Case Studies in Engineering Failure Analysis 3 (2015) 34–38

Contents lists available at ScienceDirect

Case Studies in Engineering Failure Analysis

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

Failure analysis of the pulleys during the press-fit assembling process

Eva Zdravecká [a,*], Miroslav Ondáč [a], Jana Tkáčová [a], Marek Vojtko [b], Ján Slota [a]

[a] Technical University of Košice, Faculty of Mechanical Engineering, Letná 9, 042 00 Košice, Slovak Republic
[b] Technical University of Košice, Faculty of Metallurgy, Letná 9, 042 00 Košice, Slovak Republic

ARTICLE INFO

Article history:
Received 24 October 2014
Received in revised form 20 November 2014
Accepted 21 November 2014
Available online 23 December 2014

Keywords:
Failure
Inclusions
Elongated sulphides
Production process

ABSTRACT

The present article highlights failure investigation of the pulleys during a press-fit assembling process. Pulleys are used to transmit power between rotational mechanical elements. Failure analysis was performed by metallographic evaluation using light microscopy, SEM and EDX, and chemical analyses. It was found that cooperative influence of higher carbon content with combination of elongated sulphides is reason for pulleys cracking. Steel cleanliness and homogeneous structure is an important factor for users of steel. The success of production process is connected with the optimal quality of steel.

1. Introduction

The press-fit process is used to assemble pieces in mechanical systems. Defects may be produced during the processing, fabrication and use of metals in service. Some of these defects result from complex metallurgical, chemical and physical reactions that metals undergo during these processing operations. Many publications deal with the difficulty of damage during manufacturing or service processes [1,2]. Consequently, the analyses of the damaged parts aimed to establish the technical facts surrounding the failure are carried out. It is therefore necessary to carry out experiments to understand this complicated behaviour.

One of the ways to investigate the effect of microstructure and inclusions on damaged materials is to prepare test specimens containing non-metallic inclusions whose shape, size, location, and chemical composition are metallurgically controlled. However, this is found to be difficult [3,4]. Problems of non-metallic inclusions have attracted great attention of both producers and users of steel [5]. These inclusions can reduce the toughness, ductility and fatigue strength [6,7]. Inclusions are major contributors to mechanical anisotropy in steels. It is not practically possible or commercially feasible to always avoid these defects. The pulleys were installed on the shafts to transmit power between rotational mechanical elements in continual assembling process. Due to the large number of collapsed pulleys produced it was essential to find the reason for material cracking. This article focuses on determination of the cause of failure using metallographic examination by light microscopy, SEM and EDX analyses and chemical evaluation.

* Corresponding author at: Technical University of Košice, Faculty of Mechanical Engineering, Mäsiarska 74, Košice, Slovak Republic. Tel.: +421 602 3516.
E-mail addresses: eva.zdravecka@tuke.sk (E. Zdravecká), miroslav.ondac@tuke.sk (M. Ondáč), jana.tkacova@tuke.sk (J. Tkáčová), marek.vojtko@tuke.sk (M. Vojtko), jan.slota@tuke.sk (J. Slota).

http://dx.doi.org/10.1016/j.csefa.2014.11.002

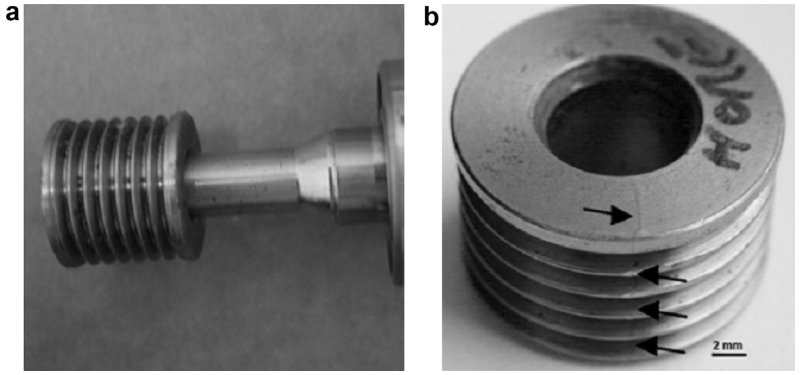

Fig. 1. (a) Assembled pulley on shaft and (b) fracture of pulley.

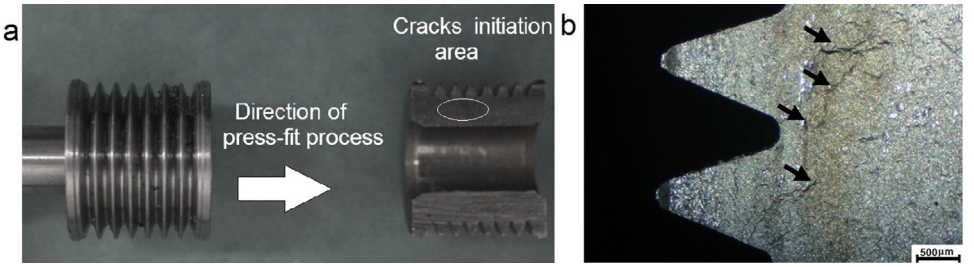

Fig. 2. Pulley (a) the cracks initiation area and (b) detailed view on the network of cracks.

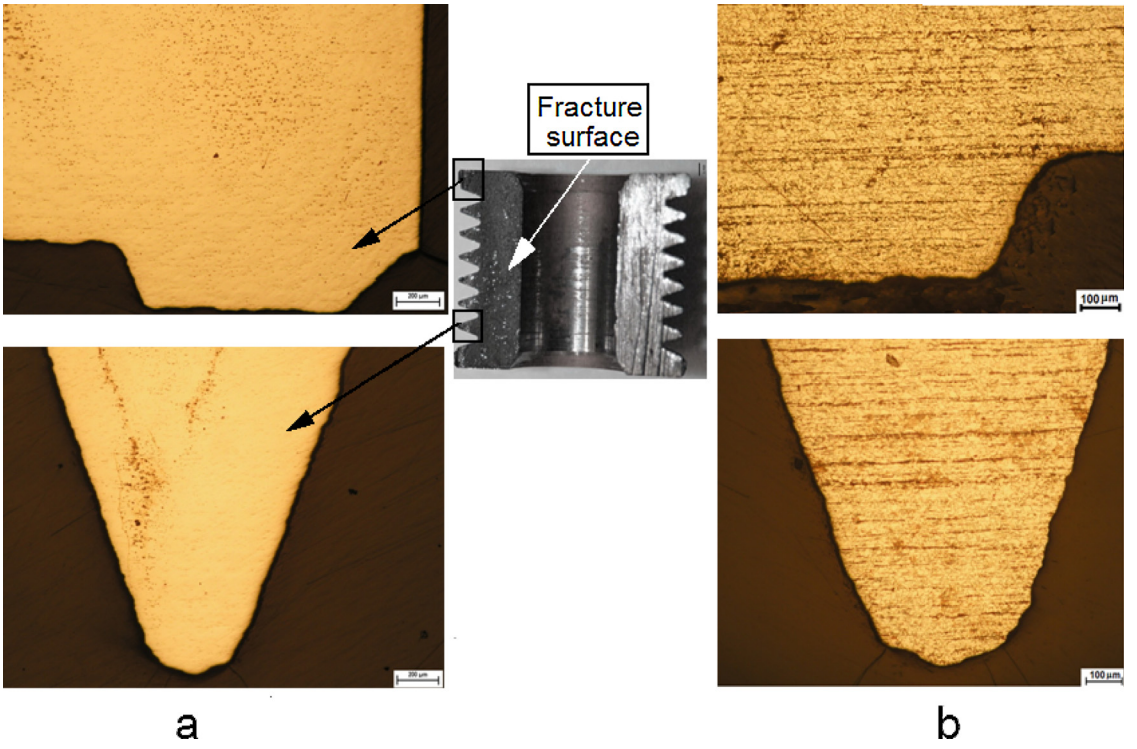

Fig. 3. Microstructure of cross section of material 2 (a) unetched and (b) etched.