CLAIMS

1. A system for pretreating a biomass comprising:

(a) an extruder comprising one or more screws, wherein an internal plug of the biomass is formed due to action of the one or more screws, thereby forming an upstream end of a pressurized reaction zone for pretreatment of the biomass; and

(b) a valve assembly attached at an output end of the extruder, wherein the valve assembly forms a downstream end of the reaction zone and adds a liquid to the reaction zone, wherein the valve assembly comprises:

a valve body comprising a large circular section, an intercalary conical section, and a small circular collar containing one or more nozzles for liquid input, the valve body having a chamber formed therein that connects an input end and a discharge end of the valve body, wherein the small circular collar is smaller in inner diameter than the large circular section;

a valve needle axially displaceable within the chamber of the valve body; and

a housing attached to the discharge end of the valve body and enclosing the valve needle when the valve needle is disengaged with the valve body.

2. The system of claim 1, wherein the system further comprises a mean for supplying steam and one or more chemicals to the reaction zone.

3. The system of claim 2, wherein the one or more chemicals comprise an acid.

4. The system of claim 3, wherein the acid is sulfuric acid.

5. The system of claim 1, wherein the housing contains a removable discharge ring.

6. The system of claim 5, wherein the discharge ring is tapered.

7. The system of claim 1, wherein the valve body contains an annular ring.

8. The system of claim 7, wherein the annular ring is removable.

9. The system of claim 1, wherein there is an annular space formed in the chamber between the valve body and the valve needle when the valve needle is closed on the valve body.

10. The system of claim 1, wherein an inner diameter of the housing at an end of the housing abutting the valve body is at least 7% larger than an inner diameter of the

valve body at its discharge end.

11. The system of claim 1, wherein an inner diameter of the housing at an end of the housing abutting the valve body is about 7% larger than an inner diameter of the valve body at its discharge end.

12. The system of claim 1, wherein the valve needle has a cone with a wide end opposing to its conical tip.

13. The system of claim 12, wherein the cone is tapered in a range of from 45 degrees to 75 degrees.

14. The system of claim 12, wherein the cone is tapered about 45 degrees.

15. The system of claim 12, wherein the valve needle has a diameter at the wide end that is at least 4% larger than an inner diameter of the valve body at its discharge end.

16. The system of claim 12, wherein the valve needle has a diameter at the wide end that is about 4% larger than an inner diameter of the valve body at its discharge end.

17. The system of claim 1, wherein the extruder is a twin screw extruder.

18. A method of pretreating a biomass through the system of any one of claims 1-17.

19. A method of pretreating a biomass, the method comprising:

(a) conveying the biomass through an extruder from a feeder zone of the extruder to a reaction zone of the extruder, wherein the feeder zone and the reaction zone are separated by a biomass plug formed downstream of the input zone and upstream from the reaction zone;

(b) adding steam and/or a chemical to the biomass in the reaction zone to partially treat the biomass;

(c) conveying the partially-treated biomass into a valve assembly attached to an output end of the extruder, and treating the partially-treated biomass in the valve assembly, thereby producing a pretreated biomass, wherein the valve assembly comprises:

a valve body comprising a large circular section, an intercalary conical section, and a small circular collar containing one or more nozzles for liquid input, the valve body having a chamber formed therein that connects an input end and a discharge end of the valve body, wherein the small circular collar is smaller in inner diameter than the large circular section;

a valve needle axially displaceable within the chamber of the valve body; and

a housing attached to the discharge end of the valve body and enclosing the valve needle when the valve needle is disengaged with the valve body; and

(d) discharging the pretreated biomass through the valve assembly.