



High temperature corrosion of a thermowell in an incineration plant

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Abstract

The thermowell inside the post combustion chamber in an incineration plant failed due to severe high temperature oxidation. The failure was caused by deep intergranular oxidation attack and surface scaling of the component. The intergranular oxidation attack is more damaging to the material integrity. Inconel 600 was improperly used as the thermowell material due to insufficient Cr content for formation of a continuous protective Cr_2O_3 layer on the alloy surface, and the high operating temperature 950 °C nearly approaching its upper temperature limit (1000 °C). Replacement of Inconel 600 by more corrosion- and heat-resistant materials is strongly recommended.

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1. Introduction

Within 6 months of service in an incineration plant of Saudi Arabia, the thermowell (Fig. 1) suffered catastrophic high temperature damages at the top end, exposing the thermocouple to the hot service PTA slurry (purified terephthalic acid – 16% acetic acid, 0.1% Co, 0.4% Mn, 0.5% Br, 30% H_2O , 25% solids, and 28% PTA. pH: 3–3.5) and CDR wastes (closed drain wastes – acetic acid traces, 0.1% H_2O , and 99.8% organics). Consequently, the service damaged the thermocouple resulting in loss of temperature indication. The wastes are fed through the rotary kiln, burnt inside the post combustion chamber (Fig. 2), and carried away through the flue gas duct outlet (gases) and the slag conveyer (slags). The thermowell measures 525 mm (length) \times \varnothing 22 mm (OD) \times 2–3 mm (thickness), about 2.5 cm long portion of the thermowell was exposed inside the post combustion chamber. The construction material of the thermowell is Inconel 600

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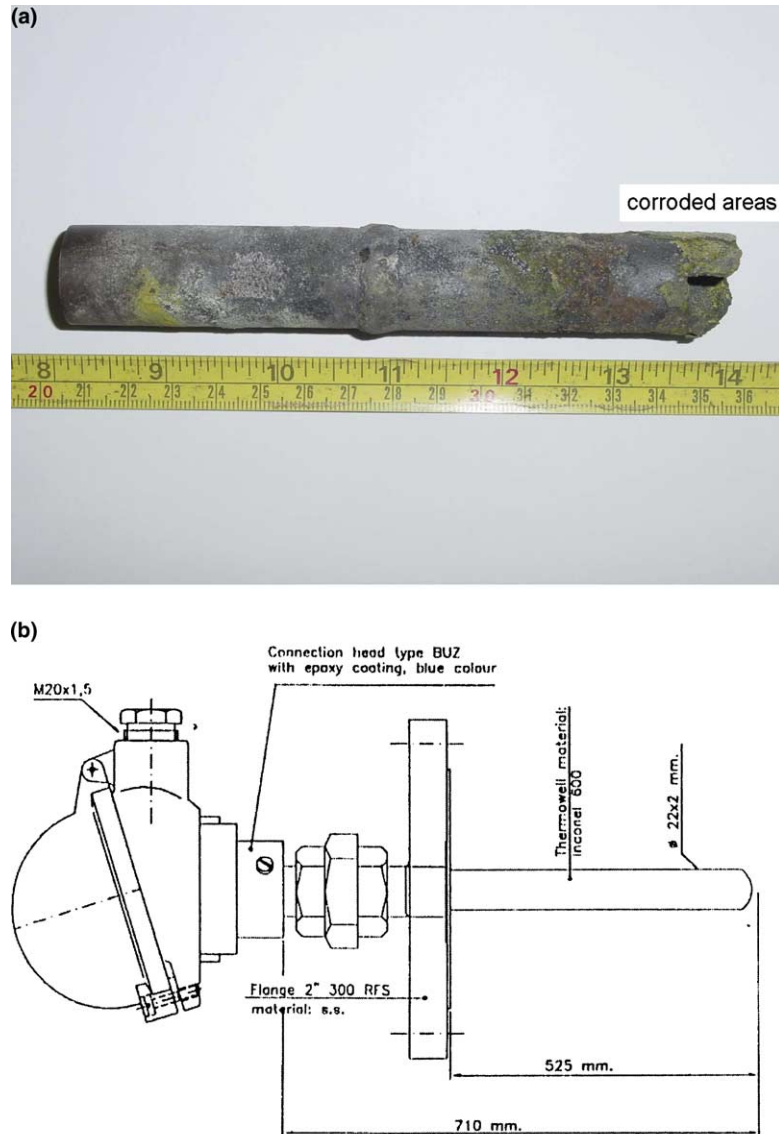


Fig. 1. (a) Photo of the failed thermowell. (b) Design specifications of the thermowell.

(Table 1). The design and operating temperatures of the incinerators are 1600 and 950 °C, respectively, at approximately one atmospheric pressure.

2. Experimental

Visual examination was carried out on the failed portion. Then, the failed thermowell was sectioned and prepared for microstructural evaluation. The etchant was Glyceregia (10 ml HNO₃, 20–50 ml HCl, and 30 ml Glycerol). Optical microscopy of etched samples along transverse cross sections was conducted. The

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