

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

Weng Yu,Liu Xuan



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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. **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. *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.

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

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 Hazards XVI, 2001 **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 **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 communications and the critical role of smart grid and power line communication systems attendees will gain a comprehensive understanding of the current state and future directions of communication technologies This exploration will not only cover traditional wired and wireless communications but will also extend to emerging domains such as radio frequency and microwave communications satellite communications and the pivotal area of green communication systems On the IoT front the proceedings of IoTCIT 2024 will delve into the expansive world of wireless sensor and actuator networks vehicle networks and the integration of IoT with big data among other topics As intelligent technologies transformative areas such as modeling and simulation of information systems distributed computing ubiquitous computing and cloud computing are discussed These discussions are set to cover both theoretical frameworks and practical applications aiming to bridge the

gap between academic research and industry solutions This convergence of technology and discourse will attract participants from students to professionals and researchers and provide more practical guidance and support for them This book will serve as a reference for students professionals and researchers to further understand and apply IoT and intelligent technologies

Advances in Machinery, Materials Science and Engineering Application IX M. Chen,M. Giorgetti,B. Jin,2023-11-14 New engineering materials techniques and applications are constantly being researched and developed and keeping up to speed with the latest advances is crucial for engineers if they are to successfully address the challenges they face in their work This book presents the selected proceedings of MMSE2023 the 9th International Conference on Advances in Machinery Materials Science and Engineering Applications jointly organized by the SAE Supmeca France and China University of Geosciences Wuhan and held on 22 and 23 July 2023 in Wuhan China For the past 12 years this annual conference has collated recent advances and experiences identified emerging trends and provided a platform for participants from academia and industry to exchange information and views helping to address the world s machinery and engineering challenges The book contains 4 sections mechanical engineering material science and manufacturing technology electrical engineering automation and control modeling simulation and optimization techniques in engineering and advanced engineering technologies and applications A total of 241 submissions were received for MMSE2023 of which 151 papers were selected for the conference and for publication by means of a rigorous international peer review process These papers present exciting ideas and methods that will open novel research directions for different communities Offering a current overview of the latest research and applications in machinery and materials science engineering the book will be of interest to all those working in the field

Advanced Production and Industrial Engineering R.M. Singari,P.K. Kankar,2022-11-23 Things change rapidly in the field of engineering and awareness of innovation in production techniques is essential for those working in the field if they are to utilise the best and most appropriate solutions available This book presents the proceedings of ICAPIE 22 the 7th International Conference on Advanced Production and Industrial Engineering held on 11 and 12 June 2022 in Delhi India The aim of the conference was to explore new windows for discoveries in design materials and manufacturing which have an important role in all fields of scientific growth and to provide an arena for the showcasing of advancements and research endeavours from around the world The 102 peer reviewed and revised papers in this book include a large number of technical papers with rich content describing ground breaking research from various institutes Covering a wide range of topics and promoting the contribution of production and industrial engineering and technology for a sustainable future the book will be of interest to all those working in production and industrial engineering

The Proceedings of the 19th Annual Conference of China Electrotechnical Society Qingxin Yang,Zhaohong Bie,Xu Yang,2025-01-06 This book compiles exceptional papers presented at the 19th Annual Conference of the China Electrotechnical Society CES held in Xi an China from September 20 to 22 2024 It encompasses a wide range of topics

including electrical technology power systems electromagnetic emission technology and electrical equipment The book highlights innovative solutions that integrate concepts from various disciplines making it a valuable resource for researchers engineers practitioners research students and interested readers *Proceedings of TEPEN 2022* Hao Zhang,Yongjian Ji,Tongtong Liu,Xiuquan Sun,Andrew David Ball,2023-03-03 This volume gathers the latest advances innovations and applications in the field of efficiency and performance engineering as presented by leading international researchers and engineers at the 2022 conference of the Efficiency and Performance Engineering Network TEPEN held in Beijing and Baotou China on August 18 21 2022 Topics include vibro acoustics monitoring condition based maintenance sensing and instrumentation machine health monitoring maintenance auditing and organization non destructive testing reliability asset management condition monitoring life cycle cost optimisation prognostics and health management maintenance performance measurement manufacturing process monitoring and robot based monitoring and diagnostics The contributions which were selected through a rigorous international peer review process share exciting ideas that will spur novel research directions and foster new multidisciplinary collaborations Industry 5.0 Indranil Sarkar,Abhishek Hazra,Poonam Maurya,2025-07-17 This edited book aims to comprehensively examine the current research trend state of the art IoT applications deployment issues potential challenges and future research scopes related to Industry 5 0 and Industry 5 0 enabled technologies such as Blockchain edge computing 5G and cloud computing The book aims to provide a thorough understanding of the application specifications and related issues of IoT in the fields of healthcare 5 0 predictive maintenance sustainable cities and transportation systems Readers of the book will gain valuable insights into applying the concepts to real world applications and will be introduced to the latest tools software and simulations available for experimenting with Industry 5 0 and ideas about diverse IIoT data analysis The book will also provide valuable insights into the use of AI tools and algorithms for designing intelligent systems to tackle Industry 5 0 issues It is of great value to readers interested in understanding the integration of Blockchain edge computing 5G and its sister technologies with IIoT and the research scope to solve Industry 5 0 issues *Flexible Automation and Intelligent Manufacturing: Manufacturing Innovation and Preparedness for the Changing World Order* Yi-Chi Wang,Siu Hang Chan,Zih-Huei Wang,2024-12-08 This book reports on cutting edge research and developments in manufacturing giving a special emphasis to solutions for the Changing World Order It covers applications of machine learning in manufacturing and advances in cyber physical systems human robot collaboration and machine tools and assembly systems It also reports on advances in logistics and supply chain and lean manufacturing Based on the proceedings of the 33rd International Conference on Flexible Automation and Intelligent Manufacturing FAIM2024 held on June 23 26 2024 in Taichung Taiwan this first volume of a 2 volume set provides academics and professionals with extensive technical information on trends and technologies in manufacturing yet it also discusses challenges and practice oriented experience in all the above mentioned areas High Temperature Alloys J.B. Marriott,M. Merz,J. Nihoul,Ian M.

Ward, 2012-12-06 Advances in industrial technologies and improved performance of constructional materials are interdependent and have become of increasing concern in recent years. This Conference aimed to provoke discussion of the limits towards which high temperature alloys properties can ultimately be developed, identify the resulting R D requirements and design developments. Following a key note paper concerning the relation of current capabilities to requirements for gas turbines, the conference was structured into 3 sessions which examined the theoretical and practical limits for HT Alloys, the potential for development in alloys and processing, engineering considerations. Finally, feeling perhaps the approaching wind of change, the Conference on remaining alloy potential was wound up with a paper entitled 'The potential problems of Engineering Ceramics'. The different sessions each included a number of invited papers followed by a series of posters and were concluded by a presentation of a synthesis by a session rapporteur and general discussion. This structure is retained in the proceedings, including the discussion points in those cases where the authors have provided written answers to questions raised.

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