New Nozzle Technology "Cleaning More with Less"

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This technical paper will explain the new nozzle technology developed by Scientific Dust Collectors that allows high air-to-cloth ratio baghouses to use 80psig of compressed air instead of the industry standard 100psig.

Background

The reverse pulse jet baghouse has been around for over 50 years and the cleaning cycle has not changed very much during that time. The cleaning cycle is the most important part of the dust collector because it controls efficiency and media life. In a generic baghouse, the cleaning system is comprised of a blowpipe that is located approximately three inches above the bag, with an orifice and a venturi, which is located at the top of the bag/cage. This system uses bursts of compressed air at 100psi and back flushes one row of filters at a time during the cleaning cycle. This cleaning system has some deficiencies and thus Scientific Dust Collectors (SDC) introduced a special converging/diverging nozzle based cleaning system in 1981. SDC eliminated the venturi and provided a unique and patented cleaning system, which significantly improved cleaning, filter life, and lowered pressure drop. Over these many years, SDC's technology has been field proven in a wide variety of applications providing longer filter life while using less filters than other manufacturers.

The Next Generation

Since 2002, SDC has researched our patented converging/diverging nozzle and sought to improve the design and remove as much inefficiency as possible. Our extensive research has yielded the extremely successful "Next Generation" Nozzle Technology that is a significant improvement on our original supersonic nozzle design. Figure 1 below illustrates the cleaning flow during operation of one diaphragm valve at a manifold pressure of 100psig. It shows results at the top, middle and bottom of a standard ten-foot (10') long bag. This graph shows the cleaning results of a venturi based cleaning system (yellow line), SDC's old nozzle cleaning system (green line), and SDC's new nozzle cleaning system (blue line).

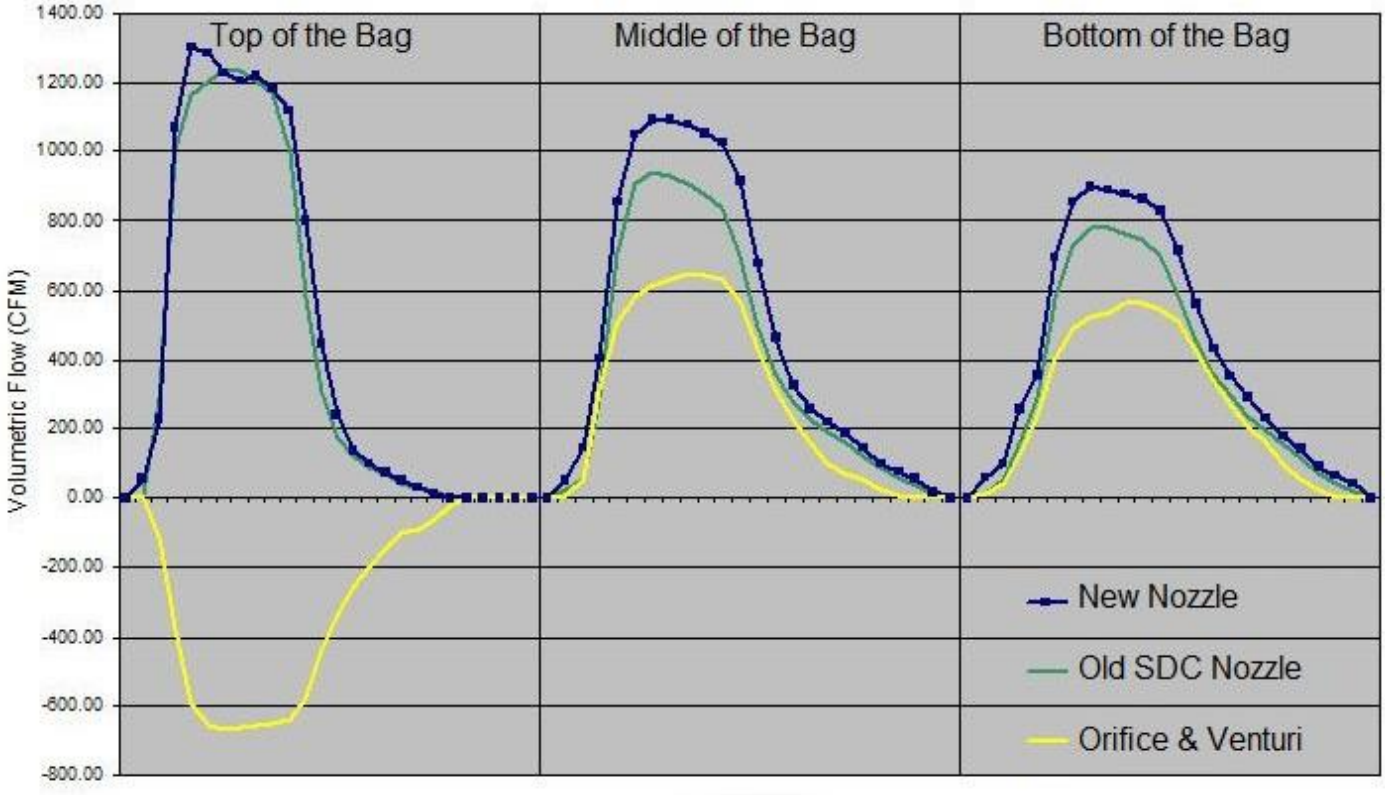

Figure 1. Volumetric Flow at the Top, Middle, and Bottom of a 10' Long Bag for all systems at 100psig

In looking at the graph, it must be noted here that the generic orifice and venturi system actually draws in a vacuum of air at the top of the bag during the cleaning pulse. That is the subject of "Advantages of Cleaning without a Venturi in Baghouse Collectors", a separate technical paper also available from SDC. Essentially, the paper provides an inch by inch analysis of the cleaning at the top of the bag with an orifice and venturi system and the SDC Nozzle cleaning and is summarized by Figure 2 on the next page.

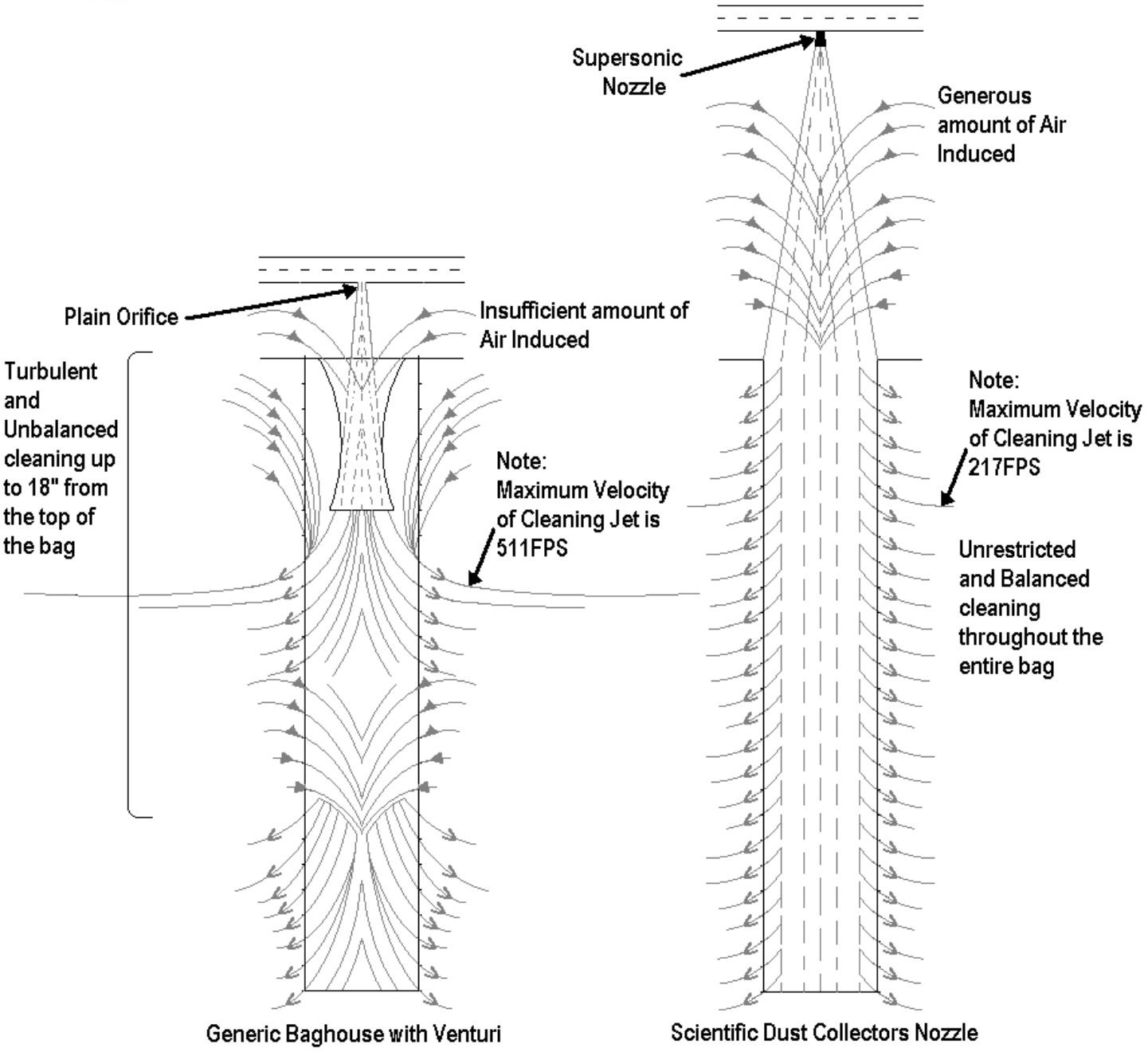

Figure 2. Cleaning system comparison of Generic Baghouse with Venturi to SDC Nozzle.

As it turns out, the generic orifice and venturi system does not allow the top 18 inches of filter to be used for repetitive cleaning and renders that section of media useless. The SDC nozzles on the other hand, provide an unrestricted and balanced cleaning throughout the entire length of the bag.

Getting back to the results in the graph in Figure 1, it is clear that both SDC nozzles outperform the generic venturi cleaning system by a significant amount. The Original SDC Nozzle provides a 38% increase in cleaning at the bottom of the bag when compared to the orifice and venturi system. The Next Generation Nozzle provides a 59% increase in cleaning at the bottom of the bag compared to the orifice and venturi based system.

Cleaning More with Less

We know that the Original Scientific Nozzle has been proven effective over the last 30 years. The original design has operated successfully at higher air-to-cloth ratios and with a manifold pressure of 100psig. With the Next Generation Nozzle, we asked ourselves: What is the minimum manifold pressure needed to achieve nearly the same cleaning flow at the bottom of the bag as the original supersonic nozzle? As shown by Figure 3 on the next page, the answer is **80psig**.

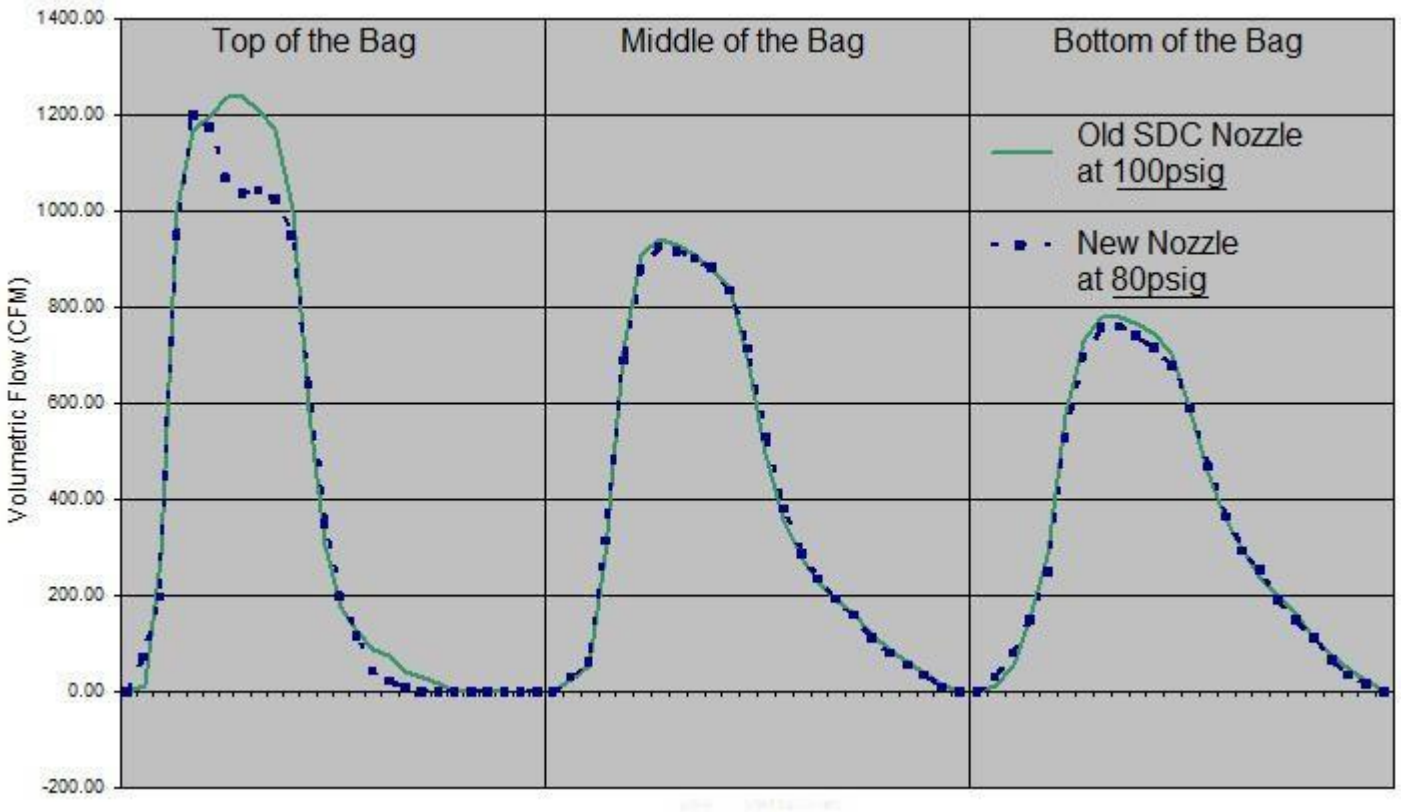

Figure 3. Volumetric Flow at the Top, Middle, and Bottom of a 10’ Long Bag for the Original SDC Nozzle at 100psig And for the Next Generation Nozzle at 80psig

As the graph shows, the cleaning provided by Next Generation Nozzle operating at **80psig** is almost identical to the Original Scientific Nozzle at **100psig**; differing by only 3%, which for practical purposes is negligible.

How This is Possible

At Scientific Dust Collectors, we do not change the design of our supersonic converging/diverging nozzle without spending the time to research and experiment because when it comes down to it, this really is “rocket science”. The significant increase in cleaning at standard pressure and similar cleaning achieved at a lower pressure is the result of our many years of research. In the next generation nozzle, we have a better understanding of supersonic flow that has allowed us to redesign and fine tune the many facets of the internal converging/diverging nozzle. Also, we were able to review the entire process from start to finish in the nozzle and eliminate flow reducing manufacturing and fabrication issues.

What This Means

1.Gentler Cleaning

By reducing the manifold pressure from 100psig to 80psig, Scientific Dust Collectors is able to provide a gentler cleaning pulse while still achieving the same volumetric cleaning at the bottom of the bag. Lowering the manifold pressure slows down the supersonic pulse which slows down the air as it enters the bag and provides a more balanced cleaning throughout the entire length of the bag.

Another benefit to slowing down the cleaning air is a reduction of the “puffing” effect. “Puffing” is a very common particle emissions problem in generic baghouses and occurs during the cleaning pulse. When the system pulses the bags to remove the dust particles, the particles are accelerated to such a high speed and end up being pushed through the pores of adjacent bags into the clean air stream. Once the dust is in the clean air stream it is then drawn out of the collector to the fan and/or stack.

Puffing occurs where the cleaning jet velocity is the greatest inside the bag. For a generic baghouse this occurs right at the exit of the venturi where the velocity is 511 FPS (feet per second) as shown in Figure 2. When the velocity is this great, larger and heavier particles are accelerated into neighboring bags which can end up wearing the media prematurely.

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On the other hand, at Scientific Dust Collectors, our maximum cleaning jet velocity inside the bag is only 217 FPS. When the dust particles are extremely fine, such as asphalt, glass, and lead oxide; even with our slower cleaning jet, these fine particles may still create a “puffing” effect. By reducing the manifold pressure down to 80 psig, the cleaning jet is slowed to roughly 180 FPS which further decreases the “puffing” effect. Reducing the “puffing” effect can reduce the risk of opacity or emissions issues as well as reduce the load and lengthen the life of any after (HEPA) filters.

2.Compressed Air Savings

Besides filter replacements, one of the most significant long-term costs associated with dust collector maintenance is the compressed air usage. According to a recent survey by the U.S. Department of Energy, roughly 10% to 30% of electricity is consumed for compressed air in a typical industrial facility. With the rising cost of energy, this will continue to grow; for this reason there is a large effort now to reduce compressed air consumption. Reducing the compressed air supply pressure by 20psig can quickly add up into savings and reduce annual compressed air cost by more than 25%.

3.Greater Flexibility

Our new nozzle has given Scientific Dust Collectors greater flexibility in terms of meeting the demands of almost any dust collection application. With our original supersonic nozzle; the approach was towards a one size fits all. But now, the nozzle cleaning system can be customized to retrofit any dust collector, clean any diameter filter bag, and operate at any pressure above 80psig while still providing the best pulse jet cleaning in the world.

In addition, the next generation nozzle is a **direct replacement** for the Original Scientific Nozzle. That means that if you are currently using the original supersonic nozzle and you want to upgrade to the next generation nozzle; simply replace the old blow pipes with new blow pipes.

The advantage of using SDC’s next generation nozzle for the end user is a more balanced cleaning system that supplies a significant amount of induced air into each bag using less compressed air and therefore less energy. SDC cleans the entire bag-top, middle, and bottom with considerably more cleaning air than the generic venturi based baghouse. This allows SDC to operate effectively and efficiently with fewer filters, less valves, and using less compressed air to clean the entire collector. SDC guarantees filter life and performance. With our new nozzle, we just made a good thing even better!