Engineering Failure Analysis 18 (2011) 1193–1202

Contents lists available at ScienceDirect

Engineering Failure Analysis

journal homepage: www.elsevier.com/locate/engfailanal

Corrosion and fatigue failure analysis of a forced draft fan blade

H. Kazempour-Liacy [a,*], M. Mehdizadeh [a], M. Akbari-Garakani [b], S. Abouali [c]

[a] Metallurgy Department, Niroo Research Institute (NRI), Tehran, Iran
[b] School of Metallurgical and Materials Engineering, University of Tehran, Tehran, Iran
[c] Department of Materials Science and Engineering, Sharif University of Tech., Tehran, Iran

ARTICLE INFO

Article history:
Received 20 November 2010
Received in revised form 8 February 2011
Accepted 19 February 2011
Available online 25 February 2011

Keywords:
FDF blade
2014-T6 Al alloy
Failure analysis
Corrosion
Fatigue

ABSTRACT

The present work was carried out to investigate the failure mechanism of a power plant forced draft fan (FDF) blade made of 2014-T6 Al alloy, using visual examination, microstructural characterizations, study of the fracture surface and hardness testing. Based on the obtained results, surface defects including corrosion pits due to the existence of Cl ion and also erosion pits due to mechanical action of particles in the air entering from the filtration system and abrading on the fan blades surfaces, increased the probability of surface crack initiation. Cyclic loading and stress concentration on these surface defects influenced the fatigue life of the blade due to elevating the mean stress and resulted in fatigue failure of the investigated FDF component.

1. Introduction and background

The failure analysis of a forced draft fan (FDF) blade of a boiler unit in a fossil power plant is presented. The investigated axial fan consists of two stages of blades which have been in service condition for about 200,000 h (according to the specifications given by the manufacturer, the expected life of these blades is 280,000 h). The fracture occurred in one of the first stage blades 40 days after the last inspection while other blades in the both stages were damaged considerably.

In general there are four main types of fans used in fossil power plants including forced draft fans, induced draft fans, primary air fans, and gas-recirculation fans. Draft fans are generally responsible for maintaining the flow of gases through the boiler. A power plant can create draft through forced draft, induced draft, balanced draft, and natural draft. The forced draft fan is placed upstream from the boiler and it applies a positive pressure to push the air and flue gases through the system [1,2]. Forced draft fans (FDF) supply the air necessary for fuel combustion by pushing the air through the combustion air supply system and into the furnace. These fans must supply enough airflow to overcome any frictional resistance and air-heater leakage problems and are typically the most efficient fans in the power plant [1]. Periodic inspections of the FDF blades and the filtration system preventing entrance of the external objects play the most important role in the maintenance of these fans.

2. Materials and experimental procedures

The investigated blades are made of 2014-T6 Al alloy and the manufacturing process includes forging and subsequently solution heat treatment and artificially aging (T6 temper). 2xxx Al-alloys are a series of wrought alloys in which copper is the principal alloying element, often with magnesium as a secondary addition. These alloys require solution heat treatment to

* Corresponding author. Tel.: +98 21 88094320; fax: +98 21 888364620.
E-mail address: hkazempour@nri.ac.ir (H. Kazempour-Liacy).

1350-6307/$ - see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.engfailanal.2011.02.014