What are the Advantages of a Downstream Injection System (DSI)?

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Using a downstream injection system with metering tips is nothing new to our industry. Downstream injection has been popular and became widespread in many In Bay Automatics and tunnels since the late 1980's and early 1990's. These systems replaced many of the conventional means of delivering pre-soaks and other cleaning agents out to the wash, giving the owners and operators a comparative experience to upgrading their vehicles engines from carbureted to fuel injection systems. The largest benefit for upgrading to DSI is the consistency that it provides. This became even more important as the industry started to evolve from conventional concentrates to Ultra or Hyper concentrated cleaning products.

DSI systems operate by using a high regulated pressure source that is forced through a jet (injector) that opens creating a large pressure loss, the size of the injector is typically measured by its flow rate at 200 pounds per square inch (psi). This pressure loss creates a vacuum which is tied into the water stream, and this vacuum is used to induct the chemical to the water stream. An efficient injector with 0 PSI of back pressure will typically obtain 26" Hg. This created vacuum will stay consistent with the regulated pressurized water source without changes in back pressure in the delivery line. Therefore, if you have a consistent regulated water stream, flow rate (GPM) and vacuum pressure, you can meter the solution through different sized orifices providing your desired mix ratios.

DSI provides two main benefits with regards to consistency that are important to the operators:

1. **Consistent dilution or mixing ratios**
   a. While benefiting from the many advantages of using Ultra-Concentrates it became extremely important to not having fluctuation with dilution ratios (chemical/water mixtures). Conventional concentrates had more water in them, and changes in mixing ratios with older application equipment were not as noticeable as they are with Ultra-Concentrates. You had to use much more of the conventional products to obtain the proper mixtures. If they were off due to pressure changes in the water source or other variances from inconsistent mechanical induction, they were not as noticeable.

      By using those same variables for Ultra-concentrates, often used in just a few mils per car, the cost of the chemical being used per application can greatly increase or decrease along with their cleaning capabilities. For example, in the older systems, if the water pressure being used to fill the pre-mixed holding tanks was lower, it would decrease the amount of chemical being drawn into the tank. When the vehicle would enter the wash and the application pump was turned on, the product being applied to the vehicle would be a less than desired mixture, resulting in a less clean vehicle.

      As many owners and operators know, a customer being dissatisfied with just one wash could mean never seeing them again and could create a bad reputation for their wash causing a decrease in annual volume.

   b. Cost per car (CPC) – This has developed into a term very well recognized in the car wash industry. For the operator to achieve their lowest CPC with their cleaning products they must first achieve consistency in their mixing ratios! Without consistency you are either delivering a rich or a weak mixture. Often the operator had to pick somewhere in the middle to ensure that they could deliver clean, dry, and shiny vehicles to their customers.

      Using regulated DSI equipment allows them to achieve the consistency, therefore providing the ability to micro adjust their mixing ratios, achieving the lowest CPC possible while still delivering the best wash experience for their customers.

2. **Application**
   a. The second factor being application, is like the first benefit but is geared towards the actual delivery of the total mixture of water, chemical and usually air in the wash bay.

   b. When using DSI systems the application of the mixtures with air can use less water. It can save on your water bill and provides delivery with "small bubbles vs large bubbles" giving the applications an "air brush" appearance.

      Using less water allows the chemicals to get to the actual surface of the vehicle without a water barrier, allowing them to more efficiently do what they were designed to do, whether its lifting the dirt or filling in microscopic imperfections giving the appearance of a smoother more reflective surface.

With less water, the customer's overall experience will be improved giving them a better show. This makes it seem as though more chemical is being applied when in most cases it is less, leaving the customer feeling like they got an added value for the cost of the wash. There are a variety of pumps used in the DSI for the application of chemicals and here are the ones most frequently used.

Water driven pump – These pumps work much like a piston in a combustible motor. Usually they are attached to lines fed directly from the incoming city water source. They will typically have a solenoid open that will allow the water to pass through the chamber and move the piston. The direction of the stroke will fill the chamber with water and at the same time push the mixture from the last cycle out, while the return stroke will siphon the chemical into the chamber to create the desired mixture. Since city water will fluctuate, especially with all the applications running in the wash, the piston can either speed up or slow down. The mixture in the chamber should remain the same, but the application pressure at the nozzle can change and so will the number of strokes.

Therefore, you may end up with one vehicle that had city water pressure of 20 psi and another with 40 psi. Assuming the gate time on the application to be equal on both vehicles, the second would go through many more strokes therefore using more solution.

Dosing pump – These pumps will also operate with a piston or a diaphragm, drawing in chemical on negative stroke and pushing chemical out on positive stroke. The mixture is usually adjusted with a dial on the pump that is based off percentages related to the length or the frequency of the stroke. These pumps will pump the chemical directly into the water stream. If the water stream is not regulated, you have the same issues—fluctuations in the mixture ratios. Pump into a pressurized water source with these types of pumps can be difficult, and can cause problems with the pump, such as cracked pump heads.

Holding tank with delivery pump – A very common traditional method of applying chemicals in washes was to use a pre-mixed solution tank and pump to deliver the mixture out to the bay. This design typically is used with an "eductor" very similar to an "injector", it also uses venturi or vacuum to draw the chemical into the water stream. One of the issues with this design is that again the water pressure going through their eductor is not regulated (consistent) pressure, again causing mixture and application variances.

There is another major difference between DSI systems and the other three above referenced systems. The chemicals that the operators are using are all passing through the main components of the other three systems. Typically, the first failure point when working with liquid chemicals and pumps will be the O-rings that are in direct contact. In most DSI designs, the chemical is only passing through the injector and then delivered out to the wash bay. The rest of the components such as manifolds and pumps are kept away from the damaging effects that some chemicals can cause to equipment.

A DSI is unique to each wash site. Therefore, any equipment used in the composition of a system, to provide optimal efficiencies and effectiveness, will be determined from an on-site custom assessment. CSI will provide a custom assessment of your site(s) and determine what is needed to develop a DSI that is exclusive to your site's functionality and cost per car.

For more information about a DSI and or to schedule a custom assessment please contact Pat Fredrickson.

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