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Characteristics of Biomass and Biomass Ash

Bulk, fibrous biomass is notoriously challenging to handle. This fact should not prevent investment in biomass-derived products, however. It's being done successfully every day but it takes special knowledge, experience and machinery.

Engineers working on biomass projects must educate facility owners on the best solution for handling the material. Identifying this solution, of course, begins with a good understanding of the material and how it behaves.

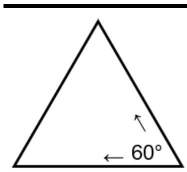
Flow

The first thing engineers need to know about biomass is that **it does not flow well**. Biomass is unlike corn, which flows like water out of a grain bin. It's more like scrap paper: it's irregularly shaped, and it has a high coefficient of friction. Its particles also weave together when at rest, which means that it can be pretty arduous getting biomass to move once it stops flowing. If the biomass is wet, it proves even more difficult to move.

Biomass ash is worse. It adheres to itself and clumps—a characteristic that's worse when charcoal (unburnt carbon) is present, as the charcoal increases the moisture content. And what more, when ash rests, it can set up like concrete. Pressure further decreases the ability of biomass ash to flow, as do reagents like ammonia, which increases the material's friction.[1]

When it comes to automated reclaim from storage, biomass' and biomass ash's resistance to flow means these materials will tend to bridge or form rat holes in round silos. They will also perform poorly in gravity-fed reclaim systems, and auger-based reclaim systems in round silos may have trouble breaking up the material when it stops flowing.

Angle of Repose



The resistance of biomass and biomass ash to flow also means **they form piles with high angles of repose**. *Angle of repose* refers to a material's natural pitch measured from the bottom edge of a pile. Without exception, all fibrous biomasses form piles with steep angles, though what that angle is depends on the specific material and whether it has just been poured, has settled, or is being actively disturbed. Woodchips, for example, form piles with a natural angle of repose around 45°. Sawdust, on the other hand, forms piles with an angle closer to 60°. But once a pile is at rest and has time to settle (so there is less air in the pile), biomass can form a 90° face as loaders reclaim material from the pile. We've witnessed piles as high as 40' with sheer faces.

These faces aren't necessarily stable, so it isn't unheard of that a front loader and its operator will become buried in a pile that has collapsed. Piles collapse, too, because materials form a different angle when disturbed—an angle much shallower than their natural angle of repose. This shallower angle not only affects reclaim from piles but storage volume. Engineers will sometimes calculate the potential storage volume of a bunker by the volume of the bunker plus whatever material will rest above the retainer wall due to the natural angle of repose. They fail to realize that once the pile is disturbed, the material will not maintain this angle, so the pile height will drop and material can flow

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[1] Source: http://biomassmagazine.com/articles/17691/getting-biomass-ash-to-flow-again.

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over the walls. Storage volume must be calculated with the *disturbed angle of repose*, not the *natural* or *initial* angle of repose.

Acidity

Another characteristic common to biomasses and biomass ashes is an **acidic nature**. While engineers may not normally consider dry materials like biomass as having acidic characteristics, they should be aware that water contained in the biomass provides a means for the natural acids to leach. This is why undried (i.e., green) biomass results in more acid-based corrosion than dry biomass; it has a higher water content. Condensation, such as what forms on outdoor conveyors in the morning, also provides a pathway for acid.

The species of biomass and where it's grown will determine how acidic a biomass material is. Some biomasses, such as western red cedar, can have a pH as low as 2.9.

Corrosion from acid is at its worst when the material and environment are hot, as the energy speeds up the rate of corrosion. This is why steam from freshly pressed pellets is so destructive. It's also why biomass ash is as corrosive as it is.

Abrasiveness

Not only is biomass and biomass ash acidic but **abrasive**, in some cases extremely so. How the biomass is handled and processed most significantly affects this characteristic. Biomass from in-woods cuttings will have more dirt and sand than, say, planer mill shavings. Bark, too, will contain a higher amount of abrasive contaminants.

These abrasives not only affect equipment handling feedstock material but biomass ash, too, as contaminants like sand and minerals will melt in the burner and fuse with ash, resulting in the formation of clinkers. The more contaminants contained in the feedstock, the larger these clinkers will be.

Large Contaminants

Biomass is also regularly **contaminated with large, foreign materials**. These foreign materials are usually mixed in by accident, though workers will sometimes do something like throw a 2x4 in with a load of woodchips (hey—they're both from a tree, right?). Unfortunately, other heavy materials have found their way into loads of biomsss also, since biomass is most often purchased by weight. But foreign materials aren't the only large contaminants that can mix in with biomass. Oversized pieces of biomass sometimes make it through a hog or chipper during the sizing process—a problem that gets worse when the screen on the sizing equipment becomes damaged.

Due to these variabilities, it's important to screen incoming biomass for oversized materials and metal contaminants. Not only is it important, but it's required by the National Fire Protection Agency's fire codes. NFPA® 664 states that operations utilizing woody feedstock (or biomass used in place of wood) must inspect it for foreign materials and prevent all foreign materials from entering process equipment. When operating at anything other than a very small scale, automated screening is therefore necessary.

Fire Hazards

Last, **biomass is inherently combustible**, particularly when dry. Under the right conditions, it will self-ignite, and its dust can explode. Due to these risks, the NFPA® developed specific requirements for manufacturers that produce or handle wood dust. NFPA® standards 652 and 664 stipulate that manufacturers complete a dust-hazard analysis and take steps toward rectifying any shortcomings they identify regarding their adherence to the fire codes.

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Biomass is as unique as the species from which it originates and the region in which it grows. Engineers, therefore, cannot gloss over the equipment that handles it. Bulk handling needs as much attention as any other process because when biomass won't flow, when the conveyors that transport it corrode and wear out quickly, and when safety issues are no longer theoretical, it's more difficult and more expensive to develop a system that works well.

If you have a system that performs poorly, we can help. And if you don't and want to avoid such problems, we can help with that, too. Talk to the experts today.

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