



بسم الله الرحمن الرحيم

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Cairo University

FIRE DAMAGE ASSESSMENT VIA LABORATORY EXPERIMENTS AND REPLICA

By

Sally Samer Sadek Oraby

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Metallurgical Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Title of Thesis:

Fire Damage Assessment via Laboratory Experiments and Replica

Key Words:

Microstructure; Replica; Simulation; Fire temperature; Cooling rates; Fire Assessment

Summary:

A Petroleum tank was exposed to a fire causing some damages at different areas. In this study, some samples were collected from this tank at different areas. Fire assessment of the fuel tank was done via laboratory experiments and replica test. Laboratory experiments were done on pieces from the tank to simulate the actual fire temperatures and cooling rates. Four different temperatures were used for testing process which are 1000, 850, 738 and 700° C for heating and cooling in furnace, air and water in each case. The results showed the suitability of fire assessment via comparisons of the in-situ replica and the laboratory specimens.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

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Signature:

Dedication

This thesis work is dedicated to my family, whom have been always a support during the challenges of graduation and life. I am truly thankful for having them in my life. This work is also dedicated to my father, who passed away. He gone forever away from our loving eyes and who left a big void never to be filled in our lives.

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Nomenclature

A1: Replica area 1 in the subject plate
AISI: American Iron and Steel Institute
API: American Petroleum Institute
ASME: American Society of Mechanical Engineering
ASTM: American Society for Testing and Materials
bcc: Body-centered cubic structure
C4: Shell course 4 in the subject tank
EPMA: Electron probe microanalyzer
fcc: Face-centered cubic structure
FFS: Fitness-for-Service
hcp: Hexagonal close-packed structure
HSLA: High Strength Low Alloy
MAWP: Maximum Allowable Working Pressure
NDE: Nondestructive Evaluation
P1: Plate 1 in the subject tank
SAE: Society of Automotive Engineers
SEM: Scanning electron microscope
STEM: Scanning transmission electron microscope
UNS: Unified Numbering System

Abstract

In this study, Fire assessment of a fuel tank was done via laboratory experiments and replica test. Laboratory experiments were done on pieces from the tank to simulate the actual fire temperatures and cooling rates. Twelve pieces from the tank were used for the investigations. The samples are subjected to four different temperatures of 1000, 850, 738 and 700 °C were tested and cooled in furnace, air and water in each case. All samples after the heating at each of the above-mentioned temperatures and cooling in furnace, air and water were polished to study the microstructure and the hardness. The results showed the suitability of fire assessment via comparisons of the in-situ replica and the laboratory specimens. The results showed that the laboratory and replica microstructures showed no difference or heat damages at 700 °C temperature and cooling conditions in air.