

**IIW Annual Assembly – Graz, Austria.
July 6th to July 9th, 2008.
Summary of Commission XII Activities.**

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Summary

Professor W. Lucas chairs this Commission. Each day had a sub-commission chairman who also took part in facilitating the proceedings. The overall Commission's work is focused on the areas of arc welding processes and production systems. The IIW meetings have two main purposes: to gather together experts from around the world to discuss welding related issues, and to allow the flow of information between the member welding societies in the parent countries.

Commission XII meetings were executed in the form of papers presented by experts in the field of welding. The following report briefly summarizes the papers actually presented at the Commission. The full text versions of the papers are available by contacting the CCIW.

July 7th, 2008 – Commission XII – Sub-commission B: Arc Welding Processes Meeting Chairs: W. Lucas and H. Hackl

Paper 1 IIW Doc No: XII-1939-08
S Kodama, Y Ishida, K Asai, M Mizumoto, T Namekata
“Development of Stainless Steel Welding Wire for Galvanized Steel Sheets”

Within the Japanese market, there is a significant amount of welding of galvanized steel sheets. This paper presents the development of a stainless steel flux-cored arc welding (FCAW) wire that is designed for welding of galvanized material. The authors discuss the efforts put in to address (and eliminate) zinc embrittlement cracking issues, and selection of the fluxing components to improve operability, reduce slag, and improve slag peel-off properties. The corrosion resistance of the weldments was also investigated.

Paper 2 IIW Doc No: XII-1947-08
Yu Umehara, Reiichi Suzuki, Toshihiko Nakano
“Development of Innovative GMAW Wire with Improved Flowing Characteristics of Molten Pool”

This paper from Japan discussed the influence of residual surface-active elements, such as oxygen and sulfur, on the weld pool flow characteristics and final weld bead shape. A basic model was proposed to explain changes in bead shape with differing amounts of %S. The wire developed for the study had a slightly increased sulfur content (0.06 %S) versus the very low conventional levels (0.01% S) to improve weld bead shape, flow characteristics and reduce cracking tendency.

Paper 3 IIW Doc No: XII-1940-08
Takaaki Matsuoka, Takeshi Yoshida, Hiroto Yamaoka, Charles C Kim
“Application of Magnetic Stir Welding to Dissimilar Metal Structural Weld Overlay”

This paper from Japan discussed the application of magnetic stir welding technology, applied to conventional gas tungsten arc welding (GTAW) overlay applications. The materials investigated were corrosion resistant alloys that were intended to resist Primary Water Stress Corrosion Cracking (PWSCC). The addition of the magnetic coil to the GTAW torch will periodically reverse the flow of the weld pool, thus increase the bead width, improve flow characteristics and reduce dilution. The technology was successfully used for welding stainless steel alloys and showed better properties than conventional GTAW.

Paper 4 IIW Doc No: XII-1941-08
Y Ishizaki, S Asai, T Tanabe, Y Yasuda, H Takebayashi
“Development of GTAW System using CO₂ Cooling for Reducing Residual Stress”

This paper looked at reducing residual stresses in the HAZ of austenitic stainless steels, to reduce the likelihood of stress corrosion cracking. The typical manner to reduce residual stresses is to perform shot peening after welding. In the experiment, they used CO₂ cooling during the welding to control the temperature of the part. They experimented with applying CO₂ fine power, regular powder and pellets. The best performance was obtained using the fine CO₂ powder. Strain gauge testing was also completed that showed a reduction in longitudinal and transverse residual stresses for thick-plate welding applications. The technology is still in the development stage; production welding may occur in the future.

Paper 5 IIW Doc No: XII-1937-08
T Era, T Uezono, T Ueyama, H Yamamoto
“Development of AC GMA Welding System using Controlled Bridge Transfer Process”

This paper described the developed of a controlled waveform Gas Metal Arc Welding (GMAW) process, intended to reduce the process heat input and weldment spatter. The process is based on an alternating current controlled bridge transfer (CBT) process (called the AC-CBT process). The paper describes how the various waveform parameters, such as current, phase balance, and frequency, are manipulated to maximize electrode melting rate, maintain stable metal transfer, and control the weld bead shape. Correlations between the waveform parameters and in-situ welding behaviour (determined with video) were shown. In addition, spatter amounts were reported and shown to be reduced.

Paper 6 IIW Doc No: XII-1952-08
D Yapp
“Advances in Hybrid Laser-arc Welding”

This presentation provided an overview of the use of laser and hybrid laser-arc welding processes in various industries. An overview of the development of laser welding technology and hybrid processes was provided. Examples of successful utilization of the process (such as the shipbuilding industry) were given.

Commission Activities

It was voted that Papers 1 and 3 be submitted to IIW for publication as “Research” Papers. It was voted that Papers 4 and 5 be submitted to IIW for publication as “Technical” Papers. The attendance was 82 people.

July 8th, 2008 – Joint Workshop of Commission IV, XII and SG 212 “Effect of Flux and Shielding Gas in Arc, Laser and Hybrid Welding”

Paper 7 IIW Doc No: XII-1935-08
Toyoyuki Sato, Makoto Takahashi
“Trends of Shielding Gases for Arc Welding in Japan”

The presentation provided an overview of trends regarding the actual use of welding gases for the automotive, ship building, and rail car industries. The collection of sales data was presented; including trends regarding the use of wire-feed processes. Trends in gas composition versus weldment quality, including porosity, bead appearance, spatter, and burn-thru, were provided. Developments in new welding gas compositions were discussed, including a highly penetrating mixture (and proprietary) for dual-shielding processes.

Paper 8 IIW Doc No: XII-1944-08
S Neumann, C Thomy, T Seefeld, F Vollertsen
“Shielding Gas in Remote Welding - Effects and Optimisation of Supply”

This paper investigated methods for properly shielding the weld zone during CO₂ laser remote welding. The investigators utilized Schlieren photography to assess a selection of commercially available nozzles, including slot, micro, laval, pipe and flat nozzles. Experiments were completed with air, Ar, and He. The area of effective shielding was examined for different nozzle designs and arrangements. Methods for optimizing shielding for high power laser welding were provided.

Paper 9 IIW Doc No: XII-1943-08
Paul Cooper, Ajit Godbole, John Norrish
“Design and Optimisation of a Novel On-torch Fume Extraction Device using CFD and Fluid Simulation”

This paper describes the investigation, using both numerical and physical modeling, to examine gas fluid-flow fields during gas metal arc welding (GMAW). The investigators modeled the dispersion and extraction of fumes in the custom-designed welding nozzle. The paper illustrates how the use of an aerodynamic flange resulted in improved fume extraction significantly. Based on the results of the modeling techniques employed, a prototype was developed and tested to illustrate improved fume extraction.

Paper 10 IIW Doc No: XII-1936-08
Eri Yamamoto, Kei Yamazaki, Keiichi Suzuki, Fusaki Koshiishi
“Effect of Flux Ratio of Flux-cored Wire on Wire Melting Behaviour and Fume Emission Rate”

The investigators examined the ‘normalized’ fume generation rates of flux cored arc welding (FCAW) with different flux compositions and flux ratios. The melting rates were also evaluated. The investigators described how both the melting rate and fume generation rate increased with the flux ratio; these effects were correlated with the heat content of the welding process.

Paper 11 IIW Doc No: XII-1945-08
H Stauer
“Laser-GMA Hybrid with Three Arcs: A High-performance Welding Process for Joining Thick-walled Tubes Made of High-strength Steel”

The paper provided an overview of laser-GMAW hybrid welding processes. The investigators described the development of a welding system that included both a laser-GMAW hybrid torch with a trailing tandem GMAW torch. Technical schematics were provided; in-situ behaviour was illustrated via video imaging, and reporting of mechanical properties from typical weldments.

Paper 12 J Norrish and W Lucas
“Update on Classification for Metal Transfer Modes”

The authors presented work to streamline the classification of traditional and modern welding processes and variants for gas metal arc welding. The following summarizes the proposed modes:

Natural transfer mode: transfer mode developed for a given wire diameter and welding gas mixture, within a specific range of current, voltage, and stick-out. Within each natural mode, there are different Sub-Modes that may develop depending on the welding parameters.

Controlled transfer mode: transfer mode is controlled directly by the power source output.

Categories of Transfer Modes: the following summarizes the various modes:

Natural Mode		Natural Sub-Mode		Controlled Mode	
A	Short Circuit	A1	Short Circuit	A1.1	Controlled Short Circuit
B	Globular	B1	Globular		
		B2	Repelled		
C	Spray	C1	Droplet	C1.1	Pulsed Droplet
		C2	Streaming	C1.2	Pulsed Streaming
		C3	Rotating		

It was voted that the above transfer modes be accepted by the XII Commission and submitted to the IIW for acceptance as the new GMAW metal transfer modes.

Commission Activities

It was voted that Papers 9 and 10 be submitted to IIW for publication as “Research” Papers. It was voted that Paper 7 be submitted to IIW for publication as a “Technical” Paper. Attendance was 96 people.

July 8th, 2008 – Joint Workshop of Commission XII Sub-Commission C: Production Systems and Applications

Wednesday, 9 July

Room : Saal Steiermark

Chairman: S Asai

Paper 13 IIW Doc No: XII-1948-08
Jean Marie Fortain
“Plasma Welding Evolution and Challenges”

The author was unable to attend the conference and a replacement presentation was provided by Fronius regarding the using the CMT process for overlay welding. No paper was provided.

Paper 14 IIW Doc No: XII-1951-08
Nuno Pepe and David Yapp
“Process Efficiency and Weld Quality for Pipe Root Welding”

This paper discussed the use of waveform controlled process for pipe root welding for the offshore pipeline industry. The authors investigated typical process efficiency ranges expected for the process during pipe root welding. In addition, heat input measurements were also performed.

Paper 15 IIW Doc No: XII-1949-08
Satoshi Yamane, Hikaru Yamamoto, Toru Nakajima, Kenji Oshima
“In Process Control of Weld Pool using Weaving Control in Switch Back Welding”

The paper discussed the development of process control techniques to optimize the “switch back” welding method. The weldments were V-groove joints without backing plates. The techniques employed reduced the likelihood of burn through by in-situ detection of the weld pool (i.e. the weaving width is adjusted on the fly). The in-situ weld pool behaviour was examined with high-speed video photography to validate the technique.

Paper 16 IIW Doc No: XII-1942-08
Masakazu Shibahara, Hayato Nagaki, Shinji Takaba, Osama Yasuda, Hisashi Serizawa, Hidekazu Murakawa
“Prediction of Hot Crack of T-joints in Full Penetration Welding Process”

This investigation examined the likelihood of hot cracking during the welding of full-penetration joints. Typically hot cracking is linked to residual chemical elements and weldment stresses. This investigation

looked at the influence of the welding conditions that led to the formation of “pear-shaped” cracking. Examination included actual weldments and Finite Element Analysis (FEA) methods. The likelihood of cracking was correlated to the heat input and weld bead aspect ratio.

Paper 17 IIW Doc No: XII-1938-08
R Boekholt, A Kranendonk and W Vogelesang
“Recommendations for the Implementation and Use of Robotic Welding and Cutting in
Smaller shipyards”

This overview presentation discussed the challenges facing the ship building industry regarding the shortage of skilled labour. The author describes steps taken to have industry work together to implement new, high-productivity automated welding and cutting systems. Case studies and examples of various automation setups were presented and lessons learned discussed.

Commission XII Activities

The Chairman discussed upcoming XII activities and the attendance for the third day was 74 people.