TECHNICAL NOTE

Effect of Welding Speed on Oxygen and Nitrogen Contents in SAW Metals†

Nobuya IWAMOTO*, Yukio MAKINO**, Kan-ichiro SHIMIZU*** and Taisuke AKAMATSU****

KEY WORDS: (SAW Metal) (Welding Speed) (Oxygen Content) (Nitrogen Content) (Flux)

In the welding process using flux, slag-metal reaction has important influences on the quantities of non-metallic elements in weld metal such as nitrogen and oxygen. Selection of suitable welding is also significant for removals of trapped slag particles and of non-metallic inclusions and for weldability. On the contrary, effect of constituent oxide in flux on welding speed is one of the essential factor for selecting flux component. In this study, SAW was performed at various welding speed using ternary oxide fluxes and effect of welding speed on oxygen and nitrogen contents in weld metal was investigated. Further, effect of constituent oxide in flux on welding speed was also investigated.

In this study, welding current and voltage were fixed to be 520±10 A and 30±5 V. Welding speed was varied from 20 cm/min to 100 cm/min by the interval of 20 cm/min. SAW 41 wire (3.2 mmϕ) and SM 41 steel plate (12 mm^t) were used for filler and base metals. Three sorts of trial fluxes and a commercial one, which compositions are shown in **Table 1**, were used. Base metal was grooved in X-shape and more than two path beads were laid in both backing and finishing sides. Oxygen and nitrogen contents in SAW metals were analyzed using a oxygen/nitrogen determinator (LECO Co., Ltd.) with impulse fusion method.

Figures 1 and **2** show the dependences of oxygen and nitrogen contents in SAW metals upon welding speed. Weld metals using trial fluxes show the higher oxygen contents from 300 ppm to 400 ppm than those using the commercial flux. Further, the discrepancy between oxygen contents in SAW metals using trial and com-

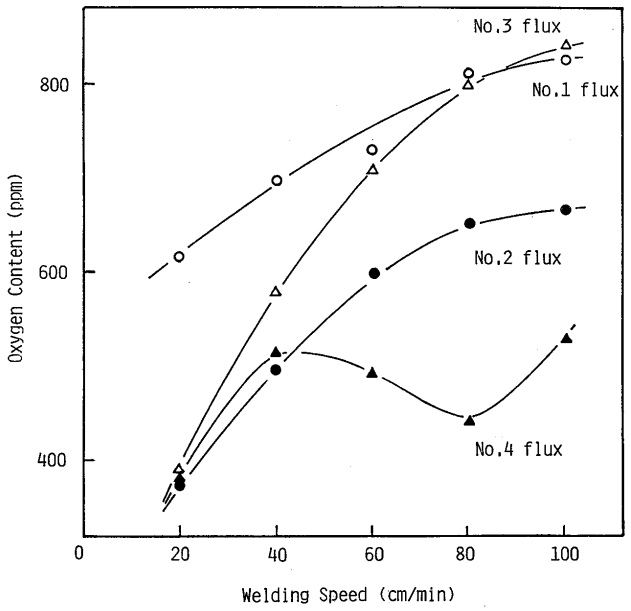

Fig.1 Dependence of oxygen content in SAW weld metal on welding speed.

Table 1 Chemical compositions of trial and commercial fluxes

Flux No.		CaO	SiO_2	MnO	TiO_2	Al_2O_3	MgO	CaF_2
Trial	No. 1	33 3	33.3	33.3	--	--	--	--
	No. 2	40.0	40.0	--	20.0	--	--	--
	No. 3	46.0	29.0	--	--	25.0	--	--
Commercial	No. 4	19.5	39.0	21.0	--	3.0	3.5	10.0

† Received on April 30, 1983
* Professor
** Instructor
*** Associate Professor, Kogakuin University
**** Professor, Kogakuin University

Transactions of JWRI is published by Welding Research Institute of Osaka University, Suita, Osaka, Japan

mercial fluxes becomes larger with increasing welding speed. On the other hand, in the case of nitrogen content as shown in **Fig. 2**, the discrepancy is about 20 ppm at maximum and increases as the welding speed increases. **Figure 3** shows the relation between oxygen content and Charpy impact value at 25°C. In the region of oxygen content more than about 650 ppm, Charpy impact value shows no dependence upon oxygen content in weld metal.

Relation between Charpy impact value and welding speed is given in **Fig. 4**. No decrease of Charpy impact value is observed weld metals using the commercial flux irrespective of welding speed. On the other hand, Charpy impact values in weld metals using trial fluxes decrease with increasing welding speed. Because oxygen content in weld metal using trial flux increases with increasing welding speed, it is suggested that the decreases of Charpy impact values in these weld metals are attributed to the increment of oxygen content. The suggestion is supported by the fact that very low Charpy impact values in the weld metals using No. 1 flux are observed without relating to welding speed.

As shown in Fig. 4, No. 2 and No. 3 fluxes gives a good characteristic on welding speed compared with No. 1 flux. This may be due to the difficulty of dissociation of TiO_2 or Al_2O_3 in slag compared with that of MnO[1], resulting in decrement of oxygen content in weld metal. No. 2 flux shows a slight good characteristic on welding speed compared with No. 3 flux. The result remains unclear although improvement of physical properties such as fluidity by TiO_2 addition is suggested[2]. In near future, metallurgical consideration will be performed by determining slag compositions and the contents of alloying elements in weld metals.

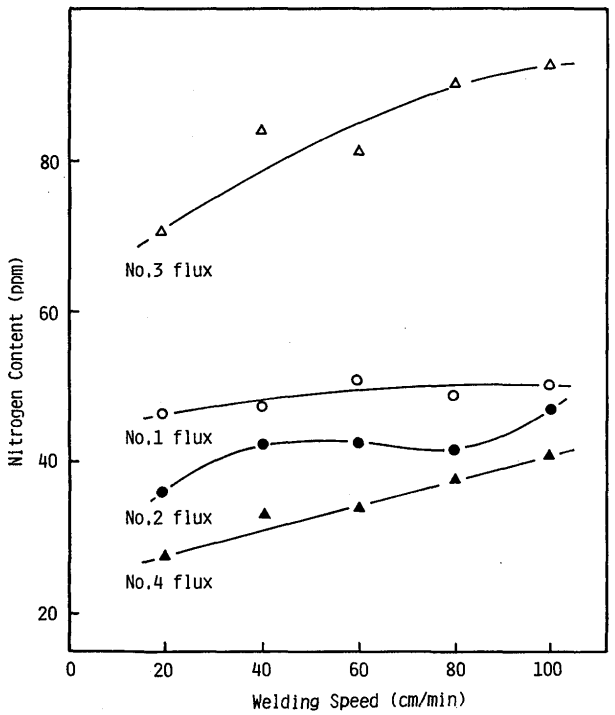

Fig. 2 Dependence of nitrogen content in SAW weld metal on welding speed.

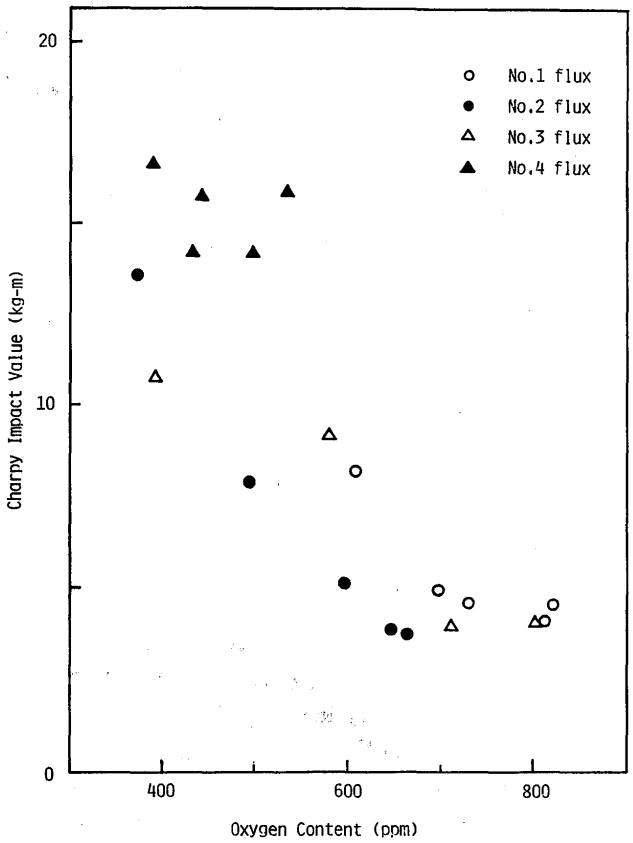

Fig. 3 Ralation between oxygen content and Charpy impact value at 25°C.

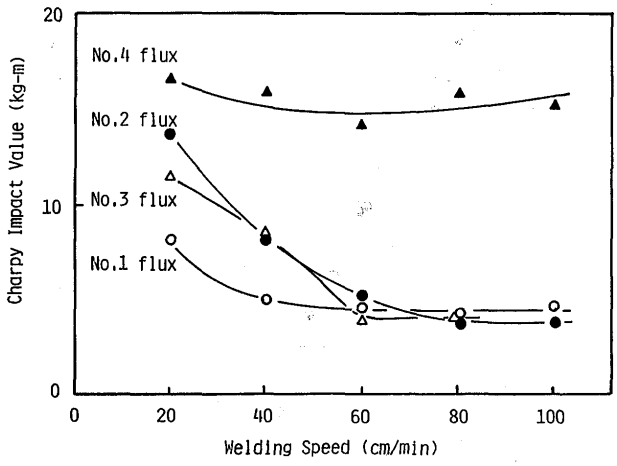

Fig. 4 Ralation between welding speed and Charpy impact value at 25°C.

References

1) L. Darken and R. Gurry: "Physical Chemistry of Metals" Chap. 14, McGraw-Hill Book Co. (1953).

2) N. Iwamoto, T. Taira, K. Akao, Y. Tsunawaki and Y. Makino: Trans. JWRI, 7 (1978), p. 49.