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Case Study: Using An Air Knife To Clean Medical Devices
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How an air knife and ionizing bar removed particles and eliminated static attraction

A cleanroom by itself doesn't prevent static electricity; and if you want to remove inert particles without using a water wash process prior to the parts entering the cleanroom, it's an even bigger challenge. All too often, the manufacturing debris on components is not soil (foreign material), but rather clean dry particles of the same composition as the finished assembly. Wiping or blowing particles off doesn't address the problem of statically charged surfaces or the statically charged particles you are trying to remove. By using an air knife with ionizing bar you can remove particles and eliminate static attraction. This in turn prevents electrostatic discharges (ESD) from the parts before packaging. However, although eliminating a water wash process for your parts is a nice idea, the thought of blowing particles all over your cleanroom sounds like you're trading one problem for another.

Particle contamination due to static
A manufacturing issue arose for Kirwan, a manufacturer of electrosurgical devices such as single-use bipolar and monopolar medical cords. Particles from the assembly process tended to adhere to the outside surfaces of cords, and they had to expend extra effort and time to prevent particles from ending up in the final packaging of the cables. "Our volume dictates that we hank (twist-tie) and keep the cords hanked early in their processing, which makes the removal of particulate from each wrapped electrical cord an even bigger problem," said Kevin Prario, RA Manager. They experimented with blowing compressed air onto the cables which showed that they could remove most of the particles, but a portion still remained due to static electricity. They concluded that they needed a system to blowoff and make static-neutral the particles while also collecting all of the debris to prevent contamination of the cleanroom.

Kirwan was in the process of planning a new cleanroom to accommodate the four new assembly stations needed for the new product line. Although they had now proven the particle blowoff concept with compressed air, they knew that the energy costs of compressed air for a full scale system with four assembly lines would be substantial. Additionally, they had not had an air ionizing bar to use during the compressed air tests to ensure complete particle removal.

Overview of a cleanroom with ionizing air knives

Medical cords are manually passed under the knives for static neutralization

What is an air knife and how does it eliminate static?
The approach to blowoff technology has changed dramatically over the last 15 years. An air knife is a non-contact method of removing unwanted surface contaminants. By directing low pressure, high velocity ambient air into a plenum chamber and out through precision slots, a controlled curtain of air is produced which can be used for many different applications. As powered by a centrifugal blower, this system delivers impact air velocities from 5000 to 45,000 FPM to the surface of products for drying, dust blow off, coating control, cooling, and heating. With pressures of 0.5 to 4.0 psig and high volumes of air, a blower air knife system produces equal or greater blow off effectiveness than compressed air at 100 psig and very low cfm while requiring an average of 75% less energy than compressed air.

18" middle inlet air knife with ionizing bar and vacuum collection system located directly below ionized air stream

The static elimination system accomplishes this function in a two-stage process. First the high velocity air knife, combined with the externally mounted ionizing bar, generates +ve or –ve ions. This is achieved with a high voltage electrical current delivered to a metal emitter which produces the ions. The ions have a life of about three seconds, during which time the high velocity ionized air stream impacts the surface of the cables, liberates the particles, and neutralizes the static charge of the cable and the particles before being absorbed back into the surrounding air. The second stage involves the collection of the airborne statically neutral particles in order that the blower air and the particles do not contaminate the cleanroom.

HEPA filtration directly coupled to a 20Hp centrifugal sonic blower system. Blower was mounted outside of the CleanRoom, as not to contaminate.

The "Air-Wash" System is put into place

Kirwan, began researching companies who could provide a turnkey system and turned to Sonic Air Systems. The company's representative brought his portable 5 Hp demo blower with 6" air knife and ionizing bar to the plant and demonstrated what they could expect from a full size blower system. Upon sizing of the full system and comparing the energy consumption of the 20 Hp blower, (needed to support one 18" long air knife on each of their four assembly tables) with the 75 Hp compressor if they chose plant air, the blower was the obvious choice. Kirwan asked for additional equipment to exhaust the dust particles which the system was blowing off the cable assemblies. The representative worked with his factory to design a down draft vacuum manifold, mounted under each assembly table and opposite the ionizing air knife. A 5 Hp exhauster located outside of the cleanroom met the needs of all four assembly tables. A turnkey "Air Wash" system was put into place, it incorporated the 20 Hp blower, in-line HEPA filter, four 18" air knives, four ionizing bars with power supply, four vacuum manifolds, a 5 Hp exhauster with collection filter and the complete system piping.

The requirements for the cable cleaning system are for each operator at their assembly table to pass the 12' long x 1/4" diameter coiled cable assembly between the push-pull of the ionizing air knife and the down draft air manifold a few times as needed. Obviously, low noise levels are also very important and with the high efficiency air knives and perforated plate vacuum manifold, the sound levels are within required decibel range. Additionally, the air from the air knives was passed through an in-line HEPA filter rated for 0.3 microns.

Overview picture of two stations including air knives and vacuum collection located under each air knife.

Summary

Kirwan reports that the air knives have made a noticeable improvement in the removal of gross visible particulate from their hanked cords. They are finding far fewer sealed pouches with visible particulate within them as the cords are inspected at the end of the packaging line. Also the process of hand manipulating the cords for removal of particulate is some two and a half times faster with the assistance of the static free air-wash.

This new generation of ionizing air knives is a big step forward for the cleanroom industry and is a direct response to cleanroom managers demanding higher specifications and less product reworks.

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