

Construction Machinery and Equipment

第53卷第6期(总第584期)Vol.53No.6(Serial No.584)

月刊 1964 年创刊 Monthly Since 1964 2022 年 6 月 10 日出版 Publishing on Jun. 10, 2022

中国标准连续出版物号 ISSN 1000-1212 CN 12-1328/TH

编委会主任 Chief of editorial committee 社长 Director 主编 Editor in chief 执行编辑 Executive editor 郑尚龙 Zheng Shanglong 张宏梅 Zhang Hongmei 张宏梅 Zhang Hongmei 孙 宽 Sun Kuan

天津工程机械研究院有限公司

中国邮政集团公司 China Post Group Co.

国内 Domestic: 6-82, 国外 Abroad: M431

津市场监管辰广经许字 2016 年 2 号

国内 20.00(CNY) 国外 5.00(USD)

主管、主办 Competent authorities and sponsor

编辑 / 出版 Edited/Published by

地址 Address

电话 Telephone

传真 Fax 网址 Website 邮箱 E−mail 天津北辰科技园区华实道 91号 (300409) No. 91, Huashi Street, Beichen Science and Technology Park, Tianjin, China 编辑部 022-26899852 26899853 广告部 022-26899850 022-26899850 022-26899850 http://www.chinacme.com.cn 专业稿件 cme@cm518.com 信息资讯, news@cm518.com 广告业务 ad@cm518.com

中国国际图书贸易集团有限公司 China International Book Tradeing Co., Ltd.

天津市云海科贸开发公司 Tianjin Yunhai Science and Trade Development Co.

《工程机械》编辑部 "Construction Machinery and Equipment" Editorial Office

Tianjin Research Institute of Construction Machinery Co., Ltd.

发行范围 Circulation area 国内总发行 Distributed in China by 国外总发行 Distributed abroad by 订购处 Subscribing place 邮发代号 Post distributing number 印刷 Printed by 广告经营许可证 Advertisement business licence 定价 Price



第三届国家期刊奖百种重点期刊 中国期刊方阵双奖期刊 全国首届优秀科技期刊一等奖期刊 中文核心期刊 中国科技核心期刊 中国工程机械工业协会会刊

本刊所有文章版权归工程机械杂志社 未经我社授权,不得以任何方式转载

目次 | CONTENTS



2022年6月10日出版

<mark>产品・结构</mark> Products and Structures

一种新型隧道超欠挖控制装置及其应用 / 刘金书 A New Control Device for Over-excavation and Under-excavation of Tunnel and Its Application / By Liu Jinshu

850H 型轮式装载机煤炭平整机构 / 张涛涛, 刘 静, 杨雪芹 Coal Leveling Mechanism of Model 850H Wheel Loader / By Zhang Taotao, Liu Jing, Yang Xuegin

试验・研究

Test and Research

摊铺机发动机测试用液压加载装置应用研究 / 奚玉石, 王振玉 Application Research of Hydraulic Loading Device for Paver Engine Test / By Xi Yushi, Wang Zhenyu 分布载荷作用下结构整体动力响应估计 / 谢远春 Estimation of Overall Dynamic Response of Structure under Distributed Loads / By Xie Yuanchun 电动叉车起升调速特性及操控性的技术研究 / 熊国栋, 产丽 P23 Technical Research on Lifting Speed Regulation Characteristics and Maneuverability of Electric Forklift / By Xiong Guodong, Chan Li 管道工程中流体速度对突扩部阻力损失影响的试验研究 / 张沛航, 杨帆, 王钰涌, 等 Test and Research on Influence of Fluid Velocity on Resistance Loss at Sudden Expansion in Pipeline Engineering / By Zhang Peihang, Yang Fan, Wang Yuyong, et al. 多维电磁振动试验台的关键部位仿真分析 / 吴希望, 王成军, 张丽, 等 Simulation Analysis of Key Parts of Multi-dimensional Electromagnetic Vibration Test Bench / By Wu Xiwang, Wang Chengjun, Zhang Li, et al. 液压挖掘机三高环境适应性评价/田 磊,郭 宇 P36 Evaluation of Adaptability of Hydraulic Excavator in Three Extreme Environments / By Tian Lei, Guo Yu 基于 PWM 驱动的装载机转向控制研究 / 蒋拓, 高名乾, 韩灏 P42 Research on Steering Control of Loader Based on PWM Drive / By Jiang Tuo, Gao Minggian, Han Hao 基于滑模速度控制器的永磁同步电机矢量控制 / 李 曦, 梁桄大, 王 琪, 等 P46 Vector Control of Permanent Magnet Synchronous Motor Based on Sliding Mode Speed Controller / By Li Xi, Liang Guangda, Wang Qi, et al.

目次 | CONTENTS



2022年6月10日出版

设计・计算 Design and Calculation

P50	盾构泥浆箱下料口多角度冲洗流场分析/于泽阳,张阳,周宇,等
	Analysis of Multi-angle Flushing Flow Field at Discharge Port of Shield Slurry Box / By Yu Zeyang, Zhang Yang, Zhou
	Yu, et al.
P54	后装压缩式垃圾车填装器结构分析及改进 / 李宗泽, 王显洲, 刘鑫鑫, 等
	Structural Analysis and Improvement of Tailgate of Rear Loaded Compression Refuse Collector / By Li Zongze, Wang
	Xianzhou, Liu Xinxin, <i>et al</i> .
P60	基于损伤累积理论的星型齿轮传动系统变载荷强度分析方法 / 张雪强, 郭丽君, 侯祥颖, 等
	Variable Load Strength Analysis Method for Star Gear Drive System Based on Damage Accumulation Theory / By
	Zhang Xueqiang, Guo Lijun, Hou Xiangying, <i>et al.</i>
P65	矿用装载机工作装置应力与疲劳寿命仿真分析 / 杨思源, 宋绪丁, 万一品, 等
	Simulation Analysis of Stress and Fatigue Life of Working Device of Mining Loader / By Yang Siyuan, Song Xuding,
	Wan Yipin, <i>et al</i> .
P72	一种除锈机械臂打磨深度的优化设计/姜明明,赵弘
	Optimized Design of Grinding Depth for a Derusting Manipulator / By Jiang Mingming, Zhao Hong
P77	履带起重机桅杆结构强度分析及头部结构改进/周 波,张 健,李云波
	Structural Strength Analysis and Head Structure Improvement of Crawler Crane Mast / By Zhou Bo, Zhang Jian, Li
	Yunbo
P81	装载机工作装置销轴与轴套配合间隙分析/岳福磊,郭孟报
	Analysis of Fit Clearance between Pin and Bushing of Loader Working Device / By Yue Fulei, Guo Mengbao
P85	某重卡车身结构改进与舒适性能提升 / 刘春月, 李敬忠, 丛支兵, 等
	Improvement of Body Structure and Comfort Performance for a Heavy Truck / By Liu Chunyue, Li Jingzhong, Cong
	Zhibing, <i>et al.</i>
P91	基于装载机实际作业工况选择合理的液力变矩器 / 卢金龙, 段传栋, 邹乃威, 等
	Selection of Reasonable Torque Converter Based on Actual Operating Conditions of Loader / By Lu Jinlong, Duan
	Chuandong, Zou Naiwei, <i>et al.</i>

目次 | CONTENTS



2022年6月10日出版

材料・工艺 Materials and Process



基于占空比优化的轴表面多弧离子镀 CrN 薄膜组织和性能研究 / 谭 勇, 王 敏, 袁建辉, 等 Research on Microstructure and Properties of Multi-arc Icon Plated CrN Film on Shaft Surface Based on Duty Cycle Optimization / By Tan Yong, Wang Min, Yuan Jianhui, *et al*.

施工技术 Construction Technologies



高原环境对混凝土搅拌站的影响与对策研究 / 肖峰, 林艳文, 冯川, 等 Research on Influence of Plateau Environment on Concrete Mixing Plant and Countermeasures / By Xiao Feng, Lin Yanwen, Feng Chuan, *et al*.

使用・维修 Operation and Maintenance

某型电动轮自卸车电机主轴断裂失效分析 / 罗 芳, 罗 朋, 邓福承 Fracture Failure Analysis of Motor Spindle of an Electric Wheel Dumper / By Luo Fang, Luo Peng, Deng Fucheng

质量·管理·营销

Quality, Management and Marketing

叉车销售企业营销渠道管理优化研究 / 王传芳

Research on Optimization of Marketing Channel Management for Forklift Sales Enterprises / By Wang Chuanfang

英文摘要 | ABSTRACTS IN ENGLISH

Publishing on Jun. 10, 2022

A New Control Device for Over-excavation and Under-excavation of Tunnel and Its Application

Over-excavation and under-excavation of tunnel is the main factor affecting the construction quality and efficiency, which will affect the stability of the tunnel in severe cases. The reasons for overexcavation and under-excavation of tunnel caused by the drilling accuracy are analyzed, and a new type of control device for over-excavation and under-excavation of tunnel is designed. The device and the set program are used to control the drilling direction of the drill pipe, which improves the drilling accuracy of the excavation equipment, thereby effectively controlling the over-excavation and under-excavation. The construction verification shows that the device can effectively reduce the over-excavation and under-excavation of tunnel and save the construction cost.

Keywords: Tunnel; Over-excavation and under-excavation; Control device; Drilling accuracy; Drilling direction

Coal Leveling Mechanism of Model 850H Wheel Loader

In order to meet the requirements of coal transportation in the port, a leveling machine is developed based on the loader

platform for the leveling operation of the train cars. Its lifting mechanism is a universal six-link, the actuator includes a transverse telescopic arm and a longitudinal telescopic arm, and the rotating mechanism is a universal four-link. The electro-hydraulic control and solenoid valve are used in parallel to realize the mechanism action. The transverse hydraulic cylinder drives the transverse telescopic arm, the longitudinal hydraulic cylinder drives the longitudinal telescopic arm, and the extension and retraction of the steering hydraulic cylinder realizes the rotation of the scraper frame. The main parameters of the whole equipment can meet the requirements of different specifications of train cars in domestic ports. The operation process of the mechanism is briefly introduced, and novices can quickly get started according to the requirements. The leveling mechanism can effectively replace manpower and greatly improve operation efficiency. Keywords: Coal; Train; Leveling mechanism

Application Research of Hydraulic Loading Device for Paver Engine Test

In the process of research and development of paver prototype, the road machinery manufacturer needs to review the engine installation quality of the paver prototype, that is, to test the performance of the air inlet filter, exhaust muffler, water-cooled radiator and intercooled radiator. These test items for the engine require that the engine reaches a high load condition. Due to the particularity of the paver construction, it is impossible to achieve the full load and stable working condition of the engine by paving asphalt or cement stabilized materials. Therefore, it is very necessary to develop a simple and fast device to realize the loading of the paver engine. At present, the traveling system, screw distribution system, scraper conveying system and vibration system of the paver developed by domestic road machinery manufacturers are all hydraulically driven, so it is feasible to realize engine loading by means of hydraulic system loading. The principle of hydraulic loading device is analyzed, and the overall layout and main monitoring parameters of the loading device are introduced.

Keywords: Paver; Engine test; Throttle valve; Hydraulic loading

Estimation of Overall Dynamic Response of Structure under Distributed Loads

Most of the environmental loads on a

英文摘要 | ABSTRACTS IN ENGLISH



Publishing on Jun. 10, 2022

large number of structures in engineering are distributed loads. Based on the existing Kalman filter Joint input-state estimation algorithm, a new idea of using modal equivalent force to estimate the overall response of the structure under distributed loads is proposed. This method does not require knowledge of the specific distribution form and size of the load. On the basis of the finite element model of the structure, the actual external load is equivalent to multiple modal forces in the modal space, the classical Kalman filter iteration step is used to realize the minimum variance unbiased estimation of the system state and load, thereby achieving the global response estimation of the structure. In order to meet the conditions of stability, observability, controllability and reversibility of the system, a 7-step normative process using the algorithm is proposed to realize the selection of relevant parameters. The cantilever beam under two distributed loads is numerically calculated by ANSYS, and the algorithm is verified by the proposed process. The numerical verification results reflect the reliability of the algorithm. Since a large number of structures in engineering can be equivalent to the combination of beam element and beam element, the method and numerical examples have certain guiding significance for engineering practice.

Keywords: Kalman filter; Dynamic response; Distributed load; Finite element

Technical Research on Lifting Speed Regulation Characteristics and Maneuverability of Electric Forklift

With the rapid growth of the forklift industry, the demand for electric forklifts is increasing, the users have higher and higher requirements for the maneuverability of the lifting process, and many valuable and precise instructions and equipment need to be accurately stacked through accurate control. The lifting fretting characteristics of the electric forklift need to be perfectly matched with the opening flow compensation of the multiway spool, the fretting characteristics of the pump motor and the speed setting to achieve the optimal effect. The lifting speed regulation characteristics and maneuverability of electric forklift are studied.

Keywords: Speed regulation potentiometer; Speed of revolution; Multi-way spool; Load sensing system

Test and Research on Influence of Fluid Velocity on Resistance Loss at Sud-

den Expansion in Pipeline Engineering

Due to the difference in the design and processing of the cross section of the engineering pipeline, it is found that the fluid velocity has an impact on the resistance loss coefficient at the sudden expansion of the pipeline (round pipe), resulting in a large deviation between the calculation results of the resistance loss at the sudden expansion of the pipeline and the actual measured values, which affects the service effect of the engineering pipeline. Based on the Bernoulli equation, a formula with high calculation accuracy is derived, the resistance loss at the sudden expansion of the round pipe is corrected through tests, and the influence of the fluid velocity on the resistance loss at the sudden expansion of the pipeline is studied, that is, when the fluid velocity increases the loss decreases. The revised formula has good application value in design and manufacture of industrial pipeline and liquid transportation engineering.

Keywords: Sudden expansion; Pipeline manufacture; Resistance loss

Simulation Analysis of Key Parts of Multi-dimensional Electromagnetic Vibration Test Bench

The existing electromagnetic vibration

英文摘要 | ABSTRACTS IN ENGLISH

Publishing on Jun. 10, 2022

aging test bench generally has problems such as less degrees of freedom and nondecoupling of motion. In order to solve the problems, two new leaf spring structures for the support frame of the electromagnetic vibration test bench are proposed, and the finite element static analysis is carried out on the key parts of the two leaf springs respectively. According to the analysis results, the structural design scheme with smaller maximum equivalent stress and smaller maximum deformation is selected, and the modal analysis is carried out to obtain its natural frequency. Compared with the frequency of the electromagnet, it is found that the leaf spring and the test bench will not resonate, which can ensure the stable operation of the test bench in the working process.

Keywords: Vibration test bench; ANSYS; Leaf spring; Modal analysis

Evaluation of Adaptability of Hydraulic Excavator in Three Extreme Environments

Taking a type of hydraulic excavator as the research object, based on the technical means of Failure Mode and Effects Analysis (FMEA), the impact of three typical environments (extremely hot, extremely cold and plateau) on the whole machine is analyzed to obtain the key impact of three extreme environments and output the key impact performance. According to the FMEA results, a four-level three-extreme environmental adaptability evaluation index system for the hydraulic excavator is established, with a total of 26 underlying evaluation indexes. The technology of Quality Function Deployment (QFD) is used to establish the relationship between the user demand and the key environmental performance, and the weight value of each key environmental performance (level-three evaluation index) is determined according to the importance of demands and indexes. The value calculation models of the positive index, negative index and intermediate membership degree of levelfour evaluation index are established respectively, and the value of the underlying index is calculated based on the test data. According to the weight of each level, the three-extreme environmental adaptability evaluation of the hydraulic excavator is realized, which solves the problem of single-sample environmental adaptability evaluation.

Keywords: Evaluation index system; QFD; Membership degree; Environmental adaptability evaluation

Research on Steering Control of Loader Based on PWM Drive

Based on the steering system of the flow amplifying valve of the wheel loader, a

new hydraulic steering control mode is proposed based on the method of PWM driving the steering gear to control the flow amplifying valve. After the corresponding analysis of the performance of the flow amplifying valve, the theoretical and simulation research is carried out based on the steering system performance of the proportional steering gear to control the flow amplifying valve, and a dynamic simulation model is established in AMESim to verify the feasibility of the scheme. The research results show that the hydraulic steering system of the loader based on PWM signal drive has good performance, can realize stable proportional speed regulation, reverses the flow amplifying valve smoothly and avoids large vibration and impact.

Keywords: Pulse width modulation (PWM); AMESim; Flow amplifying valve; Proportional control

Vector Control of Permanent Magnet Synchronous Motor Based on Sliding Mode Speed Controller

Permanent magnet synchronous motor (PMSM) has the characteristics of simple structure, good performance, small volume, light weight, large starting torque and high power density. It has been widely used in basic industries and national production fields. The in-depth study of

英文摘要 | ABSTRACTS IN ENGLISH

よ行れ続 Vol.53 | No.6 Serial No.584

Publishing on Jun. 10, 2022

PMSM drive control system has certain market value. The application of vector control technology enables the PMSM the operation effect comparable to that of DC motor. However, in the traditional vector control, the speed controller generally adopts proportional-integral (PI) control, which is difficult to meet the requirements of high precision and high stability in the fields of rail transit, electric vehicles, etc. Taking the advantage of strong antiinterference ability of the sliding mode variable structure control, the sliding mode speed controller is combined with the vector control technology to design the sliding mode speed controller, the Lyapunov theorem is used to verify its stability, and the Matlab/Simulink is used for simulation. The research shows that the sliding mode speed controller has good steady-state performance and dynamic performance and can effectively realize the vector control of PMSM.

Keywords: Permanent magnet synchronous motor; Vector control; Sliding mode speed controller

Analysis of Multi-angle Flushing Flow Field at Discharge Port of Shield Slurry Box

The flushing and dilution capacity of the slurry box is an important indicator to reflect the conversion capacity of the slurry earth pressure double-mode shield. Using the finite element analysis method, for the four flushing angles of the slurry box discharge port, the finite element numerical simulation analysis of the flushing conditions for the slurry box discharge is carried out to obtain the change law of the flushing flow field distribution when the slurry box discharge port is flushed at different angles, and then optimize the box structure of the discharge flushing port. The research results show that at 55 of the four flushing angles of the flushing port, the flushing flow beam of the flushing port is more concentrated at the bottom, the flow velocity is higher, and the flushing effect is the best.

Keywords: Slurry earth pressure doublemode shield; Slurry box; Discharge flushing port; Flow field; Numerical

Structural Analysis and Improvement of Tailgate of Rear Loaded Compression Refuse Collector

The tailgate, as an important structural component of the rear loaded compression refuse collector, not only plays the role of closing the body, but also is an important guarantee for the smooth movement of the scraper and skid to achieve the function of refuse compression. As the refuse collector is used in harsh working conditions, good strength performance is a prerequisite for the normal use of the tailgate. For the structure of the tailgate mounted on the new rear loaded compressed refuse collector, the loads in the opening and closing states of the tailgate are applied, and a finite element analysis is carried out to obtain a cloud map of the stress and displacement distribution of the tailgate structure, then predict the dangerous locations, and make structural improvement for the areas that do not meet the strength performance to improve the structural strength performance and reduce the risk of tailgate failure.

Keywords: Rear loaded compression; Tailgate; Strength; Structural improvement

Variable Load Strength Analysis Method for Star Gear Drive System Based on Damage Accumulation Theory

In view of the characteristics of complex start-up conditions and wide range of load variations of the air turbine starters, the dynamic load spectrum characteristics of the star gear drive system are analyzed, and a statistical analysis method for the gear loads under variable conditions is developed by combining the mathematical statistical method. On this basis, a calculation method for gear strength under variable loads based on the damage accumulation theory is proposed. A cal-

英文摘要 | ABSTRACTS IN ENGLISH

Publishing on Jun. 10, 2022

culation example analysis is carried out for a group of air turbine starter starting conditions to compare the strength safety factors of gears at all levels. The practical application shows that the calculation method for gear strength under variable loads based on the damage accumulation theory is of guiding significance for the design and optimization of star gear system.

Keywords: Star gear drive system; Variable load; Damage accumulation theory

Simulation Analysis of Stress and Fatigue Life of Working Device of Mining Loader

The working device of the mining loader is subject to complex forces during operation, and it is difficult to determine the fatigue-hazardous location. Taking the working device of a mining loader with a rated load of 9 t as the research object, the finite element model of the working device is constructed using HyperMesh, and the static analysis is carried out in ANSYS Workbench. The rigid-flexible coupling transient dynamic analysis of the working device is carried out based on the measured displacement of the hydraulic cylinder and the load of the hinge point. The fatigue life is solved using Ncode. The research results show that the rocker arm is subjected to the highest

stress in the static calculation results, the stresses calculated by transient dynamics are greater than those calculated by statics, and it is necessary to use transient dynamics to calibrate the strength of the working device. The calculation results of fatigue life based on statics and transient dynamics both show that the rocker arm has the lowest number of fatigue cycles under large-rock working conditions, and the rocker arm structure shall be strengthened and improved. In addition, the fatigue-hazardous locations of the base material and the welded structure of the working device are also identified, which provides a reference basis for the optimization and improvement of the base material structure and the welded structure of the loader working device.

Keywords: Rigid-flexible coupling; Transient dynamics; Mining Loader; Fatigue life

Optimized Design of Grinding Depth for a Derusting Manipulator

A derusting manipulator is designed to grind the welding stains and metal rust on the inner wall of the pipeline, Adams dynamic simulation is carried out for it, and the mathematical model of the grinding depth drive system is established. Due to the different thickness of metal rust and welds on the conduit, and the errors between the grinding trajectory of the derusting manipulator and the dimensions of the conduit, a PI controller is designed for control. The simulation results show that the grinding depth error is close to 0.01 mm, the grinding accuracy is improved by nearly 200%, and it is portable and durable, achieving an ideal derusting and grinding effect in the conduit.

Keywords: Metal weld; Metal rust; Derusting manipulator; PI controller

Structural Strength Analysis and Head Structure Improvement of Crawler Crane Mast

The mast is an important connecting component between the lifting and lowering parts of the crawler crane. The mast is modelled and simulated by using 3D modelling software and finite element analysis software to study the stress distribution of the mast under the most hazardous working conditions. The stress distribution results show that there is stress concentration at the mast head. In order to eliminate the adverse effects caused by the stress concentration, the structure of the mast head is improved. The improved structure has no stress concentration and has good workmanship, which meets the structural strength requirements and achieves lightweight structure.

Keywords: Crawler crane mast; Strength

英文摘要 | ABSTRACTS IN ENGLISH



Publishing on Jun. 10, 2022

analysis; Structural improvement; Lightweight design

Analysis of Fit Clearance between Pin and Bushing of Loader Working Device

The possible problems arising from the fit between the pin and bushing at the hinge point of the loader working device in the process of use are analyzed, the influencing factors are put forward, the relationship between the outer diameter interference and the inner diameter shrinkage of the pressed-in bushing is explored, and the inner hole shrinkage of the pressedin bushing is calculated theoretically. At the same time, a simple method to solve the shrinkage in practice is proposed, and the shrinkage is reflected on the bushing inner hole deviation during the design of mechanical parts, which enables the actual sizes to meet the fit accuracy between the pin and the bushing after the bushing is processed and pressed in. The range of values for the fit clearance between the pin and the bushing is deduced, and the calculation formula for the deflection deformation of the pin after being stressed and the shrinkage of the inner hole of the bushing in the interference fit is deduced. Keywords: Loader; Working device; Fit clearance

Improvement of Body Structure and Comfort Performance for a Heavy Truck Taking the main attachment point between the body of a heavy truck and the chassis as the excitation source and the driver's right ear as the response point, a finite element model of the truck body and a finite element model of the acoustic cavity of the passenger compartment are used to establish a finite element model of the structural-acoustic coupling of the body. The finite element model of the structural-acoustic coupling of the body is analyzed for noise sensitivity, and combined with the body modal analysis, the body components that contribute greatly to the noise transfer are analyzed. The structures of these body components are improved. After improvement, the sound pressure in the truck body is significantly reduced, thus achieving the purpose of improving the comfort of the heavy truck.

Keywords: Noise sensitivity; Finite element model; Structural optimization; Structural-acoustic coupling; Comfort of heavy truck

Selection of Reasonable Torque Converter Based on Actual Operating Conditions of Loader

In order to improve the working condition

adaptability, fuel economy and operation efficiency of the loader, from the perspective of actual operating conditions of the loader, the V-shaped operating condition is taken as a typical operating condition and divided into five operating steps, and the characteristics of the working conditions and the requirements for the torque converter of each step are analyzed respectively to derive the general selection principles of the torque converter, while it is pointed out that the torque converter with guide free wheel or lock is suitable for long-distance transport conditions. Keywords: Torque converter; Working condition; Matching; Operating cycle

Research on Microstructure and Properties of Multi-arc Icon Plated CrN Film on Shaft Surface Based on Duty Cycle Optimization

Carbon steel is the usual material for shaft parts. In view of the limitations of plain carbon steel in terms of wear and corrosion resistance and the advantages of multi-arc icon plating in improving the service life of the parts, CrN films are prepared on the surface of carbon steel shafts by multi-arc icon plating to enhance the wear and corrosion resistance. The effect of different duty cycles on the microstructure and properties of CrN films are stud-

英文摘要 | ABSTRACTS IN ENGLISH

Publishing on Jun. 10, 2022

ied, scanning electron microscopy and Xray diffractometer are used to analyze the change law of the surface microstructure and preferential growth orientation of the CrN films, and the hardness and electrochemical properties of the CrN films are tested. The results show that the CrN films are mainly composed of CrN and Cr phases, the duty cycle has a significant effect on the microstructure of the CrN films, the hardness and corrosion resistance of the CrN films are markedly higher than those of the carbon steel matrix, and the CrN films prepared at a duty cycle of 40% show the best overall properties.

Keywords: Shaft parts; Duty cycle; Multi-arc icon plating; CrN

Research on Influence of Plateau Environment on Concrete Mixing Plant and Countermeasures

Most of the main lines of the Sichuan-Tibet high-speed railway project are located in the plateau area with harsh natural environment such as high altitude, low temperature and large day-night temperature difference, and the construction of concrete mixing plants along the line cannot avoid the influence of these environmental factors. The negative effects of the plateau environment on the concrete mixing plant equipment are expounded, and from the perspective of the characteristics of the plateau environment, corresponding countermeasures for the use technology and configuration of the mixing plant in the plateau environment are proposed, taking into account of the applicability, reasonableness and economy.

Keywords: Concrete mixing plant; Plateau environment; Countermeasure

Fracture Failure Analysis of Motor Spindle of an Electric Wheel Dumper

For the motor spindle fracture failure of an electric wheel dumper in a mine, the causes of the motor spindle fracture are analyzed. It is considered that the bending load and the structure containing more ferrite in the fracture part are the main causes of the fatigue and fracture of the motor spindle. The reason for the eccentric load is that after the planetary gear bearing is damaged, the clearance between the planetary gear and the sun gear changes, resulting in the eccentric load on the sun gear. More coarse acicular ferrite reduces the local fatigue strength and hardness of the material. According to the fault causes, improvement measures are put forward.

Keywords: Electric wheel dumper; Motor spindle; Fracture; Failure analysis

Research on Optimization of Marketing Channel Management for Forklift Sales Enterprises

Marketing channels are an important way for enterprises to increase their market share and economic benefits, and marketing channel management plays a key role in the operation of enterprises. Taking a forklift sales enterprise as the research object, its current marketing channel management status quo is analyzed, and the shortcomings are pointed out. Combining the theory with the actual situation of the enterprise, corresponding improvement measures are put forward from many management aspects, such as strengthening channel terminal image management, optimizing channel advertising and promotion management, channel price differentiation management, diversified incentive for channel members, and formulating diversified channel marketing strategies, to improve marketing channel management efficiency. The innovative online marketing strategy and the adoption of online and offline integrated mode have achieved good results.

Keywords: Forklift sales; Marketing channel; Channel management; Channel member incentive