KOBELCO WELDING TODAY

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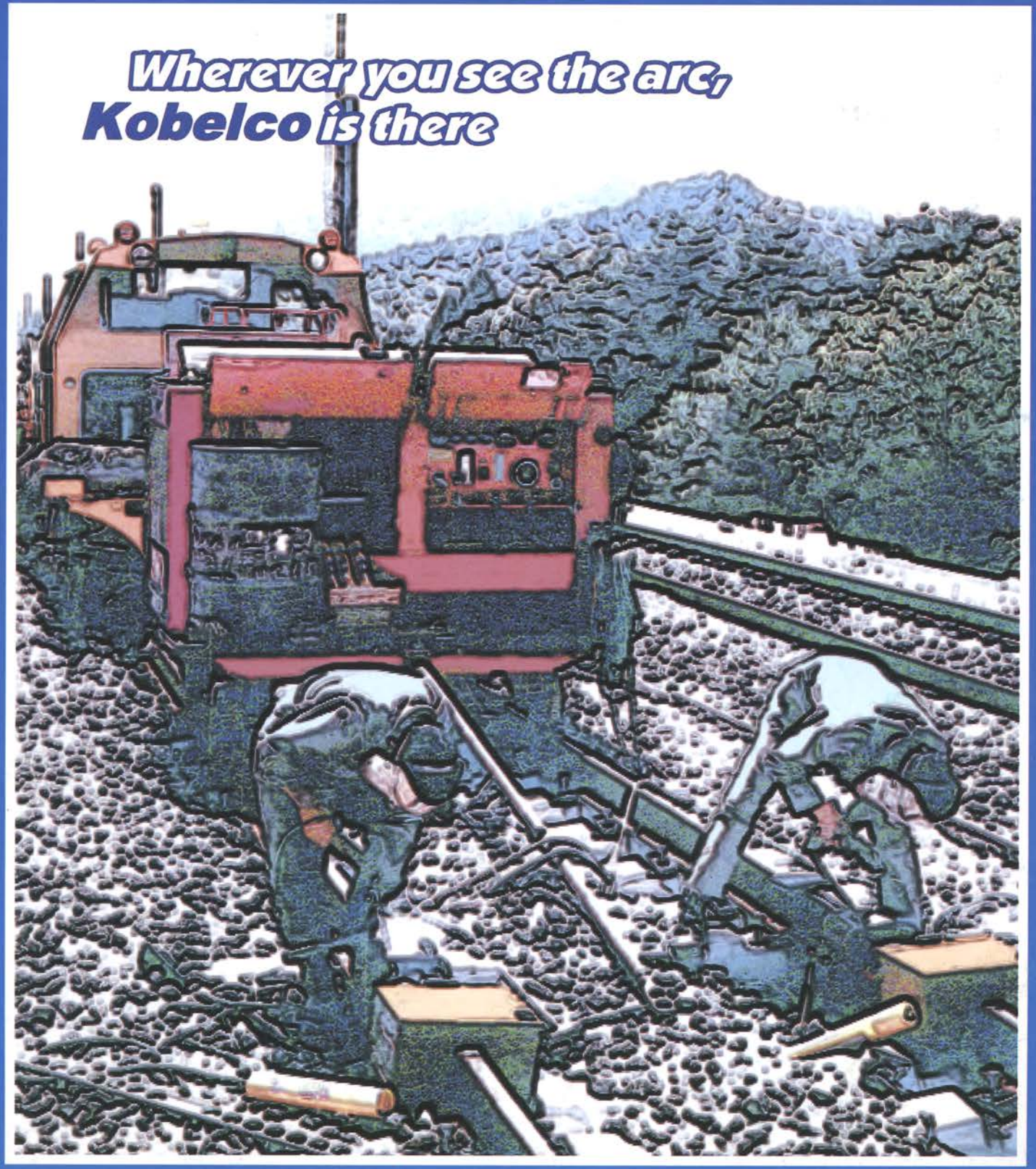


As The World's Largest Producer of Refrigeration Compressors Expands Production, A Kobelco's MG-50 CO_2 Solid Wire Meets Their Stringent Quality Requirements

Since its incorporation in 1972, Matsushita Refrigeration Industries (S) Pte. Ltd. (MARIS) has become the first factory specialising in the manufacturing and export of Matsushita refrigeration compressors. Today, MARIS is one of the world's largest makers of refrigerator compressors, with a cumulative production of over 100 million units. MARIS manufactures more than 250 types of F/Q and S/SQ models ranging from compact, lightweight, low noise compressors to heavy-duty versions.

MARIS compressors with superlative performance and reliability have earned the trust and patronage of major refrigerator manufacturers around the world. They know that they can rely on MARIS compressors because of advanced technology and vertically integrated means of production. Technological advances have enabled MARIS to develop superior products for the benefit of consumers all over the world. Currently, MARIS has more than 120 corporate customers spread over 53 countries. With their far-reaching global network and world-wide facilities, you are likely to come into contact with Matsushita almost anywhere in the world.

To remain an innovative and trusted manufacturer, whom consumers can look up to, MARIS is making great strides not only towards streamlining operational systems, but also towards enhancing quality. At every stage, stringent quality control is observed. Before a compressor can be produced, a variety of processes are necessary to produce the different components. MARIS makes most of the parts, no matter how small, at its own foundry, machining, motor and electrical components plants.

One of the processes involves welding the shells of the compressor together after the assembly process. The welding process involves CO_2 welding using automatic-welding equipment and robotic welding. The welding process requires reliable and high quality welding wire to achieve consistently high quality welds.

Fig. 1 — The welding process of refrigerator compressors involves CO_2 arc welding using automatic welding equipment

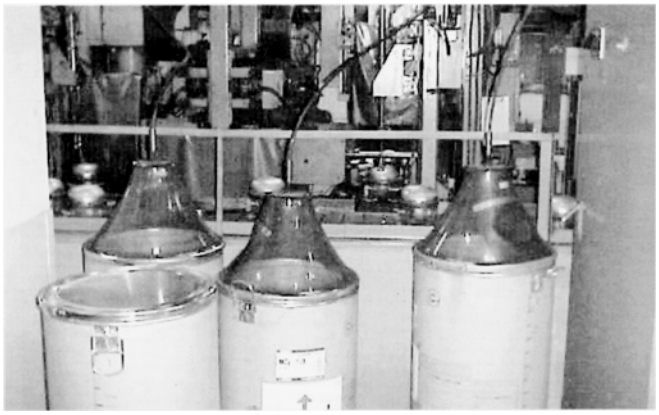


Fig. 2 — Kobelco ARROW Packs of MG-50 achieve consistently high quality welds, meeting MARIS's stringent requirements

This is achieved using a KOBE solid wire of MG-50.

The compressor welding lines runs 2 shifts of up to 14 hours per day. This requires a continuous feed of welding wire for the process, and any line stoppage due to quality of the welding wire is unacceptable. Under such severe requirements, KOBE welding wire has proven year after year to be consistently reliable and of high quality.

From the beginning of MARIS operations, KOBE has consistently provided support in terms of high quality products, responsive customer service and regular sharing of welding technical know-how. This cooperation has led to a successful long-term relationship.

(Reported by Roy Goh, KWS)

Message from the Editor

To our dearest readers of KOBELCO WELDING TODAY: We are greatly thankful to you for purchasing KOBELCO brands of welding consumables and equipment.

Now, at the third quarter of 1999, the economies of the ASEAN countries and Korea have turned to grow gradually, signaling a recovery in the demand of welding consumables too. However, stable growth in the demand of welding consumables will need more time, because these countries' economies are still on the way of structural reform.

In contrast, demand from the Japanese domestic welding industries is decreasing seriously: it is forecasted that the demand of welding consumables will drop greatly if the amount of shipbuilding decreases after 2000.

How do you forecast the demand of welding consumables in your countries or districts? We, Kobe Steel's Welding Company, will promote the business of comprehensive products of welding consumables and equipment, expecting that 1999 will result in a fruitful year for your business.

Tetsuo (Tom) Konohira

General Manager, IOD, Welding Company, Kobe Steel, Ltd.

Contents

KOBELCO PARTNERS

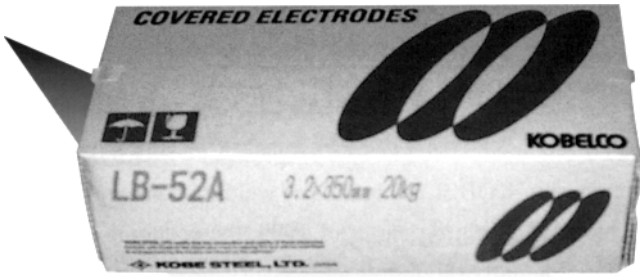
"Ying Fat Metal Company has been engaged in the welding supply industry in Hong Kong and Southern China for more than 40 years. Our goal is to offer a premium welding package to our customers, including the welding and cutting machines, welding consumables as well as on site technical support on welding related matters. As a Kobelco partner since I960, we market a full range of Kobelco consumables. With our sales effort and Kobelco's technical know how and QTQ strategy, Kobelco brands have become the best known welding consumables in Hong Kong and Southern China. With the achievements obtained in the past, we have confidence to maintain this leading marketing strategy with Kobelco towards the 21st century."

Ying Fat Metal Co.
W. M. Shing, Managing Director

Technical Report

LB-52A

(AWS A5.1 E7016)



LB-52A provides extra-grade qualities: extra low hydrogen, extra high tensile strength, and extra high notch toughness. These features assure a successful result in welding thick-section work.

Extra Low Hydrogen Can Lessen Preheating Temperature

The three main causes of cold cracking that may occur in welding thick-section work are:

(1) diffusible hydrogen in weld metal
(2) brittle weld metal and heat-affected zone
(3) the extent of restraint, or residual stresses, in a weld joint (thicker steel material generally increases restraint)

The hydrogen dissolved during arc welding can be diffusible or non-diffusible in weld metal, depending on temperature and structure. Diffusible hydrogen is prone to pile up, by diffusion, at voids in the crystal structure of the weld metal and heat-affected zone. The piled hydrogen increases pressure, which may induce cracks in the weld. Hydrogen-induced cracking may occur at metal temperatures lower than approximately 200°C; therefore, this type of cracking is called "cold cracking." The non-diffusible hydrogen (residual hydrogen) remains in a stable condition in the weld metal.

Therefore, the amount of diffusible hydrogen should be kept low in order to decrease the susceptibility to cold cracking. Fig. 1 compares LB-52A and a conventional low hydrogen electrode (E7016) in terms of the amount of diffusible hydrogen released from the weld metal tested in accordance with JIS Z3118 (Method of Measurement for Hydrogen Evolved from Steel Welds).

The crack test data of high strength steels shown in Fig. 2 illustrates how LB-52A can lessen preheating

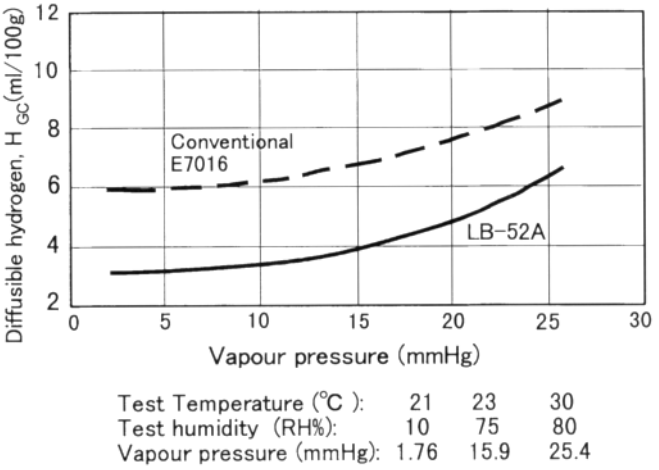


Fig. 1 — A comparison between the LB-52A and conventional E7016 weld metal in terms of diffusible hydrogen vs. ambient vapour pressure in the test. The amounts of diffusible hydrogen (H_{GC}) were determined by using the gas chromatographic method (JIS Z3118). The electrode samples were redried at 350°C for 1 hour before use.

temperatures in welding a thick-section joint. Calculation of the crack parameter (Pc) of 50-kgf/mm^2 high strength steel results in 0.33 in the use of LB-52A and 0.36 in the use of a conventional E7016. Table 1 shows the parameters used in the calculation.

Table 1 — Parameters used for calculation of Pc

Base metal	Chemical composition of base metal, %			*t* mm	Elect-rode	H ml/100g
	c	Si	Mn			
JIS SM490B	0.14	0.35	1.40	36	LB-52A	3.2
					Conv. E7016	5.0

Note: Hydrogen content (H) is calculated by using the following formula: H = 0.787 X (H_{GC}: hydrogen by qas-chro. method) – 1.72

As shown by the dotted lines in Fig. 2, LB-52A requires a minimum of 85°C to prevent cold cracking, while a conventional E7016 electrode would require approximately 125°C. In welding steel structures or machinery, however, site-proved preheating

temperatures may generally be lower than those calculated in the above, because the restraint is less than that of the test plates used for developing the data shown in Fig. 2. Anyhow, the use of LB-52A can decrease the minimum preheating temperature by 40°C.

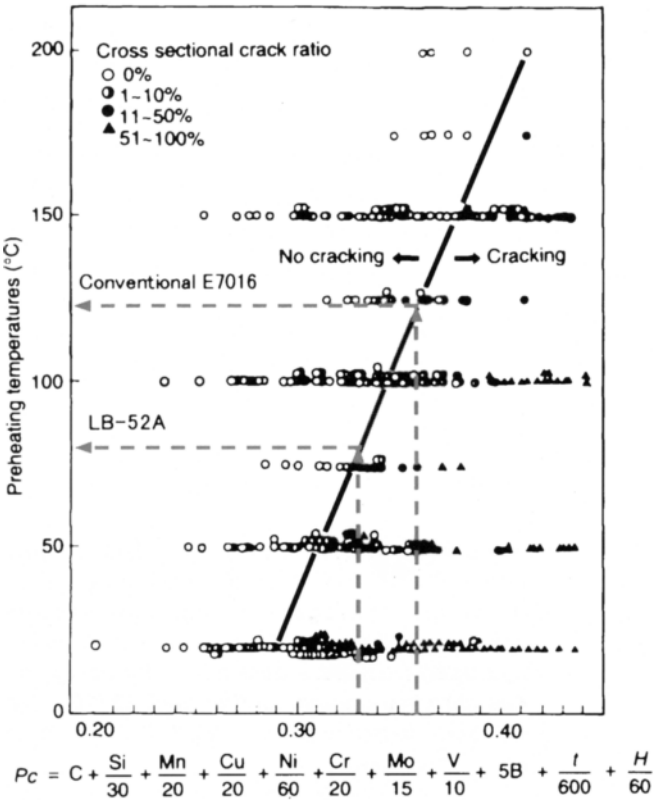


Fig. 2 — Preheating temperatures as a function of the cracking parameter (Pc) of high strength steel welds. (Source: WES 3001-96)
- Chemical composition: wt%
- Plate thickness (t): mm
- Diffusible hydrogen content determined by using the glycerol method (H): ml/100g

Extra High Tensile Strength Can Assure Longer-Hour Postweld Heat Treatment of Large, Thick-Section Work

In the welding fabrication of large, thick-section work, such as pressure vessels, postweld heat treatment (PWHT) is often required in order to relieve residual stresses. As the .work is thicker and larger, the postweld heat treatment generally requires more time. In this case, the amount of weldment tensile strength derived from the extent of postweld heat treatment is an important factor in assuring quality. Fig. 3 compares tensile strength of the LB-52A and conventional E7016 deposited metal as a function of postweld heat treatment. Where 52 kgf/mm^2 is the target (in order to assure a minimum tensile strength of 50 kgf/mm^2), the LB-52A deposited metal can be heat treated at 620°C for approximately 40 hours, while the conventional E7016 deposited metal cannot tolerate more than 4 hours of heat treatment, according to the data shown in Fig. 3.

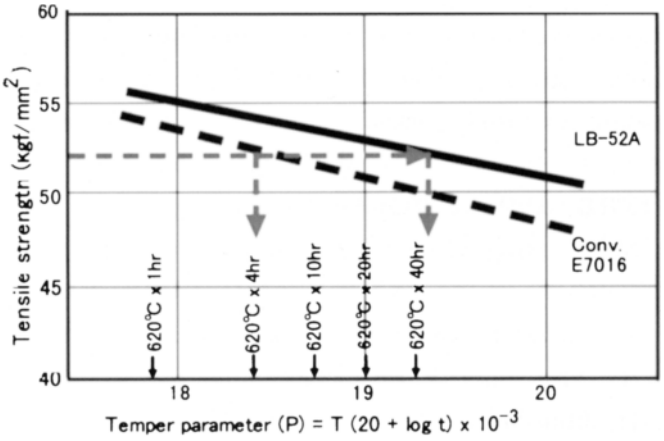


Fig. 3 — A comparison of the tensile strength of the LB-52A and conventional E7016 deposited metal over several postweld heat treatment conditions

Extra High Notch Toughness Can Tolerate the Scattering Caused by Welding Variables

Notch toughness of weld metals is often affected by variables such as heat input (i.e. welding amperage, arc voltage, and welding speed), cooling speed (i.e. plate thickness, and interpass temperature), and postweld heat treatment. Extra high notch toughness, therefore, helps assure dependable quality.

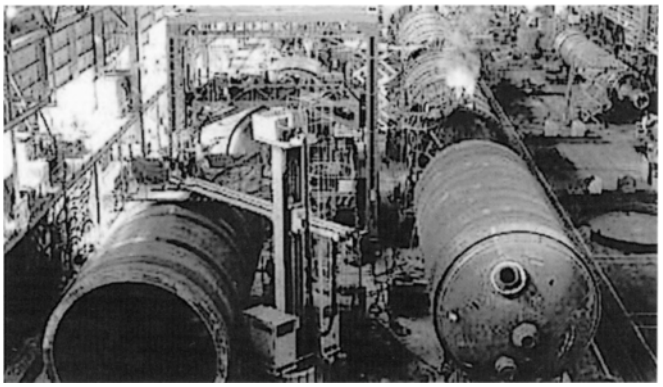


Fig. 4 — In the fabrication of pressure vessels, many variables must be severely controlled in order to assure weld qualities including notch toughness.

NC-37L

(AWS A5.4 E347-16)

NC-37L is an indispensable electrode for the 347 overlaying (with an E309/E309L electrode for buffer layers) of the internal surfaces of Cr-Mo steel pressure vessels. In addition, NC-37L is suitable for the welding of Type 347 (18%Cr-8%Ni-Nb) or 321 (18%Cr-8%Ni-Ti) stainless steel.

Niobium Is an Essential Characteristic

As you may know, according to the AWS classification (E347-16) of NC-37L, this electrode deposits a 347 type (19%Cr-10%Ni-Nb) metal in welding. Niobium (or columbium) contained in NC-37L is an essential element that characterizes this electrode. AWS E347 specifies the niobium content of the deposited metal be a minimum of 8 x C% and a maximum of 1.00%. When C% is 0.035, for example, the minimum niobium content must be 0.28%.

NC-37L Offers Superior Crack Resistance and Corrosion Resistance

NC-37L is designed so that the deposited metal contains an appropriate amount of ferrite (3-10 FN) in its austenitic structure: as a result. NC-37L offers low susceptibility to hot cracking.

Strict control of the niobium content and low carbon content (typically, 0.035%) of NC-37L provides superior resistance to "Intergranular Corrosion" due to less sensitization (i.e. less chromium carbide precipitation at grain boundaries at high temperatures) than conventional E347 type electrodes.

The Choice for welding 347-or 321-Type Stainless Steel for High-Temperature Equipment

In the past, the reactors and heat exchangers for desulfurization and reformer equipment in oil refineries used 304-type stainless steel. However, in acidic environments, the use of 304-type stainless steel resulted in "Stress Corrosion Cracking" (the cracking caused by tensile stresses in corrosive environments). This problem took place because the 304-type stainless steel had been sensitized by the heats encountered in welding fabrication and in high-temperature operations.

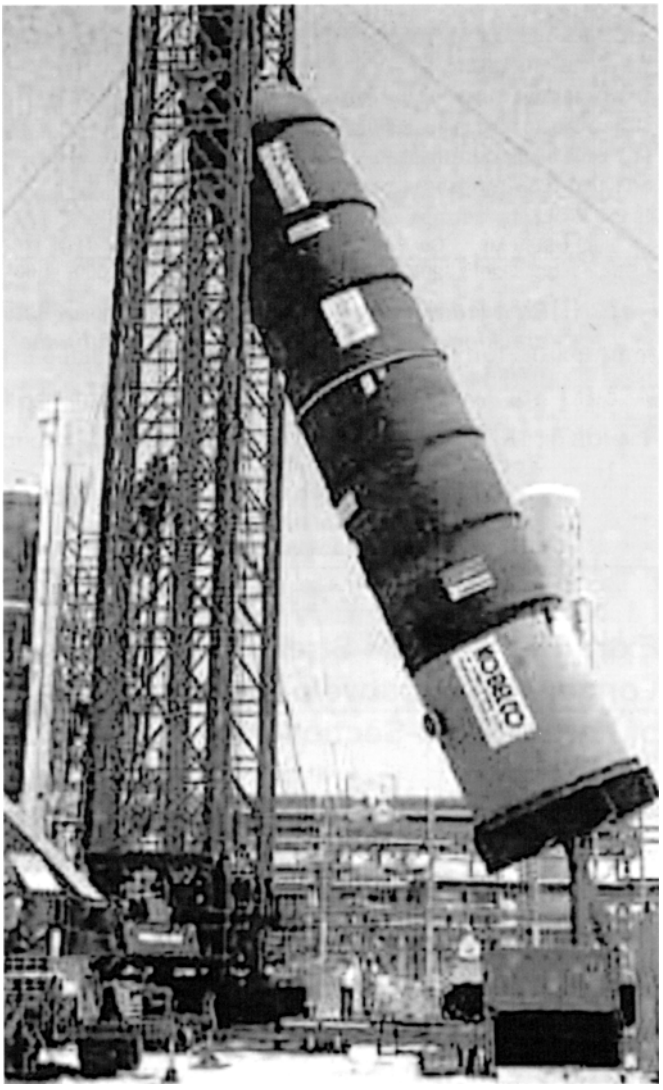


Fig. 1 — NC-37L is an indispensable electrode for fabricating high-temperature equipment in oil refineries.

Nowadays, in order to improve the sensitization, stabilized steels of the 347 and 321 types are used for the high-temperature applications. Carbon is stabilized because 347-type stainless steel contains Nb and 321-type stainless steel contains Ti, respectively. Because the stabilized carbon cannot combine with chromium, the precipitation of chromium carbides at the grain boundaries (the phenomenon known as sensitization) is prevented.

In power generation plants, high-temperature combustion gases, produced by burning fuels, heat water (lowing in heater tubes in order to generate steam. The gases also heat steam flowing in superheater tubes in order to produce superheated steam, which is supplied to power generation turbines for generating electricity. Fig. 2 shows the process of power generation: from the steam boiler, through the power generation turbine, and, finally, the power transmission line.

The temperature of the superheated steam can be 500°C or higher. Therefore, the superheater tubes made of stainless or low-alloy steel are subject to severe corrosion known as "High-Temperature Corrosion." Superheater tubes made from 347-type stainless or 9%Cr-1%Mo steel have higher resistance to high-temperature corrosion. In the welding of 347-type stainless steel tubes, NC-37L is a suitable electrode.

Tips for Welding 347- or 321-Type Stainless Steel

The choice of NC-37L can be the way to fulfill stricter requirements for ferrite content, corrosion resistibility, and mechanical properties. When you use NC-37L, however, the following instructions should be noted in order to get the best results.

(1) Do not preheat when you weld 347- or 321-type stainless steel. Rather the interpass temperature should be kept at 150°C or lower in order to prevent hot cracking.
(2) Use proper welding currents. This is to minimize the electrode-burn caused by Joule's heat. The electrode-burn degrades usability and mechanical properties of the weld metal.
(3) Redry NC-37L at 150-200°C for 30-60 minutes before use when it picks up excessive moisture. If an electrode picks up excessive moisture, it causes porosity, and its arc becomes stronger, causing excessive spatter, irregular bead appearance and undercut.
(4) Keep the arc length as short as possible in order to minimize the nitrogen contamination of the weld metal. If excessive amounts of nitrogen (in the welding atmosphere) dissolves into the molten pool, the ferrite content of the weld metal decreases because nitrogen is an austenite-forming element.

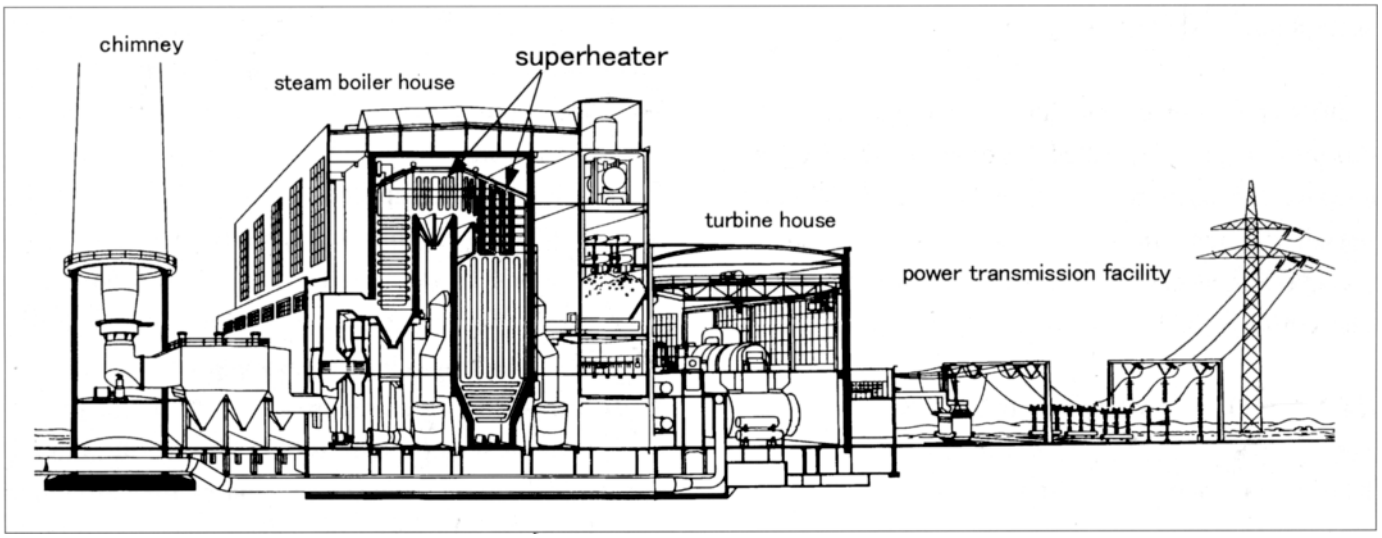
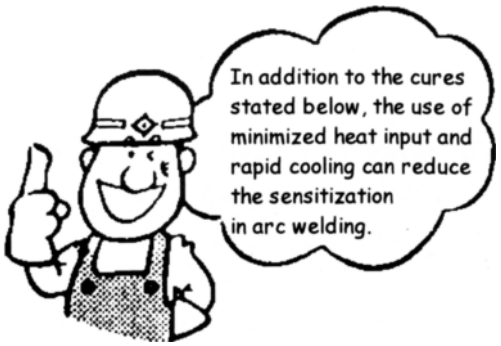


Fig. 2— A cross-sectional view of power generation plant (Source: The Oxford Duden)

Weld Decay: Its Cause and Cure



Any stainless stool contains 13% or higher chromium. Because of the large amount of chromium, stainless steels are kept tree from corrosion due to the chromium oxide forming a rigid membrane on their surfaces when subjected to such corrosive media as air or oxidizing acids (e.g. nitric acid). Austenitic stainless steel contains (in addition to chromium) nickel, molybdenum, and copper to provide the corrosion resistance against non-oxidizing acids (such as hydrochloric and sulfuric acid) and reducing acids (such as saline solution and sulfurous acid).

The typical austenitic stainless steel, Type 304 (l8%Cr-8%Ni), is used for a wide range of applications due to excellent mechanical properties, workability, weldability, in addition to superior corrosion resistance. However, the weld heat-affected zone of Type 304 may be attacked by selective corrosion, when it is exposed to a severe corrosive environment. The attack is called "weld decay," which is caused by intergranular corrosion. Fig. 1 shows weld decay that occurred on both sides of the seam weld of a 304 pipe of a hot dilute nitric process.

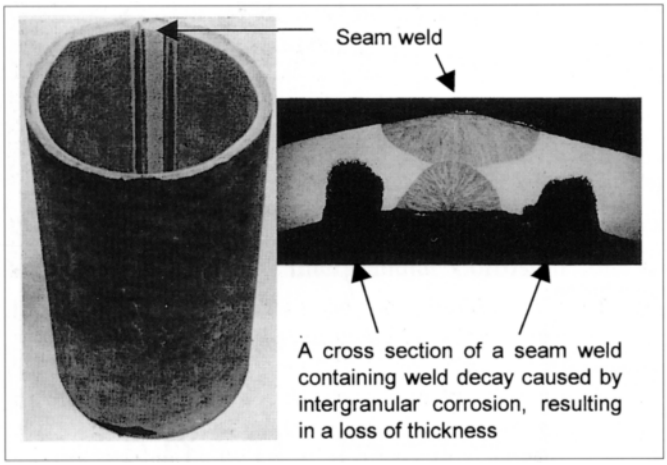


Fig. 1 — Weld decay occurring on both sides of a 304-pipe weld for a hot diluted nitric process line (Source: AWS Welding Handbook)

Weld areas are heated at high temperatures in arc welding. Fig. 2 shows the temperature distribution and the heat-affected zone in a weld.

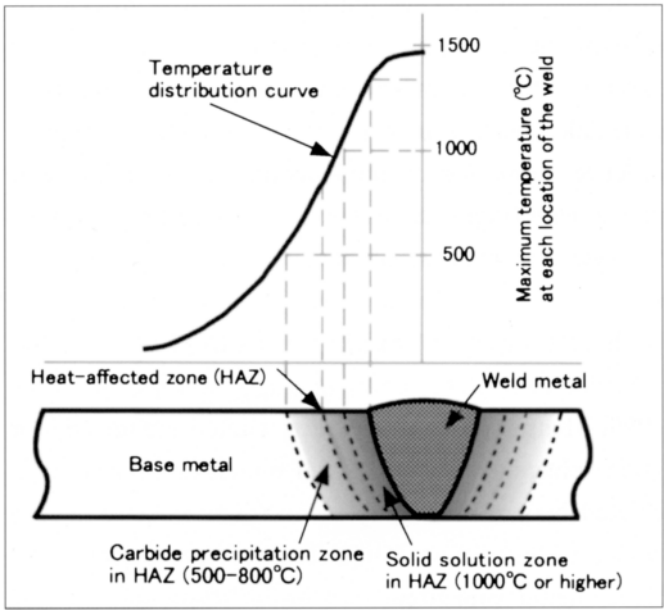


Fig. 2 — Temperature distribution and the heat-affected zone in a 304 stainless steel weld

In the carbide precipitation zone (as shown in Fig. 2) chromium combines with carbon and precipitates chromium carbides at the grain boundaries, depleting the corrosion-resistible, uncombined chromium at or adjacent to the grain boundaries. This phenomenon is called "sensitization," because the areas along the grain boundaries become sensitive to corrosion. In order to control the sensitization of the heat-affected zone, use

(1) 304L or 316L grade, because lower carbon content decreases the carbide precipitation.
(2) 347 or 321 stabilized grade, because stronger carbide-forming elements (Nb or Ti) prevent the precipitation of chromium carbides.
(3) postweld solution annealing treatment in the temperature range of 1000-1150°C, followed by rapid cooling, which decomposes the chromium carbides and make the chromium resistible to corrosion.

My Good Relationship and Mutual Understanding with Kobe Steel

Fig. 1 — Mr. Dahlan Gunawan, the former president of INTIWI, messages at a commemorative occasion of his voluntary retirement.

INTIWI (PT Intan Pertiwi Industri), whose head office is located in Jakarta, is a welding electrode manufacturer established in 1976 under license agreement with Kobe Steel, Ltd. INTIWI started the production of electrodes in 1977 in Tangerang. The initial production capacity was 150 metric tons of RB-26 per month. After 20 years of hard work. INTIWI expanded its production and sales to 19,000 metric tons in 1997. Nowadays, the company produces more than 20 products for welding mild steel, high strength steel, stainless steel and cast irons, and for pipe-welding and hard-surfacing.

I have been president director of INTIWI since the establishment of the company, and I retired in April, 1999. Throughout my 22 years of duty, I found that a good relationship and mutual understanding always existed between the licenser and licensee. Once in a while, we had different opinions, but the problems were always settled amicably.

I am thankful for the support of both Kobe Steel, Ltd. and my dedicated staff that have allowed us to achieve and maintain a 50% market share for the past few years. In addition, our quality surpasses the competitors' so much that our end users have full confidence in our brands, even at a higher buying price.

The momentary economic crisis in Asia, no doubt, has affected our business performance. Our sales dropped to only 9,500 metric tons in 1998. Indonesia is the slowest country in Asia to recover from the economic crisis. This year, INTIWI cannot expect great progress compared to last year.

Mr. Surname), my successor, has more than 22 years of experience in handling the production in the factory. With his leadership, I am sure INTIWI will continue to strive for better results to come especially in the new millennium era.

Fig. 2 — The INTIWI's factory in Tangerang started the production of electrodes in 1977 and recorded a production of 19,000 metric tons in 1997. Their persistent quality control ears a high reputation among users. Mr. Sumarno, the successor of Mr. Gunawan, has been engaged in management of the production for more than 22 years.

PT Intan Pertiwi Industri
Dahlan Gunawan,
Former President

Feature Article

Testing Services Promote the Kobelco Welding Group's Worldwide QTQ Activities: A Report from KWAI

Kobelco Welding of America, Inc (KWAI) has been serving the needs of the petrochemical industry with its DW series stainless flux-cored wire for many years. One requirement of many fabricators serving this industry is to have wires available for cryogenic applications. To serve these customers requires us to have inventory that has been tested at –196°C (–320°F). Kobelco's DW-308L and DW-308LP wires are primarily used for these applications.

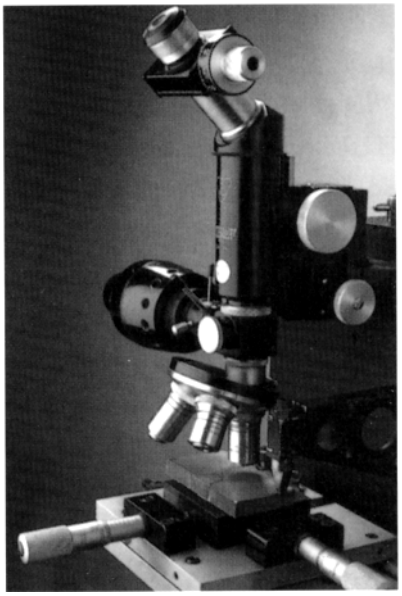


Fig. 1 — A microscope and specimen for metallurgical tests

An-Tech Laboratories, Inc. of Houston, Texas provides us with the testing and certification of wires for these cryogenic applications. Established in 1970, An-Tech provides independent metallurgical testing services for a wide array of metals manufacturers and producers. Serving fabricators, forging plants, medical suppliers, pipe and tube machining operators, as well as manufacturers of metallic and non-metallic products, petrochemical and casting operators, An-Tech continues to build its reputation as a highly capable and professional independent laboratory.

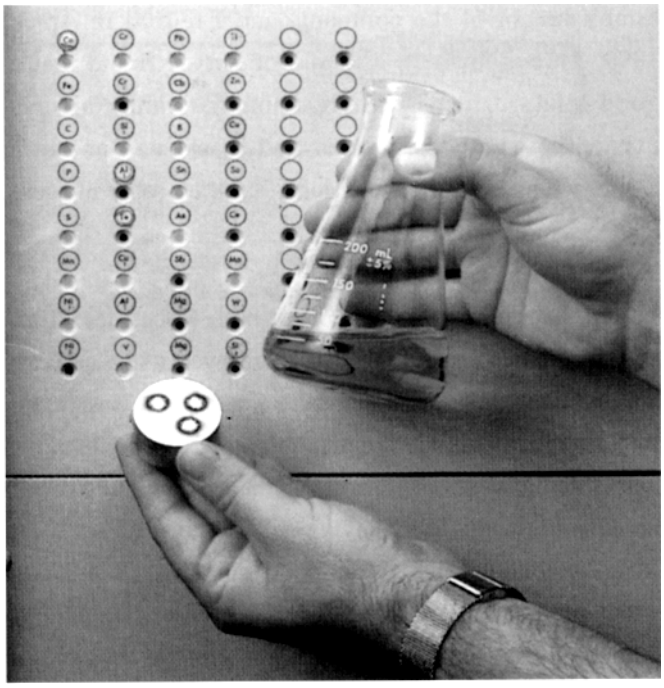


Fig. 2 — A beaker and specimen for chemical tests

All weld metal coupons of specific lot numbers of wire are sent to An-Tech. These coupons are welded in accordance with ANSI/AWS A5.22 and ASME SFA5.22. Five full size (10 mm x 10 mm) Charpy V-notch impact specimens are machined out of the all weld metal coupon in An-Tech's machine shop. These five specimens are tested at a temperature of –196°C (–320°F) in accordance with the impact test section of ANSI/AWS B4.0. This is done by submerging the impact specimens in liquid nitrogen for a set period of time to assure the proper temperature. The specimens are immediately transferred to the Charpy impact test machine and fractured, at which point an impact figure in foot-pounds is recorded. Lateral expansion is then measured in accordance with ASTM E23. In evaluating the test results, the highest and lowest lateral expansion values are disregarded. The remaining three impact specimens must exhibit a lateral expansion of 0.015 in. (0.4 mm). All weld metal tensile tests and chemical analysis can also be performed.

The combination of Kobelco's large inventory and the quick turnaround on testing from An-Tech allows Kobelco to serve the welding consumable needs of fabricators with cryogenic applications.

(Reported by Glenn Villemez,
Regional Sales Manager, KWAI)

When Traveling Abroad, Eating Local Foods Can Soothe Business Fatigue

Everybody knows that traveling on business in foreign countries, where the environment and language are different, can make a person very tired. In my case, however, trying the local cuisine, in the company of the local companies' staff, can really soothe my fatigue in business.

In Singapore, it seems to me, they have a treasure trove of Chinese, Indian, and Malay foods, in addition to great seafood. Hawker Center, an area where food stalls are concentrated, is my best choice: each stall serves about 20 dishes, and a customer can order his favorite foods, after looking at all the various stalls. Drinking Tiger beer, enjoying tofu dishes and curried fish, I feel at my happiest.

In Hong Kong, we should first speak of delicious Guangdong dishes: dried-shark-fin soup, fish steamed in a casserole, and DianXin are all famous. For breakfast in Hong Kong, however, the main food is rice porridge with fish balls. This kind of breakfast seems to be very common in Hong Kong: when looking at business men and women in suits sipping rice porridge. I somehow feel relieved.

In Vietnam, they often eat Pho, a noodle dish. My favorite Pho is made of wheat: I usually take, at one time, two bowls of Pho with fish balls at food stalls.

Fig. 1 — The reporter enjoying a noodle dish in Vietnam

In India, I often have an imitation from our customers to their home parties. India clearly reminds me of spicy curry dishes, and they are different in each district: curry held between pieces of Chapati in Mumbai, and curry put on steamed rice in Chennai. In addition, the varieties of curry are many: chicken, fish, and vegetable. I, therefore, could have enjoyed a variety of Indian curries almost every day during two weeks of my stay.

Coining back to Japan after enjoying a variety of local foods in Asian countries, my weight increased to over 110 kg. At that point I was advised by the doctor to diet. Now, I am continuing the diet, being shaken by appetite so often. However, I have no intention to quit being a gourmand. I am ready to go for enjoying delicacies, whenever you call for me.

(Reported by Kazuyuki Harada, IOD, Kobe Steel)

Editorial Postscript

The Essen Welding Asia is being held in Singapore. October 19-21. 1999. Kobe Steel and Kobe Welding Singapore will attend as a corporate exhibitor. The details of the fair will be reported in next issue (scheduled to be issued in January 2000).

A Symposium on Joining of Materials, SOJOM 2000 Exhibition, is scheduled to open in Tiruchirappalli in India, January 20-23, 2000. Kobe Steel, Nikko Boeki Kaisha, and Weldwell Speciality Pve, Ltd. will be a corporate exhibitor, as in the case of WII '99 fair held in this February.

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