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A SURVEY OF EROSION AND CORROSION RESISTANT MATERIALS BEING USED ON BOILER TUBES IN WASTE TO ENERGY BOILERS

Randall Dooley¹, Eric Wiertel²

¹ Sales Engineer, Kennametal Conforma Clad, New Albany, IN USA

² Plant Maintenance Manager, Montenay York Resource Energy, York, PA USA

ABSTRACT

Waste-to-Energy boilers, including mass-fired, RDF-fired, and biomass-fired boilers, produce very corrosive and erosive environments which can significantly reduce the life of furnace, super heater, boiler, and in-bed tubes. Combustion products from municipal waste refuse are very corrosive. This corrosion is typically caused by chloride compounds which deposit on the furnace, superheater, and boiler tubes. Due to high flue gas velocities and soot blowing required to remove ash and slag deposits, and BFB media, these tubes are also subject to substantial erosion. Since 2000, Inconel weld overlays have been used for corrosion and erosion protection on boiler tubes. During this period, many other materials have also been tested in waste-to-energy boilers with mixed results.

This paper will provide an overview of the materials that have been tested on in-bed, furnace, superheater, and boiler tubes in waste-to-energy boilers. The test results will be based on laboratory analysis used to evaluate these corrosion and erosion protection solutions. In addition, field results will be reviewed from various waste-to-energy sites to support the laboratory analysis.

INTRODUCTION

Waste-to-Energy (WTE) plants are being asked to extend times between major planned boiler outages. The superheater, boiler, and furnace tubes of coal-fired power plants are primarily subject to fly ash and sootblower erosion. WTE boiler tubes see this type of erosion but have an added wear component of excessive corrosion. This corrosion is caused by the chlorides formed from the burning of waste. There are theories being evaluated that state that the overall wear rate is compounded when you have both corrosion and erosion occurring at the same time.

This paper will present laboratory data and field data that show the overall wear resistance of various materials being used to protect WTE boiler tubes.

EROSION

Erosion is caused by the impact, cutting action, or abrasive wear of small solid particles freely immersed in the direction of fluid flow that frequently undercut portions of the material they strike [1]. Erosion is the progressive loss of original material from a solid surface due to mechanical interaction between that surface and the impinging fluid or solid particles [2].

If high erosion-resistant particles such as tungsten carbide exist in low erosion resistant or soft matrix, the impacting particles can undercut and remove portions of the material (Figure 1). However, if the high erosion resistant particles are densely packed in a matrix material that causes the impacting particles to impinge on a greater percent of the hard particle, the erosion resistance increases dramatically (Figure 2).

When evaluating the relative erosion resistance of materials, a number of factors must be considered. The obvious factors are temperature, velocity of the impacting particles, their size and shape and the impacting or impinging angle. These factors can be controlled in standardized testing but combining their range of variability to comprehensively evaluate performance is limited.

Standardized testing procedures, such as ASTM G76 Figure 3, reduce a number of the variables with the intent of providing a common baseline for comparison. This test method utilizes a repeated impact erosion approach involving a small nozzle delivering a stream of gas containing abrasive particles which impact the surface of the test specimen. A standard set of test conditions is described. However, deviations from some of the standard conditions are permitted if described thoroughly. These test methods can be used to rank the erosion resistance of materials under the specified conditions.