b. Eliminates the need to cut pipe – just drill a hole and attach a saddle or tap directly into the line.

c. The high flow venturi fittings can also be molded.

8. Dual gauge tank head.

a. Provides the ability to switch between dry and liquid products without changing the connection of the water in line.

9. Flow through design allows for faster or slower injection rates at higher flows.

10. The ability to create an adequate amount of differential pressure without affecting the water pressure or flow rate in the main flow line, and to be able to install this connection without cutting into the flow line.

11. The ability to measure and adjust the exact injection rate without the need for electronic or mechanical flow sensors or controllers.

12. The ability to inject accurate, measured amounts of a product (liquid or dry) without the need for electronic or mechanical pumps that are problematic due to constant maintenance or breakdown.

13. The ability to load the tank with dry powders and automatically inject them without plugging and in measured, accurate doses.

14. The ability to inject liquids or water soluble dry products with water flow through an aspiration-type of system with accuracy because the internal flow system prevents the continuous dilution of the product being injected.

15. The ability to install in any flow line without regard to material of construction (*e.g.*, PVC, Ductile Iron, HDPE, Poly, Copper, Brass, etc.).

SUMMARY OF THE INVENTION

The inventive injection system is an aspiration-type injection system that is used to inject any liquid or dry water soluble product into a fluid flow line. The inventive system connects to a fluid flow line and directs flow from the flow line into a storage tank that contains the product(s) to be injected into the flow line. As the fluid enters the tank, it causes the product(s) in the tank to flow out of the tank and be injected back into the fluid flow line.

The fluid is drawn from the flow line into the tank, and then injected back into the flow line by creating a differential pressure between the inlet connection to the flow line and the outlet connection to the flow line. This is done by inserting an inlet probe facing into the

Directing the incoming fluid to both the top and bottom (and sides) of the tank for water soluble dry products creates the same layering effect inside of the tank. The fluid is directed to the bottom of the tank through an inlet dip tube, and continually mixes and liquefies the water soluble powder turning it into an injectable solution. A vent port is positioned at the top of the outlet dip tube to prevent the outlet dip tube from plugging.

A fluid injection system for dispensing a solution into a fluid flow in a flow line is disclosed herein. In an aspect, the fluid injection system includes a storage tank having a product to be dispensed therein; an inlet connection for diverting fluid from the flow line into the tank; an outlet connection for returning a mixture of fluid and/or product back into the flow line; a metering gauge in fluid communication with the inlet connection for measuring water flowing into the tank; and a tank head connected to the storage tank and in fluid communication with the inlet connection, wherein the inlet connection includes an inlet probe having an opening facing into the fluid flow, the opening defined by an arc at a downstream side, wherein the outlet connection includes an outlet probe having an opening facing downstream of the fluid flow, the opening having an angled cut, and wherein the arc at the inlet probe and the angled cut at the outlet probe create a pressure differential for diverting water into and out of the storage tank.

The fluid injection system can further include a bypass connection connected between the inlet and outlet connections, the bypass connection diverting some of the fluid received at the inlet probe to the outlet probe without the diverted fluid entering the tank.

In one form, the tank head includes a dual tank head, which further includes a first metering gauge for use with dry soluble product and a second metering gauge for use with liquid products. The metering gauges include metering adjustment valves for adjusting the flow rate of fluid into the tank.

In a further form, the arc on the inlet probe has a radius of approximately 45-degrees, and the angled cut on the outlet probe has an angle of approximately 30-55 degrees.

In another aspect, a fluid injection system for dispensing a fluid and/or product contained within a storage tank into a fluid flow in a flow line is disclosed. The fluid injection system including an inlet connection for diverting fluid from the flow line into the tank; an outlet connection for returning a mixture of fluid and/or product back into the flow line; a metering gauge in fluid communication with the inlet

connection for measuring water flowing into the tank; and a tank head connected to the storage tank and in fluid communication with the inlet connection, wherein the inlet connection includes an inlet probe having an opening facing into the fluid flow, the opening defined by an arc at a downstream side, wherein the outlet connection includes an outlet probe having an opening facing downstream of the fluid flow, the opening having an angled cut, and wherein the arc at the inlet probe and the angled cut at the outlet probe create a pressure differential for diverting water into and out of the storage tank. In one form, the system is removeably attachable to the tank.

In one form, the additional exemplary embodiment of the fluid injection system further includes a bypass connection connected between the inlet and outlet connections, the bypass connection diverting some of the fluid received at the inlet probe to the outlet probe without the diverted fluid entering the tank.

The tank head can include a dual tank head, wherein the dual tank head includes a first metering gauge for use with dry soluble product and a second metering gauge for use with liquid products. The metering gauges include metering adjustment valves for adjusting the flow rate of fluid into the tank.

The arc on the inlet probe can have a radius of approximately 45-degrees, while the angled cut on the outlet probe can have an angle of approximately 30-55 degrees.

It is an object of the inventive fluid injection system to create an adequate amount of differential pressure between the inlet and outlet without affecting the water pressure or flow rate in the main flow line, and to be able to install this connection without cutting into the flow line.

It is a further object of the inventive fluid injection system to be able to measure and adjust the exact injection rate without the need for electronic or mechanical flow sensors or controllers.

It is yet a further object of the inventive fluid injection system to inject accurate, measured amounts of a product (liquid or dry) without the need for electronic or mechanical pumps that are problematic due to constant maintenance or breakdown.

It is still a further object of the inventive fluid injection system to load the tank with dry powders and automatically inject them without plugging and in measured, accurate doses

though the water outlet tube 44 at the bottom of the tank 12. In one form, the water outlet tube 44 has a vent port (not shown) which prevents plugging and can be used to adjust injection rates. The outlet water containing mixed product, flows up the outlet tube 44, through the tank head 36, the shut off valve 46, the outlet line 20, and into the main flow line 14 through the outlet probe 26. As previously noted, the outlet probe 26 includes the angled cut 32 which increases the pressure differential created by the arc 28 in the inlet probe 24 at the inlet connection 18 to the main flow line 14.

To allow use with both liquid and dry water soluble product, the tank head 36 can have alternate ports for connection to the inlet water, or may have valves which direct the inlet water to either the water inlet tube 38 (for dry water soluble product) or a diffuser (not shown) connected to the tank head 36 (for liquid product). The position of the liquid injection/vent port directs the incoming stream along the arc of the fill port cavity, reducing the velocity and turbulence, thus diffusing the agitation.

In one form, as shown in Fig. 6, the inventive system 10' may include a dual tank head 64 for ease of changing between dry and liquid products and/or increasing the flow rate. The dual tank head 64 design enables changing between liquid and dry products by adjusting the metering gauges 66 and 68, and allows for faster injection rates of dry or liquid products. In Fig. 6, elements with the same function are identified with the same reference numbers, while elements requiring modification are indicated with a prime. The dual tank head 64 includes a first metering gauge 66 used for liquid product injection and a second metering gauge 68 used for dry product injection. When liquid product in injected, incoming water will be directed through the first metering gauge 66 and into the tank 12 via an appropriate port in the tank head 36' (connected to a diffuser) for input at the top of the tank 12 since liquid product is being injected. The metering valve 70 may be used to adjust the flow rate. When dry product is injected, incoming water will be directed through the second metering gauge 68 and into the tank 12 via the water inlet tube 38 and applied to the dry product at various locations in the tank 12 (e.g., top 58, sides 60 and bottom 62, as shown in Fig. 3). The metering valve 72 may be used to adjust the flow rate. Additionally, while not shown in Fig. 6, the bypass line 54 and bypass valve 56 can be included to further adjust the injection ratio.

As previously noted, the current design shown and described herein can be adjusted to offer one to five points of mixing to provide expanded injection rations. These points of

We claim:

1. A fluid injection system for dispensing a solution into a fluid flow in a flow line, the fluid injection system comprising:

a storage tank having a product to be dispensed therein;

an inlet connection for diverting fluid from the flow line into the tank;

an outlet connection for returning a mixture of fluid and/or product back into the flow line;

a metering gauge in fluid communication with the inlet connection for measuring water flowing into the tank; and

a tank head connected to the storage tank and in fluid communication with the inlet connection,

wherein the inlet connection includes an inlet probe having an opening facing into the fluid flow, the opening defined by an arc at a downstream side,

wherein the outlet connection includes an outlet probe having an opening facing downstream of the fluid flow, the opening having an angled cut, and

wherein the arc at the inlet probe and the angled cut at the outlet probe create a pressure differential for diverting water into and out of the storage tank.

2. The fluid injection system of claim 1, further comprising a bypass connection connected between the inlet and outlet connections, the bypass connection diverting some of the fluid received at the inlet probe to the outlet probe without the diverted fluid entering the tank.

3. The fluid injection system of claim 1, wherein the tank head comprises a dual tank head, wherein the dual tank head comprises a first metering gauge for use with dry soluble product and a second metering gauge for use with liquid products.

4. The fluid injection system of claim 1, wherein the metering gauge includes a metering adjustment valve for adjusting the flow rate of fluid into the tank.

5. The fluid injection system of claim 1, wherein the arc on the inlet probe has a radius of approximately 45-degrees.

6. The fluid injection system of claim 1, wherein the angled cut on the outlet probe has an angle of approximately 30-55 degrees.

7. A fluid injection system for dispensing a fluid and/or product contained within a storage tank into a fluid flow in a flow line, the fluid injection system comprising:

an inlet connection for diverting fluid from the flow line into the tank;

an outlet connection for returning a mixture of fluid and/or product back into the flow line;

a metering gauge in fluid communication with the inlet connection for measuring water flowing into the tank; and

a tank head connected to the storage tank and in fluid communication with the inlet connection,

wherein the inlet connection includes an inlet probe having an opening facing into the fluid flow, the opening defined by an arc at a downstream side,

wherein the outlet connection includes an outlet probe having an opening facing downstream of the fluid flow, the opening having an angled cut, and

wherein the arc at the inlet probe and the angled cut at the outlet probe create a pressure differential for diverting water into and out of the storage tank.

8. The fluid injection system of claim 7, wherein the system is removeably attachable to the tank.

9. The fluid injection system of claim 7, further comprising a bypass connection connected between the inlet and outlet connections, the bypass connection diverting some of the fluid received at the inlet probe to the outlet probe without the diverted fluid entering the tank.

10. The fluid injection system of claim 7, wherein the tank head comprises a dual tank head, wherein the dual tank head comprises a first metering gauge for use with dry soluble product and a second metering gauge for use with liquid products.

11. The fluid injection system of claim 7, wherein the metering gauge includes a metering adjustment valve for adjusting the flow rate of fluid into the tank.

12. The fluid injection system of claim 7, wherein the arc on the inlet probe has a radius of approximately 45-degrees.

13. The fluid injection system of claim 7, wherein the angled cut on the outlet probe has an angle of approximately 30-55 degrees.