CLAIMS

1. A valve assembly comprising:

a valve body having an input end, a discharge end, and a chamber formed therein in connection with the input end and the discharge end, the input end attachable to a tube with a fluid or slurry input that flows through the valve assembly, wherein the valve body has a circular section at the discharge end, a circular collar at the input end that is smaller in inner diameter than the circular section at the discharge end, and an intercalary conical section therebetween;

a conical valve needle that has a cone with a wide end opposing to its conical tip and is axially displaceable in the chamber within the valve body; and

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

wherein the conical 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.

2. The valve assembly of claim 1, wherein the valve body has an annular ring that sits in a recessed cavity on an internal surface of the valve body at the discharge end.

3. The valve assembly of claim 2, wherein the annular ring is replaceable.

4. The valve assembly of claim 2, wherein an internal surface of the annular ring aligns with the internal surface of the valve body.

5. The valve assembly of claim 2, wherein the conical valve needle sits at the annular ring when closed in the valve body.

6. The valve assembly of claim 1, wherein the housing comprises therein a detachable discharge ring that sits adjacent to the discharge end of the valve body.

7. The valve assembly of claim 6, wherein the discharge ring has a tapered shape.

8. The valve assembly of claim 1, wherein the valve body comprises nozzles for input of a liquid.

9. The valve assembly of claim 1, wherein the chamber of the valve body forms a part of a reaction zone with the tube for a biomass pretreatment process.

10. The valve assembly of claim 9, wherein the tube is an extruder.

11. The valve assembly of claim 10, wherein the extruder is a twin screw extruder.

12. The valve assembly of claim 1, wherein the valve assembly further comprises an actuator and a shaft, and wherein the conical valve needle is operably linked to the actuator via the shaft.

13. The valve assembly of claim 12, wherein the actuator maintains a pressure on the conical valve needle.

14. The valve assembly of claim 12, wherein the actuator is configured to maintain a pressure of over 1,800 lbf on the conical valve needle.

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

16. The valve assembly 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.

17. The valve assembly of claim 1, wherein the cone of the conical valve needle is tapered in a range of from 45 degrees to 75 degrees.

18. The valve assembly of claim 1, wherein the cone of the conical valve needle is tapered about 45 degrees.

19. A valve assembly comprising:

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 large circular section is located at the discharge end, wherein the small circular collar is located on the input end and is smaller in inner diameter than the large circular section, and wherein the intercalary conical section is located between the large circular section and the small circular collar;

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.

20. A system for treating biomass through an extruder comprising:

(a) an extruder comprising one or more screws wherein an internal plug of biomass is

formed due to action of the screws, thereby forming one end of a pressurized reaction zone;

(b) a means for supplying steam and chemicals to the reaction zone; and

(c) a valve assembly according to claim 1 at an output end of the extruder that forms a downstream end of the reaction zone and adds a liquid to the reaction zone;

wherein the valve assembly is capable of rapidly discharging pressurized treated biomass into a non-pressurized discharge area.