hydrophobic, highly crystalline, or otherwise difficult to wet. At the same time, it is desirable to process the feedstock in a relatively high solids level dispersion, in order to obtain a high final concentration of sugar in the saccharified material, or a high concentration of the desired product after processing (e.g., of ethanol or other alcohol(s) after fermentation). In some cases, utilizing the methods described herein the solids level of the dispersion during processing can be, for example, at least 10, 15, 20, 22.5, 25, 27.5, 30, 35, 40, 45, or even at least 50 percent by weight dissolved solids. For example, the solids level can be from about 10 to 50%, e.g., about 10-40%, 10-30%, or 10-20%.

The inventors have found that the initial dispersion of a feedstock added to a liquid can be enhanced by the use of certain equipment during the addition of the feedstock. The equipment described herein permits the feedstock or other solids or liquids, e.g., nutrients, to be quickly and easily dispersed in the liquid, allowing a large quantity of the feedstock to be added to the liquid efficiently. This efficient dispersion of feedstock contributes to reduced liquification time and thus high throughput, and facilitates the production of a high solids level mixture.

In one aspect, there is provided a method comprising saccharifying a biomass feedstock in a vessel, the biomass feedstock having been dispersed in a liquid medium using a dispersing system that draws the feedstock and liquid medium out of the vessel and recirculates the feedstock and liquid medium back into the vessel, wherein the dispersing system comprises a chamber and, within the chamber, a rotating member which draws the feedstock and liquid medium into the chamber axially and expels a dispersion of the feedstock in the medium from the chamber radially.

~~In one aspect, the invention features a~~ A method may be provided comprising saccharifying a biomass feedstock in a vessel, the biomass feedstock having been dispersed in a liquid medium using a dispersing system comprising a chamber and, within the chamber, a rotating member which draws the feedstock and liquid medium into the chamber axially and expels a dispersion of the feedstock in the medium from the chamber radially.

Some implementations include one or more of the following features. The feedstock can have a bulk density of, for example, less than about 0.5 g/cm^3. The liquid medium may include water. The method may further include delivering a saccharifying agent, e.g., an enzyme, to the vessel. The rotating member may function as an impeller and the action of the rotating member within the chamber may be that of a centrifugal pump. The method may further include mixing with a jet mixer during saccharification. The rotating member may include mixing elements arranged coaxially with a rotor that is disposed in rotor-stator

relationship with a side wall of the chamber. The dispersing system may further include a jet mixer. The method may further include delivering the feedstock and/or a saccharifying agent to the vessel from a source disposed outside the vessel, for example positioned above or next to the vessel, or at a distance from the vessel

and in communication therewith by a conduit. Delivering the feedstock may include blowing the feedstock onto the surface of the liquid medium in the vessel. The method may further include delivering a stream of liquid medium from the chamber of the dispersing system onto the feedstock on the surface of the liquid medium to wet the feedstock. The feedstock may be in a substantially dry condition, e.g., 0.1 to 15% moisture content, prior to delivery to the vessel. The source from which the materials are delivered may include a hopper, which may be in communication with a vibrating device. The dispersing system may include a plurality of dispersing devices.

In some embodiments, saccharifying includes adding the feedstock to the liquid medium in discrete increments, and dispersing each discrete increment of feedstock into the liquid medium with the dispersing system before adding another increment of feedstock. The method may also include monitoring a glucose level of a mixture of the feedstock, the liquid medium and the saccharifying agent during saccharification.

Additional feedstock and saccharifying agent may be added to the vessel during saccharification and dispersed in the medium using the dispersing system.

In another aspect, there is provided a feedstock saccharification system comprising a tank, a delivery system configured to deliver a biomass feedstock and a liquid medium to the tank, a dispersing system configured to disperse the biomass feedstock in the liquid medium, a saccharifying agent delivery device configured to deliver a metered amount of a saccharifying agent to the tank, a mixer configured to mix the contents of the tank; wherein the dispersing system comprises a chamber and, within the chamber, a rotating member which draws the feedstock and liquid medium into the chamber axially and expels a dispersion of the feedstock in the medium from the chamber radially.

~~the invention features a feedstock saccharification apparatus that includes (a) a tank, (b) a delivery system configured to deliver a biomass feedstock and a liquid medium to the tank, (c) a dispersing system configured to disperse the biomass feedstock in the liquid medium, (d) a saccharifying agent delivery device configured to deliver a metered amount of a saccharifying agent to the tank, and (e) a mixer configured to mix the contents of the tank.~~

Some implementations include one or more of the following features. ~~The dispersing system comprises a chamber and, within the chamber, a rotating member which draws the feedstock and liquid medium into the chamber axially and expels a dispersion of the feedstock in the medium from the chamber radially.~~ The apparatus further includes a controller that adjusts the operation of the feedstock delivery device and/or the saccharifying agent delivery device based on input from the torque monitor. In some cases, the mixer is a

jet mixer. The delivery system may include a blower configured to blow the feedstock onto the surface of liquid in the tank, and the dispersing system may be configured to deliver a stream of liquid onto the feedstock on the surface of the liquid, wetting the feedstock.

In ~~another aspect~~example embodiments, ~~the invention features~~ a method may be provided that includes saccharifying a biomass feedstock in a vessel containing a liquid medium, the biomass feedstock having been dispersed in the liquid medium by blowing the biomass feedstock onto a surface of the liquid medium in the vessel, contacting the feedstock on the surface with a stream of liquid to wet the feedstock, and mixing the feedstock and liquid, e.g., using a jet mixer.

In some implementations, the stream of liquid is delivered using a positive displacement pump.

In ~~a further aspect~~example embodiments, ~~the invention features~~ a method may be provided including saccharifying a biomass feedstock in a vessel, the biomass feedstock having been delivered to the vessel by blowing the biomass feedstock onto the surface of a liquid medium in the vessel, and dispersed in the liquid medium using a dispersing system comprising a chamber and, within the chamber, a rotating member which draws the feedstock and liquid medium into the chamber axially and expels a dispersion of the feedstock in the medium from the chamber radially onto the feedstock on the surface of the liquid medium.

The method may further include mixing the contents of the tank with a jet mixer.

In ~~another aspect~~example embodiments, ~~the invention features~~ a feedstock saccharification apparatus may be provided that includes (a) a tank, (b) a delivery system configured to deliver a biomass feedstock and a liquid medium to the tank, comprising a blower for blowing the biomass feedstock into the tank, (c) a saccharifying agent delivery device configured to deliver a metered amount of a saccharifying agent to the tank, and (d) a mixer configured to mix the contents of the tank.

The methods described herein generally provide relatively rapid and effective wetting of a relatively high solids level of feedstock. By increasing the initial solids level of feedstock in the mixture, the process can proceed more rapidly, more efficiently and more cost-effectively, and a high resulting concentration can generally be achieved in the final product.

The saccharification processes described herein allow a cellulosic or lignocellulosic feedstock to be converted to a convenient and concentrated form which can be easily transported and utilized in another manufacturing facility, e.g., a facility configured to ferment sugar solutions to alcohols, to manufacture a product, e.g., a fuel