History of Fabric Dust Collectors

by

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History

The first pulse jet collector was developed by Pulverizing Machinery of Summit New Jersey in the early 1960's, to collect dust from their Pulverizers. They had tried to use the Blow Ring design but it could not handle the dust (powder) loads as Pulverizers became bigger. The typical load to the collectors were between 50 and 300 grains per cubic foot. The collector design was based on the same blow ring velocity and the cages were based on available designs from hipping pulverizer shafts. The pulse valves selected were diaphragm valves that were fast and the lowest cost valve available. This happened to be a ¾ inch valve. They decided to use several valves in a collector and pulse them with an electronic timer. It was found that the hole sizes and venturi were an air ejector design that had the same jet velocity that the blow ring collector was using. But the big breakthrough came with the realization that the dust was ejected from the bag during the first 4 or 5 milliseconds of the valve opening. It became apparent that the frequency of cleaning was a function of the load to the collector. For instance for loadings of 300 grains the collectors would operate at a filtering velocity of between 7 and 9 ft per minute. At material handling facilities such as a quarry would operate at a filtering velocity of 14 to16 feet per minute. The typical pressure drop in these collector designs were about 2 to 3.5 inches water gage pressure. The typical compressed air usage on the high loads were 1 to 2 SCFM at 80 psig per 1000 CFM of filtered air. For loads under 10 grains per cubic foot, the air usage was 0.2 to 0.8 SCFM per 1000 CFM of filtered air. Determining the filter velocity (then referred to as filter ratio) became a rather complicated procedure. The ratio presumably was determined by dust load, fineness of the dust, temperature of process gas stream, and other factors.

The hopper inlet was a carry over design from both the blow ring collector and the previous mechanical shaker collectors.

By 1969, there were over 10,000 collectors in operation. Almost all of them were installed on process equipment or in Foundries. Pulverzing Machinery changed their name to Mikropul and licensed FlexKleen to build and Market collectors. The collectors for MikroPul had 4 ½ inch diameter bags and the FlexKleen units had 5 inch bags. The Mikro units had six foot and an occasion a collector with 8 ft long bags (to compete with FlexKleen on some projects) and the flex units had nominally eight foot long bags. Bag life was usually 4 to 7 years.

Engineering Disaster 1971

In 1971, the patent was challenged and the Pulverizing Machinery patent was declared invalid. The market changed radically because Air Pollution Control Regulations became effective. Many new suppliers entered the market. In order to compete Mikropul changed their design. They went from 6 foot to 10 foot bags. They increased their pulse pipe holes by the same ratio. The whole industry followed and copied the new design for hole size and venturi throat diameter. At the time Mikropul had 40,000 venturies in stock and kept the same venturi sizes. This increased the jet velocity of the cleaning jet by 66 per cent.

This was when the dust collector market was growing at a 20% annual rate. With the new designs pressure drop increased to 4 ½ - 6 ½ inches w.c.. Compressed air consumption increased by over 50% for similar applications. Bag life was reduced by over 50%.

In reaction to these problems the filter ratios were reduced to between 4-6 on almost all applications.

Reasons for Disaster

What happened was no one at that time realized a rather obvious truth, that the velocity with which the dust is ejected from the bag during cleaning is proportional to the velocity of the cleaning jet. At the new velocities, dust is driven toward adjacent rows of bags in the filter mode. Depending on the dust density, the dust will be driven through the adjoining cake into the clean side of the bags. The cake becomes more dense and the pressure drop increases until the process stabilizes which takes 16-100 hours. Even after the equilibrium the dust still penetrates and bag wear is high. With low filter ratios it takes longer for the bag to wear out and require replacement.

Low Pressure pulsed air cleaning systems

Reverse Air Fan induced pulsed air collectors

In the mid 70's, it was discovered that the compressed air cleaning pulse jet collectors were encountering high pressure drops when applied to grains and to a lesser extent on woodworking applications. The reason was that the compressed air as it left the pulse pipes was subject to refrigeration cycle as the compressed air expanded. The first approach was to apply reverse air blowers to the cleaning system. The blowers were mounted on the roof of the collectors and the reverse flow was pulsed with mechanical dampers. The reverse air jet actually was higher in temperature than the process gas stream because of heat regain from the cleaning air as it passed through the fan. The downside of these collectors was that the fan on top of the roof of the collectors were difficult to service and as collector systems expanded the weight of the fan was significant. These collectors pioneered some arrangements that allowed them to operate with grain dust with densities under10 pounds per cubic foot. They introduced the high cyclonic inlets of cylindrical shaped collectors. They also featured a rotating reverse air manifold. There are thousands of these collectors some we serviced for over 20 years.

Air Pump Pulse Jet collectors with 8-10 psi operation

This was an outgrowth of the reverse air induced fan pulse jet designs. They used the technique of a cylindrical housing and a rotating pulsing arm but reduced the effects of the refrigerant cycle and loss of energy when the compressed air expanded. Also in the advanced technology concepts, they reduced the velocity and the effect of the air leaving the bags propelled to adjoining bags during cleaning. The oval shaped bags reduced the re-entrainment effect. The collectors usually had the effect of a high inlet as the air entered the bags mostly through the hollow cylinder in the middle of the cylindrical housing. Some of the advanced technology designs used a high cylindrical inlet similar to the F4 fan cleaning units. These collectors with bottom inlets were also applied to boilers at conservative issues.

Today's Conditions

<u>The disastrous design, mentioned above, continues to be employed by most of the pulse jet collector suppliers in the world</u>, especially for boilers. The market has become one in which it is a commodity and the equipment is built by the lowest cost suppliers.

New Technology

Twenty-four years ago one of our Associates worked for a Company called Scientific Dust Collectors and developed a new pulse jet collector that basically changed the cleaning system design. The key to this design was that he changed the jet velocity to a fraction of the existing designs. This eliminated the penetration of dusts from the row of cleaning bags to the adjoining row in a filtering mode.

This allowed pulse jet collectors to operate at lower pressure drops (2-3 inches w.c.), lower air consumption (50-75% less), 3 to 4 times more bag life and filter ratios of over 12 : 1 on any application while decreasing dust penetration by up to 90%.

There are many different considerations of using this new technology more effectively, which we can teach the client to apply. These techniques were developed over last 20 years for Carter Day (now Donaldson), Dustex and with several smaller companies. These include air distribution baffles and special inlet and outlet configurations. Now our has joined our group as a consultant. Over the last four years, QAM has brought this advanced technology to the Canadian market and carry on the legacy. We do not provide a design which is relatively simple but provide a technology which will enable our clients to develop new radical designs and systems. Specifically there are many little details such as protecting the inside of pulse pipes from corrosion, techniques for reducing corrosion when burning coals containing sulphur, special techniques to start up and shutdown when faced with unusual conditions, techniques for adjusting cleaning systems to operate at higher elevations, inspection techniques for qualifying critical components etc. This technology is an on going process. We have seen radical changes in periods of less than six months as new components and new manufacturing procedures are developed.

This technology allows the client to adapt to different field conditions and to burn different fuels. These collectors have been applied to incinerators which operate under the most difficult conditions. By comparison a coal fired boiler is relatively simple. Sometimes the operating techniques may change as the source of fuel is changed. There are some advanced innovations that are especially significant to operating costs. When air expands from 90-100 psi absolute, in an orifice blowpipe it accelerates the air to sonic velocity. Then the pressure in the blowpipe is 100 psia, the pressure in the throat is 52.8 psia absolute or 38 psia. The energy below that down to atmospheric is dissipated. There are techniques to design nozzles to install on pulse pipes which will increase the velocity to around 1690 feet per second and lower air consumption by 30%.

AVAILABLE EQUIPMENT AND SERVICES

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