



INDUSTRIAL TECHNOLOGIES PROGRAM

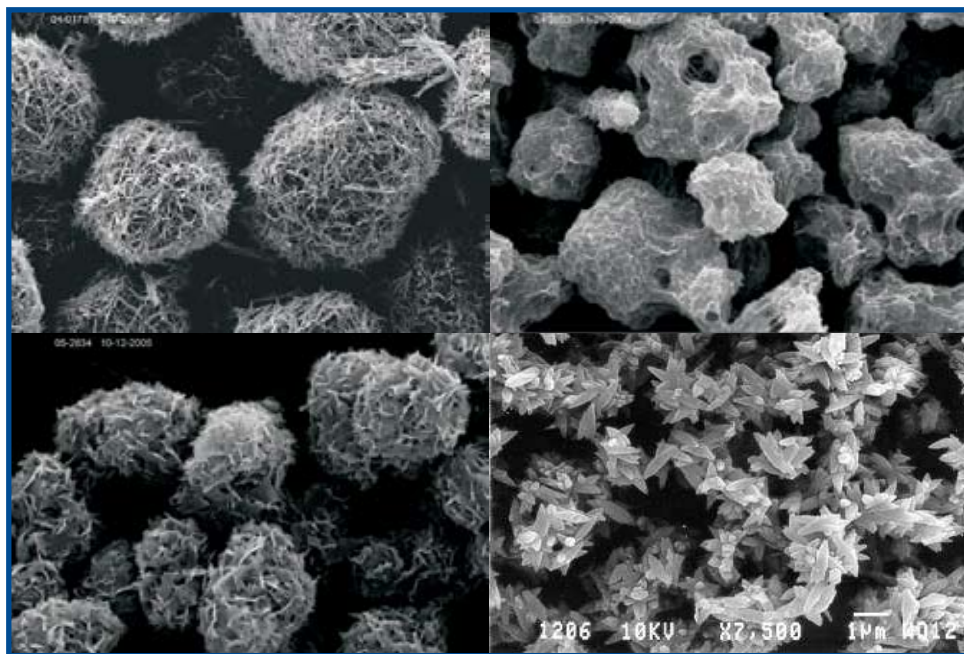
Fibrous Fillers to Manufacture Ultra-High Ash/Performance Paper

New Fibrous Filler Technology for Paper Manufacturing Promises Equal or Better Quality and Performance at a Lower Cost

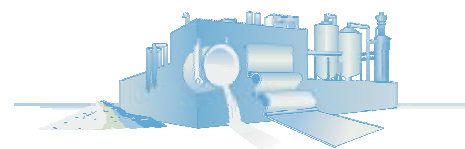
Increasing global competition, fiber shortages, and environmental and ecological concerns force U.S. papermakers to constantly work to reduce production costs and environmental load. Mineral fillers which increase paper brightness and opacity and improve the paper's print quality have reduced costs by replacing wood fiber. However, filler loading has been limited to 15% - 20% because higher levels cause a loss of sheet strength and bulk as well as "dusting" during printing.

G.R. International (GRI), in cooperation with several major industrial partners, has developed a new fibrous filler that may overcome these

problems and achieve additional replacement of high-cost wood fiber. GRI and its collaborators will study the reaction mechanism of the new filler to characterize and optimize it for manufacture and application methods. The new fillers will ultimately produce a composite paper containing up to 50% ash with equal or better performance characteristics than conventionally attainable. The fibrous fillers will also lead to better retention of fillers, additives, and pulp fines, resulting in significantly reduced biological and chemical oxygen demands (BOD and COD) in the mill process water.



Scanning Electron Microscope images of four silica- and calcium-based fibrous fillers: silicate nano-fibers (SNF, top left), silicate micro-fibers (SMF, top right), silicate micro-fibers low drying demand (SMF-LDD, bottom left), and super precipitated calcium carbonate (S-PCC, bottom right).



Benefits for Our Industry and Our Nation

- Reduces energy use by 25%
- Replaces expensive filler (TiO_2 , Silica)
- Reduces basis weight
- Saves \$10 to \$50 per ton of paper produced
- Creates additional revenue of \$50 to \$100 per ton in new products
- Improves retention and reduces BOD, COD, and turbidity in mill process water

Applications in Our Nation's Industry

Fibrous fillers could be used in all paper and board products. Free sheet papers are the most likely targets near term, but wood-containing papers and even newsprint could eventually use this product as well.

Project Description

The main objective of this project is to validate the techno-economic viability of the fibrous filler technology in order to manufacture paper containing up to 50% ash, at equal or better quality and performance and at a lower cost.

The chemical reaction forming the new fibrous fillers were carried out in GRI and Lawrence Livermore National Laboratory (LLNL). The resulting fibrous fillers were then characterized and tested for quality. The manufacturing process for the fibrous fillers was optimized by studying the reaction mechanism. Alternate raw materials and process additives were also studied to further enhance paper properties and/or lower costs. The filler manufacturing process and paper enhancing capabilities were optimized in a scaled-up pilot reactor. The fibrous fillers were then added to the wet end for paper formation, and the effect of the new fillers on the paper properties and process parameters was studied. Interfacial bonding, paper structure, fiber modification, coating formulations, paper performance, print quality, and mill balances were all used to optimize the ultra high ash paper produced with up to 50% fibrous filler. Production trials were conducted at Weyerhaeuser and Grays Harbor Paper, LLP, to produce the final fibrous filler-optimized paper, and the paper was submitted to multiple end-users for market evaluation.

Progress and Milestones

- Optimized surface treatment formulations (during initial studies) (Initial study completed December 2003)
- Optimized manufacture of silicate nano-fibers (SNF, TiSil, or T-8) and silicate microfibers (SMF or T-4) (Completed December 2005)
- Studied and elucidated the mechanism of silicate microfiber and silicate macro particle formation (Completed September 2005)
- Developed ultra-high ash paper: up to 50% calcium- and silica-based fibers (Completed March 2006)

Commercialization Plans

GRI proposals may advance the technology into commercial operations in two steps. The first step is to build a prototype plant. Upon full successful validation, the prototype plant will be converted into a commercial plant.

Project Partners

G.R. International
Federal Way, WA

Western Michigan University
Kalamazoo, MI

Lawrence Livermore National Laboratory
Livermore, CA

Weyerhaeuser Company
Federal Way, WA

Pennsylvania State University
University Park, PA

University of Washington
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A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.



U.S. Department of Energy
Energy Efficiency
and Renewable Energy

Bringing you a prosperous future where energy
is clean, abundant, reliable, and affordable

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