MAIN TOPICS, ABSTRACTS & KEY WORDS

Effect of heat input on microstructures and properties of weld metal of steel used in offshore platform

Di Xinjie, Li Chengning, Wang Dongpo

(School of Materials Science and Engineering, Tianjin University, Tianjin 300072, China). p1 – 4

Abstract The effect of heat input on microstructures and properties of weld metal of D36 steel used in offshore platform was studied systematically by using SAW process. The results show that for the primary solidification microstructure in the weld metal, with the increase of heat input, the average width of the columnar grain increases, however its proportion decreases gradually. For the secondary solidification microstructures in the weld metal, with the increase of heat input, the amount of the primary ferrite(PF) increases, meanwhile those of both the bainite ferrite(BF) and acicular ferrite (AF) decrease. What is more, the polygonal ferrite increases and the grain boundary ferrite increases at first and then decreases with the increase of heat input. The hardness of weld metal decreases along with the increase of heat input.

Key words: **offshore platform steel**, **heat input**, **characteristics of weld microstructure**, **hardness**

Effect of heat input on microstructures and mechanical properties of Q890/Q550 dissimilar steel joint by laser-MAG hybrid welding

Lei Zhenglong[1], Xiong Ying[1], Li Bingwei[1], Hai Weidong[2], Wei Guoqiang[2]

(1. State Key Laboratory of Advanced Welding and Joining, Harbin Institute of Technology, Harbin 150001, China; 2. Shanxi Pingyang Industry Machinery Co., Ltd., Houma 710025, Shanxi, China). p5 – 11

Abstract The laser-MAG hybrid welding of Q890/Q550 dissimilar steel joints was studied, and the effects of different welding heat input on microstructures and mechanical properties of dissimilar steel joints were tested and analyzed. Results show that at the same heat input, the overheated zones on both sides of the weld mainly consist of martensite and a small amount of bainite. Dense martensite is observed in the fine grained region. The martensite in the Q890 steel side is more than that in the Q550 steel side, the weld fracture has the characteristics of shear dimples and the impact toughness of the weld is higher than that of the heat affected zone. As the heat input increases from 3.5 kJ/cm to 9.6 kJ/cm, the amount of bainite gradually increases with the grain coarsening, and the impact energy of weld zone and heat affected zone slightly decrease. All The tensile specimens of three kinds of heat input are fractured in the Q550 steel, the fracture mode is ductile fracture, and the joint strength is higher than that of the base metal.

Key words: **Q890/Q550 dissimilar steel joint**, **laser – MAG hybrid welding**, **heat input**, **microstructure**, **mechanical properties**

Guidance of initial point of weld by monocular vision based on specific plane

Ni Monan, Wang Tianqi, Li Jinzhong

(Advanced Mechatronics Equipment Technology Tianjin Area Laboratory, Tianjin Polytechnic University, Tianjin 300387, China). p12 – 15,20

Abstract In order to solve the problems existed in the traditional stereo vision and template matching method in the process of automatic guidance of the weld initial point, such as the complex algorithm, the operation of low speed as well as the low accuracy of guidance. In this paper, a method to guide the weld initial point by a monocular visual based on a specific plane was proposed. Firstly, the working plane of the workpiece to be welded is calibrated by adopting "monocular and double bits" and random consistency algorithm, and the guidance range is limited to the particular plane. Then the hand-held point laser is used as the active light source to illuminate the plane, and the camera is guided to the weld initial point under the condition of keeping the unchanged status of the camera coordinate system. At last, the 3D coordinates of this point in the robot coordinate system are calculated to guide the robot to move to the weld initial point.

Key words: **monocular vision**, **weld initial point**, **specific plane**

Arc behavior of aluminum alloy fusion of tri-arc double wires

Liu Dan[1,2], Chang Yunlong[1]

(1. School of Materials Science and Engineering, Shenyang University of Technology, Shenyang 110870, China; 2. School of Materials Engineering, Liaoning Mechatronics College, Dandong 118000, Liaoning, China). p16 – 20

Abstract In order to obtain the optimal parameters for aluminum alloy fusion of Tri-arc double wires and achieve high efficiency arc fusion, the behaviors of the arcs and metal transfer were recorded by high-speed video camera, then the forces of the arcs were analyzed, and the influence factors on the arcs and metal transfer were found out. The results show that, when the current value I_m of the third arc M increases, the M arc shape bends downward obviously and promotes the metal transfer, the transition form is mixed transfer and short jet transfer. The main cause of spatter is that when the current switches, the droplets at the end of the wire do not fall into the pool, at the same time the electromagnetic force blows out the droplet transversely. I_m is set from 30 A to 38 A, the spatter is the least and the wire fuses stably.

Key words: the third arc, arc shape, metal transfer, high efficiency fusing wire

Application of FSW technology to tank manufacturing of launch vehicle and its development

Song Jianling, Li Chao

(Tianjin Long March Launch Vehicle Manufacturing Co. Ltd., Tianjin 300462, China). p21 – 27

Abstract As a new solid-phase joining technology, friction stir welding(FSW) has advantages such as high quality of welded joint and small deformation of welding products. Once it is available, it is favored by all walks of life, especially the aerospace industry. In the United States, Japan and European countries, a lot of in-depth research had been conducted on the friction stir welding technology, and it had been widely applied to the welding production of rocket fuel tanks, and the engineering application of the full friction stir welding to the rocket fuel tank had been realized. Research on friction stir welding technology developed late in China but progressing fast. In recent years, great achievements had been made in the application of engineering. At present, it has been successfully applied to the welding of fuel tanks for launch vehicles in China. With the research on the technical mechanism and engineering of friction stir welding being investigated further, friction stir welding technology is developing in the direction of intelligent equipment, process integration and high production efficiency.

Key words: launch vehicle, fuel tank, aluminum alloy, friction stir welding, stir-welding head

Researches on ultra-low carbon stainless steel electrode CHS027LT for LNG tank

Liu Qiwang, Yuan Ning, Xu Xiaolong, Bai Chang

(Sichuan Atlantic Welding Consumables Co., Ltd., Zigong 643010, Sichuan, China). p28 – 30

Abstract Stainless steel electrode CHS027LT for LNG tank was introduced about slag system selection, formula designation, and product performance, which has ultra-low carbon, ultra-low temperature and high toughness (– 196 ℃), intergranular corrosion resistance. Several welding position process performances, physical and chemical properties of deposited metal at different heat inputs were compared and mechanical stability of three batches finalized electrode products was researched. The results showed that at the welding heat input ranged from 10.2 kJ/cm to 16.9 kJ/cm, the electrode has excellent welding process performance, and the physical and chemical properties of the deposited metal meet the technical requirements, three batches finalized electrode products have the stable mechanical properties, and the impact energy at – 196 ℃ is higher than 50 J. The microstructures of the deposited metal are austenite and a small amount of ferrite.

Key words: LNG tank, Stainless steel electrode CHS027LT, ultra-low temperature and high toughness, intergranular corrosion, heat input

Automatic GMAW process of steel containment vessel

Wang Gang, Hu Guangze, Cao Zhongyun, Dong Yongzhi

(Shandong Nuclear Power Equipment Manufacturing Co., Ltd., Yantai 265100, Shandong, China). p31 – 35

Abstract High strength low alloy steel SA738GR. B was applied to steel containment vessel in the third generation of nuclear power AP1000 for the first time, and automatic welding process was tested by special welding wire ER90S – G for SA738GR. B steel plate, then the product simulation experiments were carried out. The results show that the impact properties of the welded joint can satisfy the technology requirements of the containment vessel within the range of heat input 12 ~ 29 kJ/cm. In the above heat input range , automatic welding procedure qualifica-

tion were tested on 1G/2G/3G welding position as well as the various mechanical properties can satisfy the requirements of technology. In addition, under the precondition of the optimal process, the optimal parameters of automatic welding process were determined and applied to the simulation product and the various mechanical properties can satisfy the requirements of technology.

Key words: containment vessel, SA738GR. B steel plate, GMAW, welding procedure qualification

Research on friction stir spot welding with refilling by friction forming process of aluminum alloy with keyhole-free

Li Baode[1], Zhou Li[2], Feng Yaoyao[1], Liu Xiyang[1], Cheng Zhiguo[1]

(1. Harbin Welding Institute, China Academy of Machinery Science and Technology, Harbin 150028, China; 2. Shandong Provincial Key Laboratory of Special Welding Technology, Harbin Institute of Technology at Weihai, Weihai 264209, Shandong, China). p36 – 39

Abstract 1060 aluminium alloy was friction stir spot welded with refilling by friction forming process to avoid the keyhole which was left at the end of welding by the conventional Friction Stir Spot Welding. The influence of rotating velocity on the microstructures and mechanical properties of the joint were studied. The results show that at the appropriate rotating velocity, the welded joint obtained by refilling has good appearance and no flying burr, which has higher shear capacity.

Key words: keyhole-free, friction stir spot welding, microstructure, mechanical properties

Research on electric rivet welding process and its application to sheet welding

Xu Yonghui, Su Guangyu, Hou Xinghua

(CRRC Qiqihar Co., Ltd., Qiqihar 161002, Heilongjiang, China). p40 – 44

Abstract In this paper, the application of electric riveting welding technique to the manufacturing of thin plate welding structure was studied. Through series of welding procedure tests and welding procedure qualification tests of electric rivet welding, the welding parameters of electric rivet welding were optimized, the rationality of electric rivet welding procedure was verified, and the most reasonable parameters of processing hole and welding parameters suitable for sheet covering structure were proposed. The deformation that happened in electric rivet welding process is obviously smaller than that of the plug welding procedure, which can significantly reduce the welding deformation and the flattening work and ensure the appearance quality of the structural parts to improve the commercialization degree of the wagon.

Key words: electric rivet welding, welding parameters, welding deformation, sheet covering structure

Study on application of combined welding of DP-TIG and TIG in tank

Yan Xinggui, Zhao Guoying

(Tangshan Kaiyuan Welding Automation Technology Institute Co., Ltd., Tangshan 063000, Hebei, China). p45 – 47

Abstract The longitudinal weld and girth weld of 8 mm S30408 stainless steel storage tank were carried out by the combined welding method of DP-TIG and TIG with the welding material ER308LSi. Through analyzing the weldability of S30408 tank body, designing the welding technology reasonably and controlling the key factors of welding strictly, the problem of weldability of 8 mm S30408 cryogenic storage tank was solved. According to relevant standards, the welded joints were tested for mechanical properties, X-ray detection and micro-metallographic analysis. The results show that the bending and stretching properties of welded joints meet the requirements of testing standards. The weld has no porosity, slag inclusion and other defects, and the ratio of austenite to ferrite in the weld is in accordance with the requirements. The combined welding method of DP-TIG and TIG is applicable to the welding of S30408 stainless steel.

Key words: DP-TIG, TIG, combined welding, S30408 stainless steel, cryogenic tank

Effect of welding parameters on microstructure and toughness of deposited metals by self-shielded flux cored wires

Zhang Xuejie[1], Zhang Xingyuan[2], Yao Rungang[1], Guo Chun[1]

(1. Luoyang Ship Material Research Institute, Luoyang 471023, China; 2. COSCO(Qingdong) Shipyard Co., Ltd., Qidong 226200, Jiangsu, China). p48 – 52

Abstract The effects of interpass temperature and weld passes on the microstructure and toughness of deposited metals by self-shielded flux cored wires were investigated in the paper. The results indicated that with the increase of interpass temperature, the pro-eutectoid ferrite amount increases, the austenite amount increases first and then transforms into carbide in martensite austenite island, which results in the impact toughness increasing firstly and then decreasing. The toughness of deposited metals is increased with the increase of welding layer, which attributes to the reduction of size and content of martensite austenite island as well as the increase of ratio of fine grain zone.

Key words: **self shielded flux cored wire**, **interpass temperature**, **weld pass**, **microstructure**, **toughness**

Development and application of automatic VPPA welding equipment to space curve weld of spacecraft

Zhang Pengtian[1,2], Huang Ning[1,2], Zhang Suolai[1,2], Zhang Yuliang[1,2], Chen Shujun[3]

(1. Beijing Spacecrafts Co., Ltd., Beijing 100094, China; 2. Beijing Engineering Research Center of Welding Technology and Equipment for Spacecrafts, Beijing 100094, China; 3. College of Mechanical Engineering and Applied Electronics Technology, Beijing University of Technology, Beijing 100124, China). p52 – 55

Abstract To develop automatic VPPA perforated vertical welding equipment for the space curve weld, positioner with large load, high precision and 2 degrees of freedom, three dimensional linear guide with high precision and welding robot with six degrees of freedom were adopted to constitute multi-axis linkage welding robot system. Through integration of robot arm with six degrees of freedom, positioner with 2 degrees of freedom and three dimensional mobile device, a macro-micro control strategy of space curve weld welding system under the circuit control of machine and human was put forward to realize the real-time control of the relative position of welding gun and weld by making the relative position of VPPA welding gun and weld be always vertical upward to achieve perforation vertical upward welding in the welding process of space curve weld. It is of great significance to realize the application to the welding production of large aluminum alloy seals, which can realize the direct import substitution and fill the blank in China.

Key words: **space curve**, **automation**, **welding equipment**

Crack analysis and repair of large spherical tank

Fang Wunong[1], Wang Jian[2], Feng Wei[3]

(1. Hefei General Machinery Research Institute Co., Ltd., Hefei 230031, China; 2. Petro-China Lanzhou Petrochemical Company, Lanzhou 730060, China; 3. Harbin Welding Institute, Harbin 150028, China). p56 – 60

Abstract The spherical tank is one kind of very important pressure vessels, and it is widely applied in the petrochemical industry. The scientific methods were used to find the cause of cracks for liquid ammonia spherical tanks of Q370R steel. The correct welding process was not strictly performed, which results in the high hardness and large residual stress of the welded joints, and leads to the hydrogen-induced cracks. Under the action of the medium, a large number of stress corrosion cracks are initiated. The criteria of repairing by the hardness standard and the points of welding operation were determined, which can not only guarantee the quality of the repairing work, but also prevent the occurrence of new cracks.

Key words: **Q370R steel**; **spherical tank**, **stress corrosion cracking**

Design of laser welding system for motor rotor

Yang Min

(Mianyang Vocational and Technical College, Mianyang 621000, Sichuan, China). p61 – 64

Abstract The laser welding system was designed for the sockets and cover of motorrotor. Because of the tolerance of the length and the installing dimensions after the ork-pieces being assembled, the special fixture was designed to absorb the tolerance which consists of the swiched fixture, jacking component, up-stop component and rotary fixture. The work-pieces were fixed in the swiched fixture and jacked upwards the up-stop component, which used the upper surface as the position datum ,realized the positioning for the work-piece precisely.

Key words: **laser welding**, **welding fixture**, **tolerance**, **positioning**

编辑 王龙权