

Corrosion-resistant coatings for recovery boiler ductwork

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The application of a spray-applied vinyl ester lining can be a cost-effective alternative to patching and replacing precipitator ceilings, walls, and ductwork.

For over 30 years, electrostatic precipitators have been used to remove particulate from the gas stream of recovery boilers in the kraft mill. The economic justification of using black liquor as a source of fuel to produce steam in the recovery boiler and of recovering many of the chemicals used in the kraft digesting process is well recognized in the pulp and paper industry. This is unlike the sulfite process where the "digester" liquor becomes spent and, in most instances, is of very little value. While the electrostatic precipitator and precipitator ductwork are essential pieces of equipment in the recovery boiler system, they are a source of numerous problems. The one we are concerned with in this paper is corrosion and how to cost-effectively reduce it.

Causes of corrosion

Corrosion in the electrostatic precipitator and ductwork generally occurs when structural and working components reside at or below the dew-point temperature of the flue gas. Poor performances have been registered by carbon steel and, in many instances, stainless steel materials that should be able to withstand this harsh, high-temperature environment.

The infiltration of ambient-temperature air is a major perpetrator of the corrosion process. Once this occurs and dew-point temperatures are realized, corrosion occurs and will accelerate unless corrective measures are taken. There are several remedies that can be used either singularly or in combination to stop the corrosion process:

1. Temperature control
2. Heat jackets
3. Thermal insulation
4. Ambient-air infiltration control
5. SO₃ reduction
6. Materials selection.

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Unfortunately, the first five methods have proven to be somewhat unreliable. It seems that no matter what is done in terms of controlling temperatures, air, SO₃ reduction, etc., dew-point temperatures are reached, and corrosion is inevitable.

As far as materials of construction are concerned, stainless steel alloys have been very successful in laboratory tests, but in the field there have been mixed results. For instance, a British Columbia mill had catastrophic failure of type 316L in precipitator ductwork in less than 18 months. Thus, a nonmetal coatings approach, which would not be subject to dew-point corrosion yet would be able to withstand 350–380°F (177–193°C) operating temperatures, was sought.

Solution

Since exit flue gases from the recovery boiler run consistently hot [greater than 350°F (177°C)], dew-point corrosion does not occur. However, during shutdown and startup and because of other factors that cause operating temperature instability, dew-point temperatures are reached and corrosion occurs. Particularly vulnerable to this corrosion are ductwork (both inlet and outlet), breaching, nozzles, and support beams.

For nearly a decade, a vinyl ester coating which handles continuous operating temperatures of 380°F (193°C), with excursions to 460°F (238°C), has been used successfully for this application. This specific vinyl ester resin is combined with a special curing system and inert flake pigment (not glass) and is specially formulated to provide excellent abrasion resistance (taber CS17 wheel, 1000 g weight, 8.5 mg weight loss per 1000 cycles) while retaining temperature, chemical, and other physical properties. Numerous mills in the United States and Canada already have 1–10 years successful field history using this product.

Coating new vs. existing ductwork

While coating of existing ductwork has been accomplished, it is far better to coat new ductwork, either at the time of initial installation of a new electrostatic precipitator or at the time existing ductwork is to be changed out. Surface contamination, pitted steel, and difficult access are a few of the reasons why coating of existing ductwork is difficult.

The preferred method is to coat new ductwork on the ground and leave weld joint areas bare, install the ductwork, and touch up weld areas and any other areas that may have been damaged during the installation.

Conclusion

While carbon steel and stainless alloys have been successfully used in the electrostatic precipitator, there are many corrosion problems that are more effectively resolved with an appropriate organic coating. These coating systems have proven to be very cost effective if applied in strict accordance with manufacturer's specifications. □

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