

CORROSION AND ABRASION: THE FINAL FRONTIER

NEW SOLUTIONS FOR CORROSION AND ABRASION IN CEMENT PLANTS

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Corrosion protection experts 3L&T have identified a number of areas in the cement industry where even advanced technologies have been found wanting: high temperature areas, under-refractory areas, electrostatic precipitators walls and plates and soe structural steelwork. Using a combination of technologies including inorganic nano-particles and organic resins, the company has had a number of successful applications in all of these situations.

Corrosion is the destructive attack of a metal by reaction with its environment. The serious consequences of the corrosion process have become a significant problem in many cement plants. Corrosion causes plant shutdowns, waste of valuable resources, loss or contamination of product, reduction in efficiency, costly maintenance and also can jeopardise safety. Corrosion can also be combined with abrasion in a vicious cycle that destroys metal at an accelerated rate. Many methods have been developed in an attempt to prevent and stop metal losses. This article will focus on some major issues regarding corrosion and abrasion in cement plants and some new technologies for prevention and control.

Corrosion and protection

The type of corrosion and abrasion mechanism and its rate of attack depend on the nature of the atmosphere in which the process takes place. The first step in preventing corrosion and/or abrasion is understanding its specific mechanism. The second and often more difficult step is designing a type of protection mechanism.

Three years ago, 3L&T Inc. introduced a new corrosion protection technology called FlueGard-225, with a focus on baghouse filter corrosion. Today, after four upgrades, this coating material is being used around the world. Figure 1 shows the condition of a baghouse inspected after the application of FlueGard-225 two years pre-

viously. There has been no corrosion.

In many of those cement plants, the maintenance manager has identified additional corrosion issues that need a different solution and some abrasion problems that have not been solved satisfactorily. We at 3L&T looked closely at the following situations:

- Some sections of the plant operate part of the time at very high temperatures, beyond the scope of the FlueGard-225;
- With the increase of use of alternative fuels, the kiln shell has corrosion under the refractory;
- The fans, cyclones and screw conveyors experience a difficult combination of abrasion and corrosion;

- In electrostatic precipitators not only the walls but also the collecting plates have corrosion;
- The structural steel in many cases starts corroding soon after the application of a new coating.

This article details new material technologies recently introduced to prevent those corrosion and abrasion problems in a cement plant.

High temperature corrosion

When the operating temperature of the gases in a baghouse filter exceed 225°C, it is difficult to find an organic coating that can survive very long. The use of refractory materials is prohibitive because of weight and cost issues. The best solution

Fig 1. Baghouse wall coated with FlueGard-225SLB, two years previously.





Figure 2. Application of FlueGard-325S on an economiser.

is a new inorganic binder combined with a very high loading of active fillers, some of them in the range of nano-particle materials. These nano-size fillers have a unique impact on performance: their surface area increases by a factor of one million as the particles decrease in size from 2µm to 13 nanometers. The effective dispersion of these small particles is difficult, but once it is achieved, the results are impressive.

This new coating material - called FlueGard-325 - can sustain continuous operating temperatures of 325°C and short peaks up to 500°C. So far, it has been used on two heat economisers in power plants and will be installed in two cement plant baghouse filters, one in the UK and one in Mexico. The Figure 2 shows a recent application on the exterior of a finned tube economiser that operates at 290°C.

Under-refractory corrosion

The outside shell temperature of a cement kiln is usually around 250°C. In some cases, especially in plants that use a large proportion of alternative fuels, there is severe corrosion of the inside shell under the refractory. One unusual characteristic of the thick slabs of corroded

steel that come off the shell is that it is strongly magnetic, this indicates that the material has a high content of Fe₃O₄.

For this situation we developed another inorganic, nano-particle composite designated as KilnGard-600. This material will resist corrosion and abrasion up to 600°C of continuous operation. The first successful applications were in Mexico and in Italy. This year we will be making two more applications in Italy. Figure 3 shows typical corrosion damage in the shell of a kiln, under the refractory: the corrosion slabs are up to 8 mm in thickness.

Figure 3: Kiln shell corrosion under the refractory, up to 8mm in thickness.



Abrasion-Corrosion

There are many good refractory materials for very high temperature abrasion, but they are heavy, expensive and need routine maintenance. Also there are many elastomeric materials for abrasion resistance at room temperature. There seems to be a gap in the range of 100 to 200°C, where elastomers do not survive and refractories are too heavy.

The recently introduced WearGard-200 is intended to fill that gap. The first application was in the housing of a fan in Oregon, while subsequent installations will be in the housing of a screw conveyor in Texas and the static separator of a raw mill in Spain. Figure 4 shows the application in a housing fan that operates at 160°C, to protect it from abrasion-corrosion damage



Figure 4: Coating of a fan housing to protect it from abrasion-corrosion.

Electrostatic filter corrosion

Many electrostatic precipitators have been coated with FlueGard-225SLB already, most recently a new, large ESP in Mexico for Cemex and another in Spain for Holcim. For a rehabilitation project in Italy for BuzziUnicem, under completion in May 2005, the customer specified the use of FlueGard-225SLB for the walls and the ducts but the contractor also asked about a product for the plates. This is a tough request because the coating needs to be electrically conductive.

After extensive development work, including investigation of the use of carbon nano-tubes, we



Figure 5. Severe corrosion in an electrostatic precipitator.

introduced the Electro-Gard-225. This material has corrosion protection, abrasion resistance, strong bonding to steel and conductivity of 200 Ohm-mt up to 225°C. We will follow up closely the performance of this filter to confirm the potential improvement of the plate efficiency due to the smooth surface of the coating.

The Figure 5 shows the effects of corrosion on a stainless steel electrostatic separator: this is typically due to the presence of chlorides in the gas stream.

Structural steel corrosion

The structural steel in many industrial plants is exposed to moisture and corrosive airborne dust. After sandblasting the steel, before the application of a conventional coating, some of this dust settles on the surface of the clean metal. Once the coating is done, these contaminated spots are areas for future problems. Pretty soon some small rust spots appear, followed by blisters, delamination and corrosion. Usually the maintenance cost is high due to the repetitive coatings and additionally the image of the plant suffers, since it just looks ugly.

Our most recent development in corrosion control for structural steel in

industrial and marine environments is SteelGard-50. This new technology is also the result of nano-particle fillers combined with an organic resin that withstands chemical attack and UV damage. The lab testing involved the immersion of sandblasted plates in sea water, coating them after drying and acid solution spray for six months on a scratched surface.

The results were better than any of the benchmarks coatings used for comparison. The first application in an aggregate plant in California looks very good after several months in service. Figure 6 shows the type of corrosion damage that is common in structural steel exposed to marine or industrial environment.

Conclusions

There is a lot of corrosion and abrasion out there! Fortunately, there are also many available solutions including a few more in the pipeline.

Usually the best way to solve a specific problem involves the identification of the issues by a current 'victim' and the involvement of an outsider with the technology tools to address the root causes.

The new technologies presented here are good examples of this combination. In each and every case there was an engineer with a problem and a scientist with resources and ideas on how to solve it.

A maintenance engineer in Cemex Venezuela, who pointed at the severe corrosion problems in his baghouse, got 3L&T started in this direction, and for that we sincerely thank him. We have already come a long way on the road to the elimination of corrosion as a recurring problem. **GCL**

Figure 6: Severe corrosion of structural steel.

