New Products & Technologies

KM-50S Spatterless Wire for Gas Shielded Arc Welding*

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1 Introduction

One of the obstacles to efficiency improvement in welding operation is adhesion of spatter which is generated during welding to the steel plate. Weld spatter particularly tends to increase under high-speed welding and low-voltage conditions, and in the field of thin-plate high-speed welding, its reduction is strongly desired.

To satisfy these needs, Kawasaki Steel has developed a unique wire KM-50S, in which the chemical composition is adjusted, and has made it possible to lower the spatter significantly compared with the conventional wires.

This report introduces the outline of KM-50S spatterless wire for gas shielded arc welding.

2 Features of KM-50S

KM-50S has the following outstanding features:

(1) Weld spatter has been significantly decreased to about 1/5 or below compared with the conventional welding wire.

(2) Through the stabilized welding arc phenomenon, generations of bead snaking and undercut are low, and the shapes of welded beads are satisfactory.

3 Material Characteristics of KM-50S

3.1 Chemical Composition of Wire and Standard

The chemical composition of the wire is shown in **Table 1**. The JIS Standard of KM-50S corresponds to that of YGW 17.

Standard wire sizes, packaged weights, and winding styles are shown in **Table 2**.

Table 1 Chemical composition of welding wire

(mass%)

C	Si	Mn	P	S
0.10	0.35	1.27	0.009	0.021

Table 2 Standard size, packaged weight and style

Wire diameter (mm)	Style of winding
0.8	S, M
0.9, 1.0	S, M, RPS, RPM
1.2	S, M, RPS, RPM, RPL
1.4, 1.6	S, M, RPL

Note (1) Style of winding
S : Small spool wound (standard weight 10kg)
M : Medium spool wound (standard weight 20kg)
RPS : Small pail pack (standard weight 100kg)
RPM : Medium pail pack (standard weight 250kg)
RPL : Large pail pack (standard weight 350kg)

3.2 Performance of All-Weld Metal

3.2.1 Welding conditions

Welding conditions are shown in **Table 3**. For the welding machine, a turbo-pulse power source was used, and DCEP was adopted. Further, for the gas shielding, 80%Ar-20%CO_2 mixed gas was used.

Table 3 Welding conditions of all deposited test

Welding wire (dia.)	Steel plate (thick.)	Current (A)	Voltage (V)	Speed (mm/min)	Heat input (kJ/mm)	Preheat temp. (℃)	Interpass temp. (℃)
KM-50 S (1.2 mm)	SM-400A (19 mm)	300	30	400	1.35	30	≦ 200

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Table 4 Mechanical properties of deposited metal

Tensile properties[a]				Charpy impact properties[b]		
YP (MPa)	TS (MPa)	El (%)	RA (%)	Absorbed energy (J)		
				−20℃	0℃	+20℃
510	542	26	68	59	111	126

[a] JIS Z 3111 A 1 [b] JIS Z 3112 No.4

3.2.2 Mechanical properties

Table 4 shows the results of the tensile test and Charpy impact test of the all-weld metal of KM-50S. Both tensile performance and Charpy impact performance sufficiently satisfy the standard values and became satisfactory values.

3.3 Amount of Spatter Generated

3.3.1 Welding conditions

Welding conditions are shown in **Table 5**. For welding speed, a strict condition of 1 200 mm/min, which is liable to cause spatter, is adopted.

Table 5 Welding conditions of bead on plate

Welding wire (dia.)	Steel plate (thickness)	Current (A)	Voltage (V)	Speed (mm/min)	Wire ext. (mm)	Shielding gas	Welding machine
KM-50 S (1.2 mm)	SPCC (2.5 mm)	200	22	1 200	20	Ar-20% CO_2	Turbo pulse (OTC)
Conventional type YGW 12 (1.2 mm)							

3.3.2 Results of spatter measurement

Spatter measurement results, when the pulse peak current width was changed, are shown in **Table 6**. Compared with the conventional material, the spatter is extraordinarily reduced to about 1/5 or below, and spatter adhesion to the steel plate rarely occurs.

Table 6 Test results of spatter generation (g/min)

Welding wire \ Width of pulse peak current (ms)	0.7	0.9	1.1	1.3	1.5
KM-50 S	1.45	0.70	0.35	0.35	1.00
YGW 12[a]	2.74	2.00	1.50	1.50	2.80

[a] conventional type

3.4 Mechanism of Low Spattering

Spatter generation in pulse MAG welding is strongly related to the globule-shifting mechanism. As shown in **Fig. 1**, in an ideal state, in which the globule at the wire tip will break away in synchronization with the period of the pulse current as shown in Fig. 1, almost no spatter is generated. On the other hand, if the pulse current not synchronized, a short-circuit phenomenon will, as shown in **Photo 1** (a), occur, which is different from the satisfactory shifting, and when the location is cut off by the fusing action, a large quantity of spatter will be generated.

Then, in the case of KM-50S, the wire chemical composition has been adjusted in order to realize ideal globule-shifting of 1 globule per pulse. As shown in

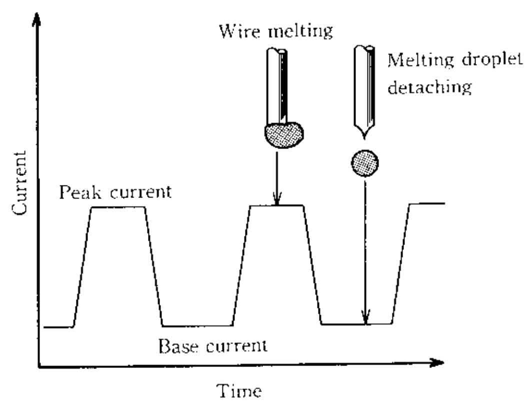
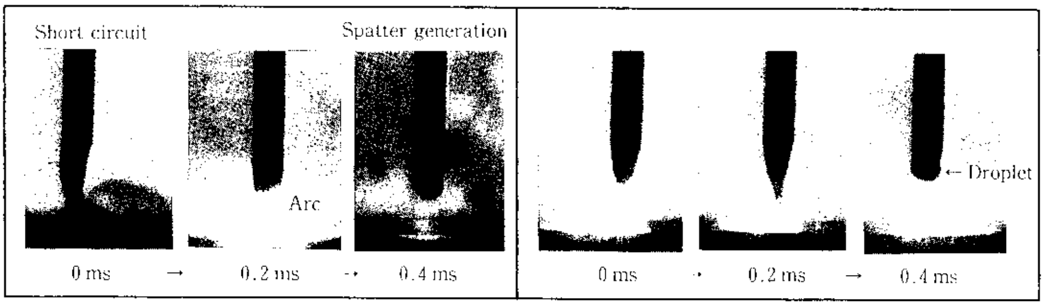


Fig. 1 Relationship between current form and droplet transfer



(a) Bad arc phenomena (b) Good arc phenomena

Photo 1 Arc phenomena of welding observed by high speed video camera

Photo 1 (b), in KM-50S, shifting of 1 globule per pulse has already been achieved, and the short-circuit shifting phenomenon hardly occurs. Thus the spatter has also become small.

4 Concluding Remarks

As mentioned in the present report, by developing KM-50S wire, whereby stabilized welding arc can be obtained in the thin-sheet high-speed welding arc, it has become possible to reduce the spatter generation weight and to stabilize the welded bead shapes.

In the future, it is hoped to expand the application of KM-50S to the fields of products other than thin sheets where the reduction of the spatter is also desired.

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