



Available online at www.sciencedirect.com

SCIENCE @ DIRECT®

Engineering Failure Analysis 12 (2005) 400–404

**ENGINEERING
FAILURE
ANALYSIS**

www.elsevier.com/locate/engfailanal

Failure of a rotary tiller spur gear

Ibrahim Akinci *, Deniz Yilmaz, Murad Çanakci

Department of Agricultural Machinery, Faculty of Agriculture, University of Akdeniz, 07070 Antalya, Turkey

Received 8 April 2004; accepted 10 April 2004

Available online 4 January 2005

Abstract

This paper analyzes the failure of a transmission gear in a rotary tiller. The failed gear was examined, the reasons for the failure were determined and preventive methods were explained. The failure types were abrasion and plastic deformation. The reasons for the failure were design errors and material faults. Selection of the gear material was wrong (the material was not hard enough) and the tooth profile was not correct.

© 2004 Elsevier Ltd. All rights reserved.

Keywords: Gear-tooth failures; Agricultural machinery failures; Wear; Abrasive wear; Plastic deformation

1. Introduction

Failure studies have previously been carried out in the authors' institution to prevent damage in machinery parts and to develop the techniques of failure analysis [1–3]. In soil tillage implements, the rotary tiller is one of the main machines in minimum tillage farming. The machine is driven by tractor Power Take Off (PTO) shaft line. It is especially used in field, fruit and greenhouse agriculture. The rotary tiller is used to mix the topsoil layer and to prepare the seedbed preparation directly. In field works, it is operated under heavy loads and vibration. These effects can cause some problems such as breakdowns, failures etc. Most failures occurred in gear systems [4]. In this study, the failure types and failure reasons were explained and a sample failure that occurred in the transmission gear of a rotary tiller was examined. Its construction system, material features and working conditions were investigated and analyzed. Failure reasons were determined and preventive methods explained.

* Corresponding author.

E-mail address: iakinci@akdeniz.edu.tr (I. Akinci).

2. Failure types and reasons

2.1. Failure types

Failure types are fracture, surface fatigue, abrasion and plastic deformation in gear mechanisms [5]. Fracture damage results from surface fatigue, high loads or abrasions. Surface fatigue results from tensile stress, compression stress and sliding stress under the gear surface. Abrasion damage is defined as loss of material at touching gear surfaces.

2.2. Failure reasons

Failure reasons are faults of usage, heat treatment, design, manufacture and material [5]. Usage faults are caused by incautious operation and insufficient technical knowledge. These faults can cause important damage in machinery. Design faults include incorrect shape, dimensional errors, bearing faults, selection of wrong material and insufficient technical knowledge. In studies of gear design, usually a dimensional error has been made and or the wrong material has been selected. In research on gear failure types and reasons, 931 gears were investigated during 35 years [5]. Results show that the failure types were fractures of 571 gears, fatigue of 188 gears, abrasion of 122 gears and plastic deformation of 50 gears. The most encountered failure is fracture (61.2%) and the least is plastic deformation (5.3%) (Table 1).

The failure reasons were determined as usage faults of 696 gears, heat treatment faults of 151 gears, design faults of 64 gears, manufacturing faults of 13 gears, material faults of 7 gears. Consequently, the most encountered failure is usage fault (74.7%) and the least one is material fault (0.8%) (Table 2).

Table 1
Failure types

Failure type	Gear	
	Number	%
Fracture	571	61.2
Surface fatigue	188	20.3
Abrasion	122	13.2
Plastic deformation	50	5.3
Total	931	100

Table 2
Failure reasons

Failure reason	Gear	
	Number	%
Usage faults	696	74.7
Heat treatment faults	151	16.2
Design faults	64	6.9
Manufacturing faults	13	1.4
Material faults	7	0.8
Total	931	100

Download English Version:

<https://daneshyari.com/en/article/10415326>

Download Persian Version:

<https://daneshyari.com/article/10415326>

[Daneshyari.com](https://daneshyari.com)