancing CLT.

Comment 12-2. Can topic 11 be tied into this?

Comment 12-3. We agree that this is an important and growing wood composite field. However, based on other research topic priorities we cannot provide a "high interest" rating this time around. It is not directly applicable to our company. If it does not make the cut this time, suggest keeping it on the list for future funding cycles.

Comment 12-4. Besides the known MT products, it will be interesting to include LVL, and how the product differences compare between each other.

Directors' Comments

Frazier: No comment here.

Sinha: This can be tied to Topic 11 and some other topics in this area. This has far reaching application not only in product evaluation, certification, and quality control but also in forensics and damage assemssment. Perhaps this can be tackle under a wider project.

TOPIC 2024 – 13 RATING: 6.00

Improved wood/overlay adhesion testing methods

JUSTIFICATION

Current methods such as cross hatch, and IB, are subjective and/or labor intensive. The test is to rate the quality of the bond between the paper overlay and the composite panel it's bonded to. Ideally, it would be a method that could be done quickly at the plant site to be used for in-process adjustments.

COMMENTS TOPIC 2024 – 13

Comment 13-1. Would fracture testing methods be feasible (similar to previous WBC crack propagation method)?

Comment 13-2. Sounds like a good idea but unless someone has a lead on an approach, not likely to yield benefits.

Comment 13-3. Would be valuable to develop an easy test for the wood bonds.

Comment 13-4. Improved QC techniques are always welcome, especially those that eliminate subjective assessment. Lab QC staff turnover is a problem that this could alleviate. More details on the rating system and testing methods would be great for in-depth understanding of the interface bonding behaviors between similar or dissimilar materials.

Comment 13-5. Can this topic benefit from the work in topic 10? Both measure the bond integrity of a wood material albeit one is a resin (assuming) impregnated paper; but, this is an assessment of the glue line. Other comments are still relevant.

Directors' Comments

Frazier: Comment 13-1, yes David Dillard at VT has developed such tests via mode-I cleavage. Adhesion tests are incredibly difficult to design and interpret. This is a very challenging topic, to make something that the industry will actually use.

Sinha: No comments on this!

TOPIC 2024 – 14 RATING: 7.60

Investigate the process of adhesive penetration based on molecular size properties of the adhesive.

JUSTIFICATION

It is well known in the industry that adhesive penetration plays a key component in bond quality. However, we do not have a good understanding of what portions of the adhesive penetrate and which stay on the bondline based on the adhesive interaction with the wood structure. Understanding this fundamental aspect of adhesive penetration would give a better understanding of how a strong bond is built.

COMMENTS TOPIC 2024 – 14

Comment 14-1. Topic sounds interesting. There is the potential for expanded applicability to finishing. Understanding and controlling penetration is a key component of coating performance, as well as adhesive performance. Understanding how to formulate for preferential absorption benefits coatings and adhesives.

Comment 14-2. Not clear if they are discussing cell wall or void penetration. Either one could be good fundamentals that help all members.

Comment 14-3. Can this be tied in with Topic 17?

Comment 14-4. This is a good project for fundamental research.

Comment 14-5. Many options here to study: high MW vs. low MW vs. blend of MW; multi-step vs. one step process; optimization of post treatment curing / processing. In addition, the efficacy of resin initial wettability / leveling and the penetrating effect over time at harsh conditions also need to be evaluated for better understanding of the workability and bonding performance.

Comment 14-6. This topic is similar to 17. May be interesting to combine and see what is developed.

Comment 14-7. It will be good to discuss the types of resin that could be used for this project. Currently, there is a lot of interest in understanding over and under-penetration of PF in veneer products.

Directors' Comments

Frazier: This topic has been fundamental to the WBC since day 1, and it still is. This is a project that I would love to tackle; l but I think it's a PhD project, and I am no longer taking PhD students- I will retire in 5 years.

Sinha: This brings back memories of many of our alumni working on similar projects and some of them are in the IAB now. This is a good extension of the work we have been doing in the WBC since 2010. It is a critical topic and we should consider discsussing more and put together a team of scientists to tackle this (since Fred retired and Chip is contemplating in a few years). With FPL and access to their scientists, this is a great time to develop something in this area.

TOPIC 2024 – 15 RATING: 4.90

Cure development of protein-based adhesives during pressing as a function of composition, time, temperature, and moisture content.

JUSTIFICATION

While there is remarkable interest in using protein-based adhesives in wood products, there is a lack of understanding of basic properties of these materials. For example, even though soy flour is sometimes added dry to particleboard and fiberboard panels along with other adhesive agents, there is absolutely no publicly available data on how soy flour coalesces into a film when pressed at low moisture content (below 50%). We only know that wet flour makes a film when pressed, and dry (5% MC) flour does not. We would like to determine the impact of flour type, pressing time, temperature, and moisture content on the cure curve of inexpensive protein sources such as soy, cottonseed, and canola flour. Extensions of the project could investigate the role of wetting out (time between water contact with flour and pressing) as well as crosslinker addition on adhesive strength development, and extractability of the cured adhesive. There are methods already developed to cure neat adhesives in a hot press in pancake form. These pancakes can then be immersed in water, where they absorb water and become gels. The mechanical properties (moisture uptake, wet fracture resistance, wet stiffness, etc.) of these gels can then be evaluated to determine the extent of strength development and how it is affected by film formation conditions. We believe wet fracture strength is key to at least some protein adhesives because 1) we commonly observe cohesive failure in soy samples and 2) Research has shown a 0.91 correlation between the force required to propagate a crack through a wet plywood glueline and the D906 performance (between 0 and 1.7MPa in D906, pulled closed, soy adhesives). We believe this data would be very useful to developing protein-based adhesives by showing how pressing conditions impact adhesive performance.

COMMENTS TOPIC 2024 – 15

Comment 15-1. Spectrum of protein adhesives is broad.

Comment 15-2. Not applicable to our company. Forest Products Laboratory has done much work on soy protein adhesives. See work of Chris Hunt and Chuck Frihart to ensure novel work is done here.

Comment 15-3. Similar to the biomaterials topic. 15. This could possibly lead to more efficient resin systems regardless of chemistry basis. Could this be assessed on existing market products (e.g. States plywood) already using a soy based adhesive? Could this project advance the development of an exterior grade soy resin system?

Directors' Comments

Frazier: This is an exceptionally challenging project that requires great resources to make progress. Great efforts have been exerted; it's just not clear how to judge these proteins in a fashion that reliably speaks to performance.

Sinha: No comments on this project!

TOPIC 2024 – 16 RATING: 5.70

Find a microscopic solution for viewing amino and pMDI adhesives that do not require a secondary preparation such as a dye.

JUSTIFICATION

Adhesive distribution on composite wood products and adhesive penetration in veneered wood products are critical factors in bond quality. Methods for visually inspecting these properties exist for PF adhesives but are limited to other adhesive types (pMDI, UF, MUF, etc). For example, current methods of viewing adhesive penetration for these alternate adhesives involve secondary preparation such as adding a dye. These preparation techniques often alter the structures you are trying to view. An alternative would be highly beneficial to understanding adhesion properties.

COMMENTS TOPIC 2024 – 16

Comment 16-1. Given the variability of wood struction, unsure how microscopic assessment of penetration provides practical representation of entire panel

Comment 16-2. Adding the dye to visualize bondlines means adding water, and this is not always desirable. This goal could theoretically be achieved with IR microscopy or AFM-IR. For a particular mill and wood/adhesive mix, NIR could work, thought the wavelengths are even longer/lower resolution.

Comment 16-3. Would be nice to have this tool, achievable in MS program.

Comment 16-4. Important topic for all wood composite producers. pMDI especially of interest to us.

Comment 16-5. Similar to topic 14 with more detail on variables to bond quality.

Directors' Comments

Frazier: Hasn't Fred Kamke done this? This is similar to Heisenberg uncertainty; the act of measurement changes the nature of what you measure. If Fred didn't solve this, then we need a completely new approach.

Sinha: Fred did a lot of work in this area with couple of our members helping out in tagging. I would reach out Jesse Paris WVCo to be abreast with the recent developments.

TOPIC 2024 – 17 RATING: 7.20

Effect of phenol formaldehyde molecular weight on infiltration into wood cell wall nanostructure

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JUSTIFICATION

The development of improved moisture-durable wood adhesives would be accelerated by an improved understanding of how infiltration into the different nanoscale structures of wood cell walls affects moisture swelling at the bulk scale. A recent study combining nanoindentation, synchrotron X-ray fluorescence microscopy, and small-angle neutron scattering led to the discovery that the nanoscale infiltration of a low molecular weight phenol formaldehyde (PF) into the cellulose microfibrils likely plays a critical role in creating moisture durable wood-adhesive bondlines. We propose manufacturing a series of PF resins with low polydispersity that have discrete ranges of molecular weights and study the effect of the PF resin molecular weight on the dimensional stability of PF-treated wood wafers subject to water soaking. The hypothesis is that the extent of infiltration into different wood polymers and nanoscale structures, such as cellulose microfibrils and lignin/hemicellulose matrices, is molecular weight dependent and will cause differences in the moisture swelling of the water-soaked wafers. Transitions in the moisture-induced swelling with molecular weight will be particularly interesting as they likely indicate a change in degree of nanoscale infiltration of the PF.

COMMENTS TOPIC 2024 – 17

Comment 17-1. Project sounds interesting. How will the wood wafers be treated? Under pressure? Vacuum? Ambient application and cure? Etc. Will the study combine gravimetric changes and dimensional changes with exposure to water? Exposure to water vapor also under consideration? Elevated temperature and %RH conditions or steam, etc.

Comment 17-2. What is the scale of the experiments? Best method to get discrete Mw would be to fractionate a PF resin. Interesting academic project for training students.

Comment 17-3. Excellent fundamentals.

Comment 17-4. Tie in with Topic 14

Comment 17-5. This is a good project for fundamental research.

Comment 17-6. This proposal ties in well with Topic 9 and deserves consideration for funding. There has been some work done previously, it would be interesting to investigate the interactions between PF polymer with

bonded water existed among cellulose fibrils and how PF could affect the hydrogen bonding (H-bonds) among various polarized functional groups in cell wall ultrastructures.

Comment 17-7. This topic is to assess low molecular PF and could be ground breaking for exterior or higher water exposure applications. Can be discussed under topic 14 and 16.

Directors' Comments

Frazier: Why is this not combined with "Investigate the process of adhesive penetration based on molecular size properties of the adhesive"?

Sinha: Combining it with Topic 14 and considering a multi-year approach is critical. Access to FPL facilities and scientists will be an asset in this area.

TOPIC 2024 – 18 RATING: 7.10

Method to accurately measure adhesive application rate using a smartphone or handheld device

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JUSTIFICATION

Adhesive application rate is one of the key factors to ensure plywood and LVL panels are made consistently and with good bond quality. Currently, many mills use manual checks of adhesive application by applying glue to a test strip of a known weight and size and then weighing it to calculate the application rate. Mill operators regularly skip making this check because it is inconvenient and it slows the layup process. It also is not always checked across the length of the applicator, resulting in inconsistent application across the length of the sheet. A quicker, and less burdensome method to accurately measure application rate could have a positive impact on adhesive rate consistency and thus improve bond quality and downfall rates. It would also have less of an impact on the layup process. Optimally, a smartphone or handheld device would be used to check this important metric so that mill operators could easily check spread rates in multiple areas. This project would be in addition to the current O-02-VI PF by vis/NIR on OSB.

COMMENTS TOPIC 2024 – 18

Comment 18-1. This project sounds interesting. There is potential for expanded applicability to surface coatings as well. Project output could aid process sustainability (financial and environmental).

Comment 18-2. I think it's an important question. As I can't imagine a physical or optical phenomenon that could couple with a smartphone to do this measurement, I'm not optimistic about success. Online-mounted sensors are a different story, maybe. If a proposal has a strong preliminary data or good theory, then rate much higher.

Comment 18-3. It will be good to finish the ongoing project to expand on this topic.

Comment 18-4. Seems like a project that would benefit producers of a wide variety of EWPs. An easy method for accurately determining adhesive application rate would improve throughput and more allow for frequent evaluation in manufacturing.

Comment 18-5. Application rate is not the same as bond integrity. Could the tech be applied to other chemical treatments? Also, can the scope increase to different types of resins?

Directors' Comments

Frazier: Is the intention to stand next to the line and get all of that info from a smartphone? I don't see it. Maybe call ChatGPT :)

Sinha: No comments!

TOPIC 2024 – 19 RATING: 4.90

Effectiveness of Citric Acid and Sorbitol as pesticide treatment in SYP and DF

JUSTIFICATION

The International Research Group in Wood Protection (IRG) conference highlighted that European companies have been making headway in Citric Acid and Sorbitol as more environmentally friendly alternatives to current Borate and Phosphate based preservative treatments. Information on whether these are effective alternatives for US predominant species is valuable to the industry. This is targeted for lumber and plywood.

COMMENTS TOPIC 2024 – 19

Comment 19-1. Citric acid and sorbitol treatment is a bulking treatment. If it works in some species, there is a very high probability that it will work on other species that have similar permeability, hemicellulose content, and swelling. The proposed advancement is to show that a system that works on their wood also works on ours. That's not much advance. I hope the researchers want to push further in understanding.

Comment 19-2. What "pests" target SYP and DF? Is the proposed pesticide effective against said "pests"? There is a need to develop treatments that are safe to apply and handle. Topical treatments especially.

Comments 19-3. As currently presented, it is difficult to rate this project proposal as a high-priority interest. However, the need to find non-biocidal protection methods for wood products against degradation is important in the big picture. It would be helpful to clarify if these would be for insect or decay protection, or both. These actives are not registered pesticides (in US or Canada) and it would be unlikely for them to get registered should they prove efficacious. Cost is too high to do so. Another angle to consider is if they can be used to enhance the performance of a currently registered pesticide. They could then, potentially, be added to a pesticide registration as a formulation additive. We'd encourage the proponent to revise this proposal and provide more details / goals for the body of work. It has potential.

Directors' Comments

Frazier: No comment here.

Sinha: No comments on this one!