

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

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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.

Remnant Life Prediction

**Dimitris Kiritsis, Christos
Emmanouilidis, Andy Koronios, Joseph
Mathew**

Remnant Life Prediction:

Intelligent Fault Diagnosis and Remaining Useful Life Prediction of Rotating Machinery Yaguo Lei, 2016-11-02

Intelligent Fault Diagnosis and Remaining Useful Life Prediction of Rotating Machinery provides a comprehensive introduction of intelligent fault diagnosis and RUL prediction based on the current achievements of the author's research group. The main contents include multi-domain signal processing and feature extraction, intelligent diagnosis models, clustering algorithms, hybrid intelligent diagnosis strategies, and RUL prediction approaches, etc. This book presents fundamental theories and advanced methods of identifying the occurrence locations and degrees of faults and also includes information on how to predict the RUL of rotating machinery. Besides experimental demonstrations, many application cases are presented and illustrated to test the methods mentioned in the book. This valuable reference provides an essential guide on machinery fault diagnosis that helps readers understand basic concepts and fundamental theories. Academic researchers with mechanical engineering or computer science backgrounds and engineers or practitioners who are in charge of machine safety operation and maintenance will find this book very useful. Provides a detailed background and roadmap of intelligent diagnosis and RUL prediction of rotating machinery involving fault mechanisms, vibration characteristics, health indicators, and diagnosis and prognostics. Presents basic theories, advanced methods, and the latest contributions in the field of intelligent fault diagnosis and RUL prediction. Includes numerous application cases, and the methods, algorithms, and models introduced in the book are demonstrated by industrial experiences.

Residual Life Prediction and Optimal Maintenance Decision for a Piece of Equipment 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.

Remanent Life Prediction PEP (Professional Engineering Publishers), 1998-03-13. The need to repair or replace structural components can lead to considerable expense if the plant has to be taken out of service whilst these operations are carried out. This text discusses methodologies which accurately and safely predict the remaining life of components.

Condition-Based Maintenance and Residual Life Prediction Chandan Deep Singh, Davinder Singh, Kanwaljit 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

Engineering Asset Management and Infrastructure Sustainability Joseph Mathew,Lin Ma,Andy Tan,Margot Weijnen,Jay Lee,2012-05-11 Engineering Asset Management 2010 represents state of the art trends and developments in the emerging field of engineering asset management as presented at the Fifth World Congress on Engineering Asset Management WCEAM The proceedings of the WCEAM 2010 is an excellent reference for practitioners researchers and students in the multidisciplinary field of asset management covering topics such 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 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 Sustainability in asset management

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 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 **Proceedings of Innovative**

Computing 2024, Vol. 3 Yan Pei, Hao Shang Ma, Yu-Wei Chan, Hwa-Young Jeong, 2024-06-25 This book comprises select proceedings of the 7th International Conference on Innovative Computing which was held in Taichung City Taiwan Jan 23 26 2024 IC 2024 focusing on cutting edge research carried out in the areas of information technology science and engineering Some of the themes covered in this book are cloud communications and networking high performance computing architecture for secure and interactive IoT satellite communication wearable network and system infrastructure management etc The essays are written by leading international experts making it a valuable resource for researchers and practicing engineers alike **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

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 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

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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*

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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

Advanced Intelligent Computing Technology and Applications De-Shuang Huang,Yijie Pan,Wei Chen,Bo Li,2025-07-21 This 20 volume set LNCS 15842 15861 constitutes in conjunction with the 4 volume set LNAI 15862 15865 and the 4 volume set LNBI 15866 15869 the refereed proceedings of the 21st International Conference on Intelligent Computing ICIC 2025 held in Ningbo China during July 26 29 2025 The total of 1206 regular papers were carefully reviewed and selected from 4032 submissions This year the conference concentrated mainly on the theories and methodologies as well as the emerging applications of intelligent computing Its aim was to unify the picture of contemporary intelligent computing techniques as an integral concept that highlights the trends in advanced computational intelligence and bridges theoretical research with applications Therefore the theme for this conference was Advanced Intelligent Computing Technology and Applications

Digital Protective Schemes for Power Transformer Dharmesh Patel,Nilesh Chothani,2020-07-11 This book provides a comprehensive overview of protection schemes used for power transformers and describes the internal fault conditions and external abnormalities that may disrupt the operation of a power transformer It also highlights the issues of current protective schemes which pose several challenges in terms of the detection of internal faults and abnormalities including computational burden reduced accuracy difficulty to implement increased cost computational complexity impermeability to high resistance faults HRF and malfunction in conditions like cross country fault To address these problems the book develops an effective novel transformer protection scheme that can eliminate all the said difficulties using an innovative algorithm Given its scope it is a useful resource for researchers and practitioners working in the field of power system protection allowing them to design novel protection schemes and providing insights into the hardware validation of developed technique

Proceedings of the 3rd International Conference on Internet of Things, Communication and Intelligent Technology Jian Dong,Long Zhang,Tongxing Zheng,2025-08-18 As the Internet of Things IoT continues to evolve and integrate more deeply into various industries the IoTCIT 2024 conference is emerging as a critical platform for sharing insights and advancements in IoT and its symbiotic technologies This year we are broadening our horizons to include sophisticated communication systems IoT applications and the burgeoning field of intelligent technologies The proceedings will feature a robust selection of papers spotlighting the latest developments in both fundamental and applied aspects of communications From the intricacies of communication signal processing to the frontiers of next generation 6G mobile

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