Innovation and Optimization of the Szego Mill for Reliable, Efficient, and Successful Up-Scaling of the Deacetylation and Mechanical Refining Process for Biofuel Production

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This proposal describes innovative research which will drive the conversion of lignocellulosic biomass to drop-in biofuel from the laboratory setting to a commercial reality. The National Renewable Energy Laboratory (NREL) has invented and developed the deacetylation and mechanical refining (DMR) process to the point of laboratory-scale success. The mechanical comminution of the biomass to a defibrillated, high surface area slurry is both a key secret to this process` success, but it is also the current weak point of the process. The DMR process achieves the final mechanical refinement through the use of a Szego Mill, which is quite effective at refining the slurry, but it is also lacking in long term mechanical reliability and is unoptimized for biomass comminution. The University of Alabama (UA) will lead the proposed effort and will partner with NREL and General Comminution Incorporated (GCI) to improve the reliability and energy efficiency of the Szego Mill, while maintaining the yield efficiency of the DMR process for lignocellulosic biomass conversion. The proposed work will research, optimize, and implement three generations of Szego Mill to accomplish these goals. A detailed failure analysis will be conducted based upon the performance of the current laboratory scale of the SM160 Szego Mill. Proposed improvements to the materials, fabrication processes, and component design will be evaluated using a new, small pilot-scale SM280 Szego Mill. The most successful combination of roller design, materials, and fabrication process will be incorporated into a new, fully innovated, large pilot-scale SM320X Szego Mill. This new mill will be installed and tested at NREL in their DMR process line to demonstrate a 0.5-1 tonne per day biomass conversion rate with demonstrated 100 hours of continuous operation and 500 hours of cumulative operation time. By its end, this project will deliver an experimentally validated, commercial pathway for the DMR process to convert 1-5 tonnes per day of lignocellulosic biomass to drop-in biofuel.