MAXIMIZING PERFORMANCE OF ELECTROSTATIC PRECIPITATORS

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A FOUR-STEP PROGRAM FOR IMPROVEMENT CAN MAXIMIZE PRECIPITATOR PERFORMANCE.

DUE TO INCREASINGLY STRINGENT PARTICULATE EMISSION regulations, plant maintenance personnel have been given the responsibility to maintain a continuously clear stack by getting the maximum performance out of the electrostatic precipitator. Reduced maintenance budgets and downsizing make achieving this objective no easy task. The chemical, pulp and paper, utility, cement, and metallurgical industries, among others, have been affected. This article presents a practical approach to the maintenance specialist responsible for maintaining and improving the overall performance of the electrostatic precipitator. Maximum performance is defined as minimizing emissions, increasing reliability, and reducing maintenance cost.

PROGRAM OUTLINE

The practical approach to improving precipitator performance begins with determining the original design conditions of the precipitator and current performance level(s). The precipitator maintenance specialist must assemble the most recent operation and maintenance logs, emission test reports, gas distribution test, dust analysis reports, resistivity curves, inspection reports, the original design specification, maintenance manual, drawings, and any other available documents that relate to the operation and/or performance of the precipitator for review and evaluation. This information will be used as a reference source or database for review of the performance evaluation.

The performance improvement program is divided into four major steps:

1. Mechanical inspection and repair
2. Electrical inspection and repair
3. Process review and adjustment
4. Optimization of EP performance.

Figure 1 illustrates how these steps work together to provide maximum precipitator performance.

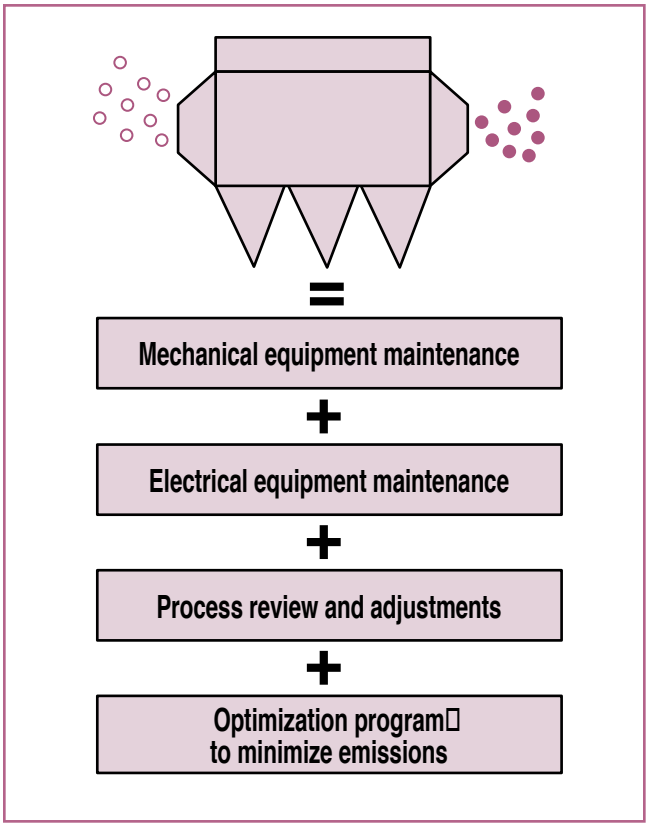
The program described below is offered as a guideline. It should be adjusted to suit specific plant operating and maintenance procedures. To achieve the best results, the program sequence should be followed as described above. It is important to document the date and time when any adjustment, changes, or both are made to the precipitator. This will permit the maintenance specialist to monitor the effect these changes have had on precipitator performance.

STEP 1: MECHANICAL INSPECTION/REPAIR

The precipitator must be taken out of service and an internal inspection performed to ascertain the mechanical condition of the precipitator. The mechanical condition and location of discrepancies must be documented in an inspection log book, i.e., AutoCAD layout. Discrepancies between the actual mechanical condition and the manufacturer's recommended tolerances must be corrected.

Areas to be inspected include:

- Collecting plate and discharge electrode alignment
- Collecting plate rapping system
- Discharge electrode rapping system
- High voltage support insulator system



1. Steps to achieve maximum precipitator performance

- Collecting plates for bows and bends
- Discharge electrodes for bows, missing electrodes
- Gas distribution screens (plugged holes, missing screens)
- Gas distribution of casing, hoppers, inlet and outlet transitions
- Dust removal system
- Locations where air-in leakage can occur.

Collecting plates, discharge electrodes, and casings should also be checked for corrosion. Discrepancies such as broken electrodes, bowed plates, and excessive corrosion sometimes result from other problems within the process operation or the precipitator.

Potential problems such as operating the precipitator below the acid dew point temperature or mechanical fatigue can be identified at this time and corrective action taken prior to a catastrophic failure. Recommended repairs and corrective action should be supervised by a qualified electrostatic precipitator technician to ensure that the mechanical condition of the electrostatic precipitator is in accordance with the approved standards.

STEP 2. ELECTRICAL INSPECTION AND REPAIR

The mechanical condition and electrical operating properties of the transformer-rectifiers, transformer rectifier controls, insulator heaters, rapper (coils or motors), rapping controls, and so forth must be inspected to ensure that the operation is in accordance with the specifications. Documenting the mechanical conditions and electrical readings in an inspection logbook is helpful in identifying future problems. The electrical equipment should be operated at design parameters, the electrical data recorded, and replacement/repairs made where discrepancies to the specifications are noted.

Equipment to be inspected and operated includes:

- Transformer-rectifiers and controls
- Rapper controls
- Rapper motors, coils, vibrators
- Key interlock system
- Hopper heaters
- Insulator heaters
- Insulator compartment/penthouse ventilation system
- Data management systems.

A very important tool to the precipitator maintenance specialist is the development of current/voltage curves for each electrical bus section under air load (static) and gas load conditions. These curves can be used for future reference and evaluation to identify grounds, dust buildups, full hoppers, and high resistivity and assist in troubleshooting or diagnosing operating problems.

The purpose of documenting the findings is to establish a baseline for precipitator operating parameters, mechanical condition, and electrical condition. This baseline data can be compared to information gathered in the future to evaluate precipitator performance.

STEP 3. PROCESS REVIEW AND ADJUSTMENT

The operating conditions of the process must be evaluated, documented, and compared to the original precipitator design conditions. A simple spreadsheet is recommended. Evaluation of the actual performance versus the expected performance of the EP must be completed. Conditions such as gas volume (ACFM), gas temperature (°F), dew point (°F), inlet dust loading (GR/ACF), resistivity, particle size and gas/dust flow distribution must be collected, recorded, and evaluated. The historical data that was assembled for review can be utilized at this time to evaluate the changes in performance.

The specific application or process conditions can have a significant impact on the performance of the precipitator. The process variables must be reviewed and evaluated to determine their effect on precipitator performance. The objective of the process review is to find areas in which the process can be optimized to reduce

the gas volume into the EP, increase the moisture dew point, adjust temperature to the optimum resistivity, and/or reduce the dust loading into the EP. Optimizing the process will not only stabilize the electrostatic precipitator performance but can reduce operating cost.

This is also a good time to interview the plant operators and discuss what changes in the operation have made the precipitator operation change.

One example of process optimization is where the precipitator operates under a high negative pressure (more than –15 in. wg). Air leakage can cause significant operating problems, such as corrosion, dust buildup, and reduced production. Unnecessary air in-leakage must be prevented in areas such as access doors, expansion joints, screw conveyors, and penetrations in the casing. Reducing or eliminating air in-leakage will reduce gas volume in the precipitator, reduce emissions, increase temperature, reduce corrosion, reduce power consumption, and increase process production rates. The result is that the process runs more efficiently and the precipitator works better.

STEP 4. OPTIMIZATION OF EP PERFORMANCE

Precipitator optimization can only take place after the mechanical and electrical equipment have been inspected, maintained, and reconditioned in accordance with the specifications; the process review has been completed; and the process has been optimized.

The objective in Step 4 is to compare the baseline data to operating data collected later to determine what effect (positive or negative) adjustments to the system have had on the overall performance of the precipitator. After the changes affecting precipitator performance have been determined, positive steps can be taken to improve performance and reduce emissions.

The performance of the precipitator can be improved by:

- Changing product variables (quantity and characteristics)
- Improving gas and dust distribution
- Retrofitting state-of-the-art automatic voltage controls (microcomputer controls sensing secondary voltage spark detection, semi-pulse ener gization, multiple mode operation)
- Optimizing the rapper timing intensity and sequence
- Substituting power off rapping or reduced power rapping with standard rapping
- Installing precipitator management control system (supervisory control)
- Additional field sectionalization (additional bus sections)
- Installation of performance enhancement equipment, such as an injection/conditioning system using ammonia and/or SO_3.

Achieving the best performance from the electrostatic precipitator requires maintaining the mechanical and electrical components, tuning the process, and observing what changes had the most significant effect on precipitator performance. Using this knowledge and taking positive, proactive steps will result in a well-maintained precipitator that has reliable and consistent performance. In addition, the results of a performance evaluation program can be used to develop future plans for maintenance and upgrade alternatives. TJ

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