



MONICA SHAW
EDITORIAL DIRECTOR
mshaw@tappi.org

Meeting highlights challenges and opportunities with lignin valorization and biobased products

Earlier this year, around 30 participants gathered for a virtual meeting to discuss the challenges and potential opportunities existing in the lignin research community. Moderated by Jan Bottiglieri, editor of TAPPI's *Paper360°* Magazine, the meeting included experts from industry, academia, research organizations, and manufacturing consortia. Below are some of the key points of discussion, central among which was the need for more collaboration within the lignin research community.

Lignin research community challenges

Bottiglieri opened the session with a discussion about the state of unity and knowledge-sharing within the lignin research community. One participant described efforts to convert agricultural waste into tissue products and the difficulty in marketing the resulting lignin co-product. Interest in valorizing lignin was considered high, yet coordination among pulp producers was identified as insufficient. Another participant noted that, while considerable work has explored lignin's value, translating interest into tangible progress remains a significant hurdle.

Lignin commercialization barriers and biobased opportunities

Discussion next turned to the technical obstacles of separating lignin into its highest-value elements. Ongoing projects at leading research institutions were cited, but scaling these processes economically has proved challenging thus far. One participant pointed to the "activation energy" required as a major roadblock to commercialization. Attendees agreed that niche markets are emerging—yet broader adoption depends on a willingness among consumers to accept a premium for biobased materials.



Image credit: R. Davies, Georgia Institute of Technology, and R. Davies, Oak Ridge National Laboratory.

Alternative fibers as lignin sources

Attention shifted to recent biorefinery concepts leveraging alternative feedstocks like switchgrass and miscanthus for both fiber production and biobased polymers. Collaborative efforts between universities and potential funding from government sources were highlighted as key enablers in capitalizing on lignin resources in the future. Plans for an investor consortium and innovation hub focused on crop-based biorefining were also presented, alongside an invitation to explore networking platforms like TAPPI.

Lignin production challenges and solutions

Representatives of a European technology partnership outlined the economic barriers to commercial lignin production and stressed the need for increased consumer awareness. Potential applications in textiles and nonwovens were noted, though no commercial products have yet reached the market in that region. It was observed that limited knowledge-sharing between research and industry constrains progress, suggesting a role for professional associations like TAPPI in bridging this gap.

Biotechnology industry growth and lignin valorization

One participant evaluated the current state of the industrial biotechnology industry, noting a growing “green premium” in high-value, consumer-oriented sectors such as carbohydrate fermentation and sustainable aviation fuel. A shifting focus in the U.S. Department of Energy toward biomaterials and full biomass utilization was seen as a positive driver for improved lignin valorization. Fundamental research in reactive fractionations was highlighted, as well as the need to produce lignin of sufficient quality for high-value uses like carbon fiber. The underappreciated value of feedstock production in improving soil health was also recognized.

Optimizing product growth streams

A market analysis of lignin and complementary bioproducts was mentioned by an attendee as a benchmark for slow progress in the area since its publication several years ago. The challenge of selling biobased materials is that it often requires the customer to undertake a significant R&D project. To enhance profitability, biorefineries were encouraged to optimize all biomass streams, with some operators already producing nanocellulose or microcellulose alongside lignin. Early successes in Europe like Fibenol in Estonia were cited as reasons for cautious optimism.

Kraft lignin extraction and biorefineries

The economic realities of extracting and modifying kraft lignin were scrutinized. High separation costs mean that lignin’s primary value remains as an onsite fuel in pulp operations. However, as global markets shift toward biobased solutions in the future, the potential of kraft lignin-cellulose biorefineries looks more feasible.

ABOUT THIS PAPER

Cite this article as:

Shaw, M., *TAPPI J.* 24(5): 224(2025).
<https://doi.org/10.32964/TJ24.5.224>

DOI: <https://doi.org/10.32964/TJ24.5.224>

ISSN: 0734-1415

Publisher: TAPPI Press

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Global research considerations

Research on producing a wide variety of materials remains ongoing around the world, including that for new applications like insulation materials and alternative lignin types for renewable packaging. The importance of cost considerations from an industry perspective was reiterated, alongside the observation that commercial kraft lignin is already available for applications in plastics and engineered wood products.

Lignocellulosic bioeconomy collaboration and coordination

Participants reiterated the need for a lignocellulosic bioeconomy built on clear communication among research centers, universities, and industry. Emphasis was placed on aligning laboratory measurements with industrial requirements and ensuring that commercial feasibility drives research priorities. Broad consensus emerged around the fragmentation of current efforts and the potential for TAPPI to serve as coordinating association to build cohesiveness.

TAPPICon meeting and community proposals

Based on feedback during this meeting, TAPPI organized an in-person meeting held at TAPPICon in Minneapolis, MN, on May 7. To further expand coordination within the lignin community, additional suggestions included forming an ongoing forum for research sharing—whether through conferences, publications, or digital platforms—and developing a shared contact registry. Feedback was solicited on what formats and resources would best serve this community’s evolving needs.

If you would like to participate in ongoing efforts within the lignin research community, please contact Jan Bottiglieri at jbottiglieri@tappi.org. **TJ**