Energy wasted grinding switchgrass smaller to improve flowability

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Biofuels processors who mill switchgrass into fine bits to help its flowability should be able to save time, energy and money by not doing so, a Purdue University study shows.

Switchgrass can be used in a number of biofuel applications, but moving it - especially feeding it into boilers - can be problematic, said Klein Ileleji, an assistant professor of agricultural and biological engineering. While corn and soybeans are round and spherical, switchgrass is shaped more like matchsticks, causing pieces to interlock and disrupt its ability to flow. Those blockages cost time and can be dangerous for those tasked with breaking the clog, he said.

"In any facility -- in a power plant or in a processing facility -- when you have a blockage, it's a processing nightmare," said Ileleji, whose findings are in the current issue of the journal *Transactions of the ASABE.*

Ileleji compared circularity, roundness and aspect ratio for corn, soybean and switchgrass that had been hammermilled to three different sizes. Aspect ratio, which has the greatest effect on the ability of switchgrass to flow, is the ratio of a switchgrass particle's length to its width.

Conventional wisdom held that grinding switchgrass into smaller pieces would bring its aspect ratio closer to that of corn and soybeans, which have ratios close to 1 and no problems with flowability.

"Switchgrass is not a good flowable feedstock. You would think grinding

it smaller would help," Ileleji said. "But grinding does not necessarily change the morphological characteristics in switchgrass that are important for flow."

Ileleji's testing showed that hammermilling - one of the most common grinding techniques, which beats and breaks biomass until it is small enough to pass through screens - breaks switchgrass in a way that keeps its aspect ratio about the same no matter the size. Unless the switchgrass is milled into a powder, those high aspect ratios would keep causing switchgrass to interlock and clog in bulk flow.

Ileleji said processors could save money with the information because they can stop hammermilling switchgrass when it fits through a 6.4 mm screen, the largest Ileleji tested.

"Grinding consumes a lot of energy. It is one of the highest energy costs in a processing facility," Ileleji said. "It's better to grind switchgrass through a 6.4 mm screen than to use more energy to grind through a smaller screen expecting that its handling characteristics would be improved dramatically."

Ileleji said he would study flow behavior of switchgrass through hoppers to try to find ways to keep it from creating blockages. Duke Energy and the Purdue Energy Center funded his research, which is part of his doctoral student Cedric Ogden's research on the flow mechanics of switchgrass bulk solid in hoppers under gravity discharge.

Provided by Purdue University