Flow of Brazing Filler Metal and Flux†

Ikuo OKAMOTO*, Akira OMORI** and Masaaki MIYAKE***

A solder which produces good spreading on a base metal does not always show good penetration in a capillary. This important fact already was found in the previous report[1]. The present paper describes the similar phenomenon observed in silver brazing of a stainless steel.

Two experiments were done. One is a spreading test and another is a tee joint test. In both tests the austenitic stainless steel (SUS304) as base metal, BAg 5 of JIS specification as filler metal were used, respectively, and nine fluxes were used. In Fig. 1, the main ingredient of seven candidate fluxes designated by the letters "A" to "G" is a mixed salt of 30wt%KCl and 70wt%-LiCl system, to which 10wt% of metallic chlorides such as $FeCl_3$, $NiCl_2$, CuCl, AgCl, $CuCl_2$, $CrCl_3$ and $SnCl_2$ added in order of the letters. Accordingly, the main ingredient in each flux is 90% by weight. The composition of "H" flux is the main ingredient alone and "I" flux is a fluoride type commercial flux used to compare with the virtue of seven candidate fluxes.

The spreading test was made by placing a sized pellet (0.1g) of BAg 5 and powdery each flux (0.2g) in the center of 40mm square by 0.5mm thick base metal plate. This combination was then placed horizontally on a temperature controlled hot plate. The temperature of specimen was 800°C and held for 1 min. The spread area obtained about each flux is shown in Fig. 1. From this result, it is evident that the addition of $FeCl_3$, $NiCl_2$ or CuCl is considerably effective for spreading of BAg 5 on the base metal. On the other hand, no the spread produced in the case of "H" flux. Also, the effect of adding AgCl, $CuCl_2$, $CrCl_3$ or $SnCl_2$ was not almost recognized as compared with the spreading when "I" flux was used.

Tee joint test was done to evaluate the ability for fillet formation of BAg 5 filler metal with candidate fluxes. As shown in Fig. 2, the tee joint specimen was made from two strips of the base metal, vertical member of 5mm thick by 15mm wide by 25mm long and horizontal member of 1mm thick by 30mm wide by 40mm long, and by wiring the two strips together with a fine molybdenum wire of 0.25mm dia. without tack weld. Accordingly, a space at faying surface seems to be zero perhaps. A sized pellet (0.45gr) of BAg 5 was placed at one side of the tee and powdery each flux (0.25gr) at both sides. The specimen then was heated with the same manner and conditions mentioned above. After the filler metal completely flowed around the joint and

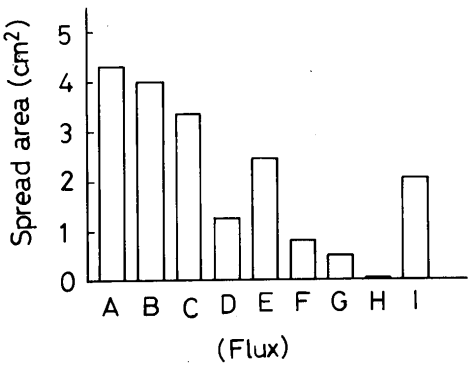

Fig. 1 Spread of BAg 5 on stainless steel using various fluxes

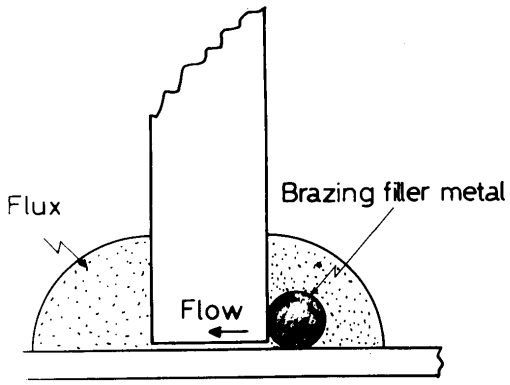

Fig. 2 Specimen for evaluating fillet forming characteristics

† Received on Sep. 16, 1976
* Professor
** Research Instructor
*** Co-operative Researcher (1976), Assistant Professor, Junior College of Engineering, University of Osaka Prefecture

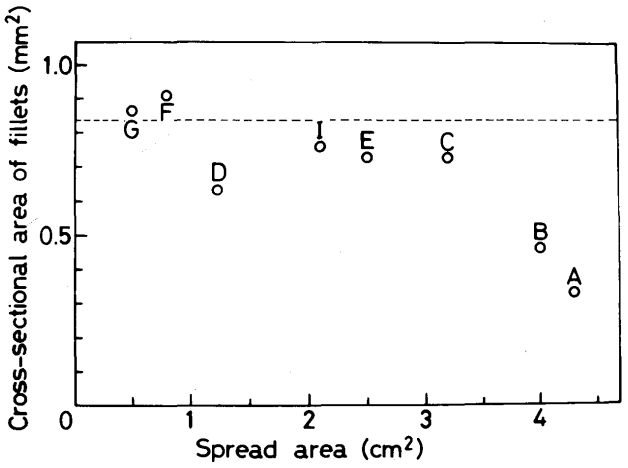

Fig. 3 Relation between cross sectional area of fillet and spread area obtained in Fig. 1.

cooled, the specimen was cut transversely at a center part of longitudinal direction to evaluate fillet forming characteristics of BAg 5 with each flux. The cross sectional areas of fillets formed at both sides of the tee were measured and their mean value is shown in Fig. 3 relatively to the spread area showed about each flux in Fig. 1. A dotted line in Fig. 3 shows the ideal value of cross sectional area when the used filler metal uniformly flowed around the tee with a equal leg length. Except both "A" and "B" fluxes, the values of cross sectional areas of fillets formed by using another fluxes approximately distribute on this line. On the measurement of cross sectional area, it causes the shift of "A" and "B" from this line to neglect the spread part showed a thin film state on the surface of horizontal member. The "A" flux added $FeCl_3$ and "B" flux added $NiCl_2$, these fluxes, anyhow, promoted for spreading of BAg 5 on the stainless steel plate as mentioned above. The formation of fillets in tee joint depends greatly on the spread-ability of filler metal on the horizontal member. Accordingly, it was concluded again that horizontal flow and vertical flow of brazing filler metal and flux should not be identically evaluated.

Reference

1) I. Okamoto, A. Omori, K. Den and K. Tamaki: Relation between spreading area and penetration height in soldering, Transactions of JWRI, Vol.4, (1975), No.2, p.105 (IIW. Doc. No. IA-279-75).