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### LAB-SCALE STUDY ON FIRESIDE SUPERHEATERS CORROSION IN MSWI PLANTS

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#### ABSTRACT

Combustion of the municipal waste generates highly corrosive gases (HCl, SO<sub>2</sub>, NaCl, KCl and heavy metals chlorides) and ashes containing alkaline chlorides and sulphates. Currently, corrosion phenomena are particularly observed on superheater's tubes. Corrosion rates depend mainly on installation design, operating conditions i.e. gas and steam temperature and velocity of the flue gas containing ashes. This paper presents the results obtained using an innovative laboratory-scale corrosion pilot, which simulates MSWI boilers conditions characterized by a temperature gradient at metal tube on the presence of corrosive gases and ashes. The presented corrosion tests were realized on carbon steel at fixed metal temperature (400°C). The influence of the flue gas temperature, synthetic ashes composition and flue gas flow pattern were investigated. After corrosion test, cross section of tube samples were characterised to evaluate thickness loss and estimate corrosion rate while the elements present in corrosion layers were analysed.

Corrosion tests were carried out twice in order to validate the accuracy and reproducibility of results. First results highlight the key role of molten phase related to the ash composition and flue gas temperature as well as the deposit morphology, related to the flue gas flow pattern, on the mechanisms and corrosion rates.

**Keywords :** Waste-to-Energy boiler, fireside corrosion, temperature gradient, velocity of flue gas

#### INTRODUCTION

The recent revision of the European Waste Framework Directive paved the way by setting ambitious policy targets of 60% recycling and 40% energy recovery by 2020. More precisely, high energy efficiency thresholds have been fixed to classify MSWI plants as energy recovery facilities (Directive 2008/98/EC). Consequently, the EU encourages the Waste-to-Energy industry to play an essential role in both sustainable energy supply and environmentally sound waste management. In municipal solid waste incineration (MSWI) facilities, options for increasing the energy recovery efficiency consist to:

- i) promote, when it is possible, combined heat and power (CHP) generation instead of condensing power generation,
- ii) reduce boiler loss,
- iii) optimise the water/steam process.

This last case implies higher steam pressure and temperature to increase electrical efficiency. An increase of steam temperature, entering into a condensing turbine, from 400°C to 500°C lead to an increase of 20% of power generated. Nevertheless, combustion of waste with high chlorine and alkali content generate highly corrosive gases and ashes [1, 2, 3]. Fireside corrosion mechanisms of heat exchanger tubes includes simultaneously :

- corrosion by gaseous phase including "active oxidation" by chlorine (HCl, Cl<sub>2</sub>) [4,5],
- condensation of alkali and heavy metals chloride and/or sulfates [6],