

Remnant life prediction of service-exposed 12Cr1MoV superheater tube in power plant

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Keywords: 12Cr1MoV steel; Larson-miller equation, piping in boiler; remnant life

Abstract. Tensile test at ambient temperature, tensile test at high temperature and high temperature tensile creep test were carried out before remnant life prediction. According to the high temperature tensile creep test data, the relationship between working stress, working temperature and rupture life was obtained by MATLAB surface fitting tool. In order to obtain the temperature field and stress field of the superheater tube, ANSYS software was used. Then, the remnant life of the superheater tube was predicted by the extrapolating method and the relationship between working stress, working temperature and rupture life.

Introduction

How to prolong the life of power equipment[1-3] and ensure its normal operation has become an important problem concerned by power field. At the present time, many achievements[4, 5], which have a high value of practical application, have been acquired in the fields of equipment life management and prediction, and equipment condition monitoring and fault diagnosis.

Presently, the methods[6, 7] for remnant life prediction of service-exposed boiler tube can be divided into the following types. The first type is periodic measurement of boiler tube diameter, wall thickness and etc. The second type is based on working temperature, working stress and Robinson rule. The third type is based on the changes of distribution of eutectic carbide and secondary carbide as time goes on. The fourth type is based on high temperature tensile creep test and Larson-miller equation. The fifth type is based on low cycle fatigue test. The sixth type is based on the changes of density and voids. All the methods need to take a lot time. To acquire more reliable result, it is necessary to simultaneously use two or more methods to confirm with each other.

In the paper, we use the finite element software ANSYS to analyze the temperature field and stress field of the 12Cr1MoV, and get the maximum working stress. Based on Larson-miller equation and MATLAB[8] surface fitting tool, the remnant life of the service-exposed 12Cr1MoV superheater tube was predicted.

Experimental details

These experiments include two parts: (1) tensile test at ambient temperature and tensile test at high temperature, (2) high temperature tensile creep tests.

The chemical composition of the experimental material 12Cr1MoV steel was shown in Table 1. The mechanical properties and physical properties were respectively shown in Table 2 and Table 3.

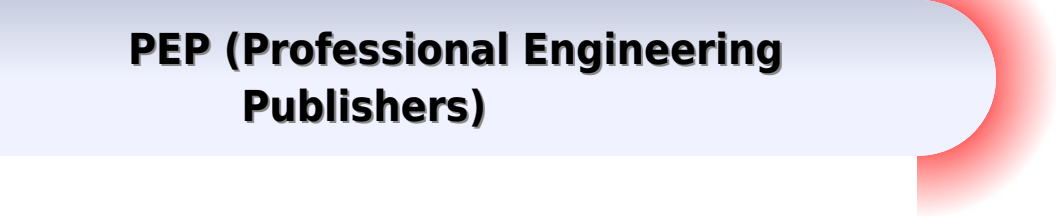
Table 1 Chemical composition of 12Cr1MoV steel

Element	C	Si	Mn	Cr	Mo	V	P	S
Test sample	0.12	0.19	0.60	1.04	0.28	0.18	0.018	0.008
GB 5310-2008	0.08-0.15	0.17-0.37	0.40-0.70	0.9-1.2	0.25-0.35	0.15-0.30	<0.025	<0.01

The test samples were made according to Chinese standard GB/T 2039-1997. The procedure of tensile test at ambient temperature was based on Chinese standard GB/T 228.1-2010. The procedure of tensile test at high temperature was based on Chinese standard GB/T 4338-2006. The tensile test and creep test (Table 4) at high temperature were carried on CSS-3905 electronic high temperature creep testing machine.

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Changhua Hu,Hongdong Fan,Zhaoqiang Wang,2021-07-30 This book addresses remaining life prediction and predictive maintenance of equipment It systematically summarizes the key research findings made by the author and his team and focuses on how to create equipment performance degradation and residual life prediction models based on the performance monitoring data produced by currently used and historical equipment Some of the theoretical results covered here have been used to make remaining life predictions and maintenance related decisions for aerospace products such as gyros and platforms Given its scope the book offers a valuable reference guide for those pursuing theoretical or applied research in the areas of fault diagnosis and fault tolerant control remaining life prediction and maintenance decision making

Condition-Based Maintenance and Residual Life Prediction Chandan Deep Singh,Davinder Singh,Kanwal Jit Singh,Harleen Kaur,2025-03-10 Condition Based Maintenance and Residual Life Prediction is essential for those looking to effectively implement condition based maintenance strategies and enhance fault detection through a comprehensive understanding of vibration data analysis and residual life prediction addressing key challenges in the field Issues related to

condition based maintenance include its high initial cost new techniques that can be difficult to implement due to resistance older equipment that can be difficult to retrofit with sensors and monitoring equipment and difficult to access equipment during production that is difficult to spot measure Keeping the above issues in mind a general handbook for condition based maintenance and residual life prediction is required to carry out in fault detection Condition Based Maintenance and Residual Life Prediction aims to develop analyze and model condition based maintenance and residual life prediction through vibration data The analysis of vibration responses will aid in developing a fault detection system The sources of vibration may be due to the presence of different types of defects such as cracks in the shaft a bent shaft or misalignment of shafts This will give designers a diagnostic tool for predicting the trends of vibration conditions leading to early fault detection The devised tool will be capable of quantifying the amplitude of vibration based on the severity of defects With the features available in the devised diagnostic tool the proposed model can be used for design predictive maintenance and condition based maintenance

Filter-Based Fault Diagnosis and Remaining Useful Life Prediction Yong Zhang,Zidong Wang,Ye Yuan,2023-02-10 This book unifies existing and emerging concepts concerning state estimation fault detection fault isolation and fault estimation on industrial systems with an emphasis on a variety of network induced phenomena fault diagnosis and remaining useful life for industrial equipment It covers state estimation monitor fault diagnosis and remaining useful life prediction by drawing on the conventional theories of systems science signal processing and machine learning Features Unifies existing and emerging concepts concerning robust filtering and fault diagnosis with an emphasis on a variety of network induced complexities Explains theories techniques and applications of state estimation as well as fault diagnosis from an engineering oriented perspective Provides a series of latest results in robust stochastic filtering multirate sample and time varying system Captures diagnosis fault detection fault isolation and fault estimation for time varying multi rate systems Includes simulation examples in each chapter to reflect the engineering practice This book aims at graduate students professionals and researchers in control science and application system analysis artificial intelligence and fault diagnosis

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Recent Advances in Industrial and Systems Engineering S. G. Ponnambalam, Purushothaman Damodaran, Nachiappan Subramanian, J. Paulo Davim, 2024-08-26 This book presents select proceedings of the International Conference on Recent Advances in Industrial and Systems Engineering RAISE 2023 It covers the latest research in the areas of industrial and systems engineering including manufacturing supply chain digitalization resilience and sustainability Various topics covered in this book are additive manufacturing artificial intelligence modeling and simulation production planning and management digital manufacturing and many more This book is useful for researchers and professionals working in the areas of industrial and production engineering supply chain management quality control and allied fields

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infrastructure management etc The essays are written by leading international experts making it a valuable resource for researchers and practicing engineers alike *Data Science in Engineering, Volume 9* Ramin Madarshahian, Francois Hemez, 2025-08-08 Data Science and Engineering Volume 9 Proceedings of the 39th IMAC A Conference and Exposition on Structural Dynamics 2021 the ninth volume of nine from the Conference brings together contributions to this important area of research and engineering The collection presents early findings and case studies on fundamental and applied aspects of Data Science in Engineering including papers on Data Science in Engineering Applications Engineering Mathematics Computational Methods in Engineering **International Conference on Electronics and Electrical Engineering**, 2014-07-24 All papers including in this proceedings had undergone the strict peer review by the experts before they are accepted for publications This proceeding covers the subjects of analog circuits and digital circuits assembly and packaging biomedical circuits computer architecture computer engineering control engineering electric power system and automation energy and power systems instrumentation engineering signal processing and other related areas We hope this proceeding will contribute in stimulating debate and research among scholars researchers and academicians CEEE 2014 is to provide a forum for researchers academicians engineers and government officials from all over the world to involved in the general areas of Electronics and Electrical Engineering to disseminate their latest research results and exchange views on the future research directions of these fields This conference provides opportunities for the participants to exchange new ideas and application experiences face to face Big Data and Social Computing Xiaofeng Meng, Lizhen Wang, Hongmei Chen, Hao Chen, Shuai Xu, Xiu-Xiu Zhan, 2025-08-11 This book constitutes the refereed proceedings of the 10th China National Conference on Big Data and Social Computing BDSC 2025 held in Kunming China during August 15 17 2025 The 40 full papers included in this book were carefully reviewed and selected from 140 submissions They were organized in topical sections as follows Digital Society Construction and Governance Modelling and Simulation of Social Systems Internet Intelligent Algorithm Governance Social Network and Group Behavior Innovation Risks and Security of Large Language Models Artificial Intelligence and Cognitive Science Applications of Large Language Models in Societal Contexts and Social Geography and Urban Computing **Comprehensive Structural Integrity** Ian Milne, R. O. Ritchie, B.L. Karihaloo, 2003-07-25 The aim of this major reference work is to provide a first point of entry to the literature for the researchers in any field relating to structural integrity in the form of a definitive research reference tool which links the various sub disciplines that comprise the whole of structural integrity Special emphasis will be given to the interaction between mechanics and materials and structural integrity applications Because of the interdisciplinary and applied nature of the work it will be of interest to mechanical engineers and materials scientists from both academic and industrial backgrounds including bioengineering interface engineering and nanotechnology The scope of this work encompasses but is not restricted to fracture mechanics fatigue creep materials dynamics environmental degradation numerical methods failure

mechanisms and damage mechanics interfacial fracture and nano technology structural analysis surface behaviour and heart valves The structures under consideration include pressure vessels and piping off shore structures gas installations and pipelines chemical plants aircraft railways bridges plates and shells electronic circuits interfaces nanotechnology artificial organs biomaterial prostheses cast structures mining and more Case studies will form an integral part of the work

Engineering Asset Management Dimitris Kiritsis, Christos Emmanouilidis, Andy Koronios, Joseph Mathew, 2011-02-03 Engineering Asset Management discusses state of the art trends and developments in the emerging field of engineering asset management as presented at the Fourth World Congress on Engineering Asset Management WCEAM It is an excellent reference for practitioners researchers and students in the multidisciplinary field of asset management covering such topics as asset condition monitoring and intelligent maintenance asset data warehousing data mining and fusion asset performance and level of service models design and life cycle integrity of physical assets deterioration and preservation models for assets education and training in asset management engineering standards in asset management fault diagnosis and prognostics financial analysis methods for physical assets human dimensions in integrated asset management information quality management information systems and knowledge management intelligent sensors and devices maintenance strategies in asset management optimisation decisions in asset management risk management in asset management strategic asset management and sustainability in asset management

Advances in Materials Technology for Fossil Power Plants, 2011-01-01 *Asset Condition, Information Systems and Decision Models* Joe E. Amadi-Echendu, Kerry Brown, Roger Willett, Joseph Mathew, 2012-11-05 Asset Condition Information Systems and Decision Models is the second volume of the Engineering Asset Management Review Series The manuscripts provide examples of implementations of asset information systems as well as some practical applications of condition data for diagnostics and prognostics The increasing trend is towards prognostics rather than diagnostics hence the need for assessment and decision models that promote the conversion of condition data into prognostic information to improve life cycle planning for engineered assets The research papers included here serve to support the on going development of Condition Monitoring standards This volume comprises selected papers from the 1st 2nd and 3rd World Congresses on Engineering Asset Management which were convened under the auspices of ISEAM in collaboration with a number of organisations including CIEAM Australia Asset Management Council Australia BINDT UK and Chinese Academy of Sciences Beijing University of Chemical Technology China Asset Condition Information Systems and Decision Models will be of particular interest to finance maintenance and operations personnel whose roles directly affect the capability value of engineering asset base as well as asset managers in both industry and government

Bridge Maintenance, Safety, Management, Digitalization and Sustainability Jens Sandager Jensen, Dan M. Frangopol, Jacob Wittrup Schmidt, 2024-07-12 Bridge Maintenance Safety Management Digitalization and Sustainability collects the lectures and technical papers presented at the 12th International Conference on Bridge Maintenance Safety and

Management IABMAS 2024 Copenhagen Denmark 24-28 June 2024 This Open Access book contains 480 contributions including the T Y Lin Lecture 9 Keynote Lectures and 470 technical papers from 44 countries The contributions are presented bring together academic and technological developments in Bridge Maintenance Safety Management Digitalization and Sustainability to solve new and old problems with innovative solutions Major topics include advanced bridge design construction and maintenance approaches safety reliability and risk evaluation life cycle management life cycle resilience sustainability standardization analytical models bridge management systems service life prediction structural health monitoring non destructive testing and field testing robustness and redundancy durability enhancement repair and rehabilitation fatigue and corrosion extreme loads needs of bridge owners whole life costing and investment for the future financial planning and application of information and computer technology extensive data analysis and artificial intelligence for bridges among others Bridge Maintenance Safety Management Digitalization and Sustainability provides an up to date overview of the field of bridge engineering and significant contributions to making more rational decisions on bridge safety maintenance management life cycle resilience sustainability and bridge innovations to enhance society's welfare The Editors hope that this book will serve as a valuable reference to all concerned with bridge structure and infrastructure systems including engineers researchers academics and students from all areas of bridge engineering

Advances in Clean Energy and Sustainability, Volume 1 Sankara Sarma V. Tatiparti, Srinivas Seethamraju, 2024-10-02 This book presents the proceedings of the 9th edition of the International Conference on Advances in Energy Research ICAER 2023 and delves into the research trends of energy systems in terms of generation storage and distribution so they can become more sustainable in the future The topics covered include conventional non conventional and renewable energy technologies energy storage and conversion energy policy energy economics energy efficiency and management electric vehicles and smart grids and the social and environmental aspects of energy The topics presented in the book are a combination of experimental and modeling studies which include simulation design and optimization of the systems This proceedings volume is a compendium of the latest advances in energy research for scientific researchers policymakers academicians and industry experts It is also expected to benefit economists rural activists and social scientists among others

Data Information in Online Environments Weng Yu, Liu Xuan, 2025-09-30 This book constitutes the refereed proceedings of the 5th International Conference on Data and Information in Online DIONE 2024 held in Sanya China during November 1-3 2024 The 34 full papers were presented in this volume were carefully reviewed and selected from 99 submissions They focus on Machine Learning and Artificial Intelligence Optimization and Intelligent Systems Privacy Security and Risk Management Emerging Applications and Interdisciplinary Research

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