**TIVAR® 88-2 replaces Stainless Steel in Dust Collection System**

By: Carolyn Busack, Steve Honabarger and Ron Mesing

September 30, 2011

This paper details how solutions to dust collection challenges in the STP (sludge treatment process) resulted in a new application of TIVAR® 88-2 material at an AEP power plant in Ohio.

The AEP Plant is a coal-fired electrical generating station currently with four active units. The total generating capacity of the four units is 1,695 MW.

For the past 30 years, pug mills have been used to mix calcium sulfite (scrubber sludge) with fly ash and lime to stabilize the material. After the material is discharged from the pugmills, the mixture is transported by conveyors (Fig. 1) to a concrete pad and then trucked to the landfill.

Figure 1 – Scrubber sludge after it has been mixed with fly ash and lime

Mixing a wet sludge with a dry powder is a dusty process and requires a dust collection system to control the sticky, moist dust that is generated from the pug mills.

**Background:**

The old STP system had multiple issues. The pug mills were not mixing effectively. Pockets of dry powder (fly ash and/or lime) frequently exited the pug mills instead of the desired homogenous mixture of sludge, fly ash, and lime. Consequently, less fly ash and lime could be utilized during the mixing process, which led to a longer time period for stabilization to occur. Typically, the sludge mixture would have to sit on a concrete pad for about three days in order to stabilize. The sludge would then be transported by truck to the landfill.

The original dust collection system utilized a Roto-clone hydrostatic-precipitator with an exhaust fan on the clean side of the system. Due to build-up of sludge particles, the stainless steel main header required frequent cleanings. The unit had to be taken out of service approximately every three weeks, and two operators were required to pressure wash the ducts. The mist eliminators constantly plugged, hindering the clean air from exiting the dust collection system. Fly ash coated the exhauster fan, causing vibration due to imbalance. Periodic unit curtailments often resulted.

As part of a mercury reduction project, the system was refurbished. New pug mills were installed for more effective mixing. New conveyors were added to create a back-up system. And more reliable dust collectors were incorporated to make the system more efficient.

Although the old pug mills had adequate capacity, they had exceeded their design life and were no longer mixing properly. The new pug mills are able to produce a homogenous mix; therefore, more fly ash and lime can be utilized to stabilize the sludge. Each pug mill is driven by a 100 hp motor that rotates the shaft and paddles at 60 rpm.

The output mixture of sludge with lime and fly ash uniformly added by the new pugmills is much easier to transport. The new system also requires less cleaning, which helps to reduce operating costs.

The replacement dust collection system (venturi scrubbers, cyclone separators, and exhaust blowers) was installed to collect airborne fly ash and lime particles and was located on the floor above the pugmills and conveyor system. There were four dust collection units, one for each of the two pug mills and two for the discharge conveyors.

Upon installation of the new dust collection system, the stainless steel ductwork was found to plug during startup. It was determined that a different duct material was needed. Also, the venturi scrubbers and cyclone separators were moved to the pugmill and conveyor floor in order to control pressure drop and reduce the length of ductwork (to minimize the potential for pluggage). It was further determined that only the two dust collectors on the discharge conveyors would actually be required. They had sufficient capacity to exhaust the pug mills in addition to the conveyors. This was made possible by full skirtboards for the length of the conveyors.

**Problem:**
The stainless steel dust duct system was continuously plugging, and the operation had to be frequently shut down for cleaning. A material with a lower coefficient of friction (C.O.F.) was needed to prevent the moist dust from adhering to the duct walls. TIVAR® 88-2 was suggested as a material for the dust collection hoods. AEP engineers were familiar with TIVAR® liners because they had been used for years in bunkers, railcars, chutes and hoppers. This application was unique, however, in that rather than using

TIVAR® 88-2 as a liner for the stainless steel dust collection hoods, the hoods would be manufactured completely out of TIVAR® 88-2 material.

TIVAR® 88-2 is a modified UHMW-PE polymer. Additives are incorporated to enhance the C.O.F., impact and abrasion resistance, and other properties of the material. Although TIVAR® 88-2 is a UHMW-PE based product, its key properties have been amplified. A comparison of TIVAR® 88-2 to UHMW-PE is similar to comparing stainless steel to carbon steel. TIVAR® 88-2 is also non-corrosive and lightweight (1/8 the weight of steel), making it an excellent choice of materials for this particular application.

**Challenges:**

Typically TIVAR® 88-2 is viewed throughout the bulk material handling industry as a flow promotion device (liner) that is used to enable various materials such as coal, limestone, fly ash and aggregate to flow freely in bunkers, silos, receiving hoppers, chutes and railcars. Although these applications are well known in the power, rail and cement industries, TIVAR® materials have also been used to fabricate a myriad of parts such as gears, sprockets, pulleys, bushings, wear pads and even fly ash paddles.

One of the concerns using TIVAR® to fabricate a continuous one-piece dust collection hood was the expansion/contraction of the material. In this application, the atmospheric temperature range could vary from 0° F in the winter to over 100° F in the summer. With repeated thermal movement, there existed the possibility of stripping the TIVAR® liner by repetitive loosening and tightening of the attachment hardware on the access doors and port areas of the duct. And last, but not least, the negative pressure inherent to the dust collector vacuum system had to be accommodated in the design. Successfully incorporating design features to meet these three requirements proved to be a challenge. Furthermore, the authors concluded that TIVAR® 88-2 material had never been used in a similar application, hence there were no previous historical records and/or projects to reference.

**Solution:**

With these challenges in mind, AEP engineers and SystemTIVAR® Engineering designed a complete duct system that incorporated small duct sections, flanges, gaskets, stainless steel hardware, inspection doors, impact plates, test ports and inlet and outlet ducts (Fig. 2).

Figure 2 – Dust duct

The expansion and contraction issue was addressed by incorporating expansion joints at the critical connection points within the system. The expansion joints permitted the entire system to “float” and move freely, preventing the fractures and/or cracks that would occur if the system was fixed against movement.

One of the concerns with using a “plastic” structure for the main body of the duct was the possibility of torquing fasteners too tight and stripping the “plastic” threads when reassembling the access doors. Stripping the threads in the main body of the duct would lead to loose connections and cause leaks in the system. To eliminate this possibility, stainless steel threaded inserts were incorporated at the doors and ports. Although this design minimized the stripping potential, signs were placed on the duct body instructing personnel to use “hand tools only.”

Since the fines are very cohesive, it was suggested that impact plates be installed on the main body of the ducts where fines may be sticking to the sidewalls. Operators would then be able to periodically hit the sides of the ducts with a rubber mallet to loosen any dust accumulations. Even a simple bump with the hand when passing by would clean the ducts since there would be minimal adhesion of the dust particles to the TIVAR® 88-2 sidewall.

In designing for the negative pressure, the ducts and hoods had to be fabricated in such a way as to create a leak proof system that would maintain a 3500 CFM air flow. The TIVAR® 88-2 walls were made thicker than the standard 11 gage (approximately 1/8” thick) stainless steel walls to prevent the duct from collapsing under the negative pressure. The square duct sections were fabricated using 1/2” thick TIVAR® 88-2 material. Three-quarter inch thick flanges were fabricated and extrusion welded to the duct sections at the joints. The length of each section was limited to between 2 ft. and 4 ft. long to facilitate the installation of the sections between floors.

To create a leak-proof construction, the bodies of the duct sections were extrusion welded on the inside, and neoprene gaskets were used between each flanged section of the duct to make the joint airtight. TIVAR® 88-2 inspection doors and inlet and outlet ducts were located at strategic areas. To prevent loss in pressure drop and possible dusting, neoprene gaskets were used to seal access doors to the duct sidewall. In addition, the HVAC (heating ventilation air conditioning) engineers needed a means to easily measure the air flow in the dust collection hoods. Hence, four (4) access ports were incorporated into the dust collection hoods to allow insertion of instruments to measure air flow.

Stainless steel handles were installed on the lightweight access doors so they could be handled easily and without damage to the Tivar (Fig. 3).


Figure 3 – Dust duct access door

**Results:**

The TIVAR® 88-2 "plastic" dust ducts and hoods have been a success. Due to the low C.O.F. of the TIVAR® 88-2, the hoods have proven to be self-cleaning, which means any dust buildup on the sides reaches a certain thickness and then falls off due to its own weight. Typically, two weeks after a cleaning there is approximately ½" of build-up on the TIVAR® walls and a maximum of 1" in the corners of the dust collection hoods. This, however, seems not to affect the operation of the dust collection system. In the past eight months that the TIVAR® ducts have been in operation, periodic cleanings have been required only at the transition between the TIVAR® and the stainless steel piping (which connects the TIVAR® dust collection hoods to the venturi scrubbers). Spray nozzles have been added to help reduce the buildup in the stainless steel piping. The nozzles run for three minutes at 10-minute intervals to clear away any buildup in the transition point.

Overall system improvements have been successful as well. More flyash and lime can now be mixed in the sludge material, which results in quicker stabilization. In addition, less required cleaning has produced the positive result of decreased overall conveying cost and a reduction in system down time.