Automated Paste Application versus Pre-placement of Amorphous Brazing Foil

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Introduction

Developments in the application of paste, which is a mix of brazing powder and a polymer binding agent, have focused on faster application speeds. The major processes used for faster, selective paste application are roller coating and screen printing. Neither of these processes are new and have been taken from other industries for use in braze paste depositing. For instance screen, printing has been used in graphic application on t-shirts for decades and roller coating is how adhesives are typically applied to tapes. Both of these processes have benefits for the user over the traditional methods of spraying or dispensing paste, but they still have limitations that will be addressed in this paper.

Roller Coating

Roller coating is a paste application process that uses a driving roller to move the substrate forward and a coating roller to coat the substrate. There are multiple derivations of this technique, but generally three rollers are used as can be seen in Figure 1, with one of them being stationary to hold the braze alloy in place and limit the coating thickness on the coating roller. This process can coat parts at approximately 65 feet per minute and even has the capability to coat on both sides of a substrate if needed. Coating thicknesses are typically between .002 to .004".

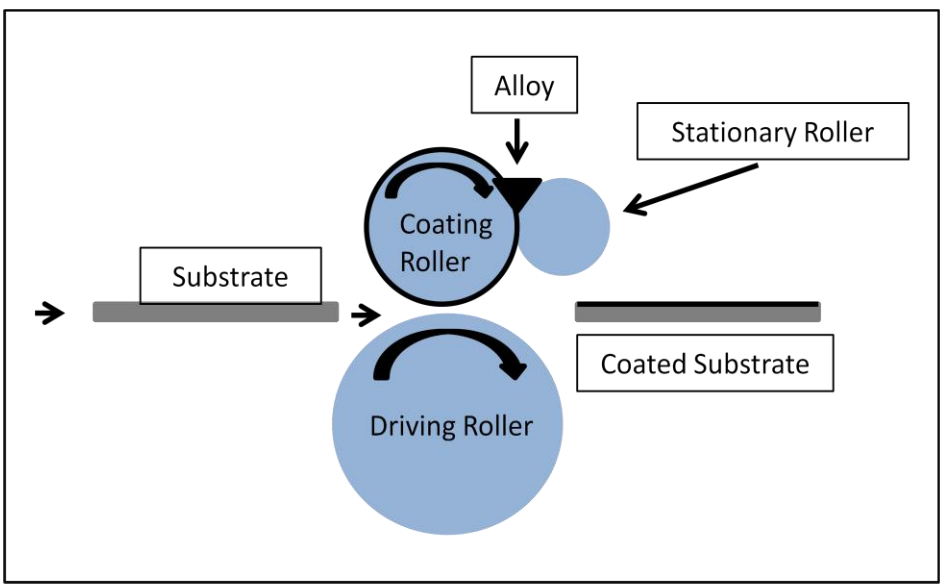

Figure 1: Illustration of the roller-coating process for applying braze paste

Screen Printing

Screen printing is a process that utilizes a screen to selectively deposit braze paste on the substrate. A screen is laid over the substrate and braze alloy is pressed over the screen using a squeegee. This forces the paste through the holes in the screen on onto the substrate. Excess material left over after screen printing is re-used on the next piece, or next pass. The thickness of the braze paste layer is typically between .004-.012" thick

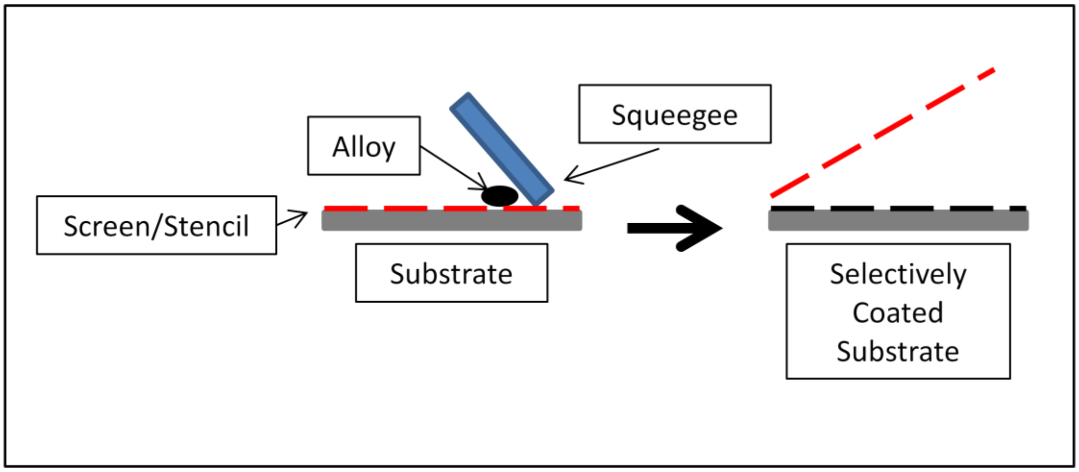

Figure 2: Illustration of the screen printing process for applying braze paste

Both of these processes offer distinct advantages over the more traditional dispensing and spraying techniques lending themselves to less expensive automation and faster application speeds. Even with these processes automated they will still require intensive process qualification to verify repeatability, inspection to ensure proper coverage of the substrate and drying time to ensure there is no splatter during heat-up. There also still remain the negatives associated with using brazing powders in general that still apply to these processes.

Amorphous Brazing Foils versus Brazing Paste

Amorphous brazing foil has the following advantages over brazing pastes:

- Lower erosion (see figures 3 and 4)
- Lower porosity (see figures 3 and 4)
- Faster brazing cycle and cleaner furnaces as a burn-off of binder is not required
- One step foil placement which easily lends itself to automation
- Thickness controlled via product and not dependent on operator or process
- Fully homogeneous, dense, metallic foil with uniform melting characteristics
- Foil can be stamped and formed into preform for even more placement control

An independent investigation was conducted by Kanto Yakin Kogyo (KYK) in Japan using their Oxynon® belt furnace to determine the brazing differences between nickel based brazing powder FP-613 and a nickel based amorphous brazing alloy MBF67, which have similar chemistries. Some micrographs from this investigation can be seen in Figures 3 and 4 below.

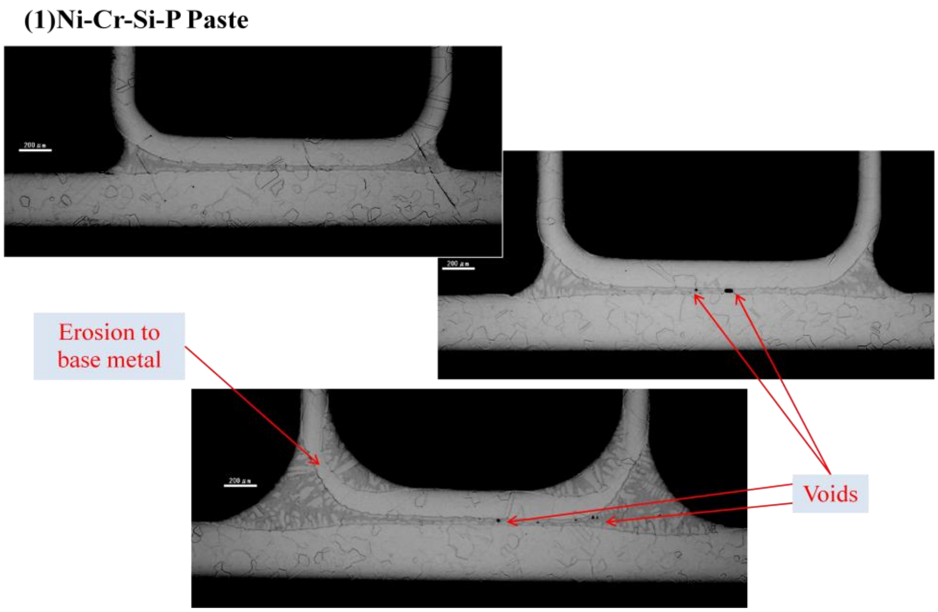

Figure 3: Cross section of corrugated stainless steel sheet brazed to flat stainless sheet by KYK in their Oxynon® belt furnace with Fukuda FP613 paste.

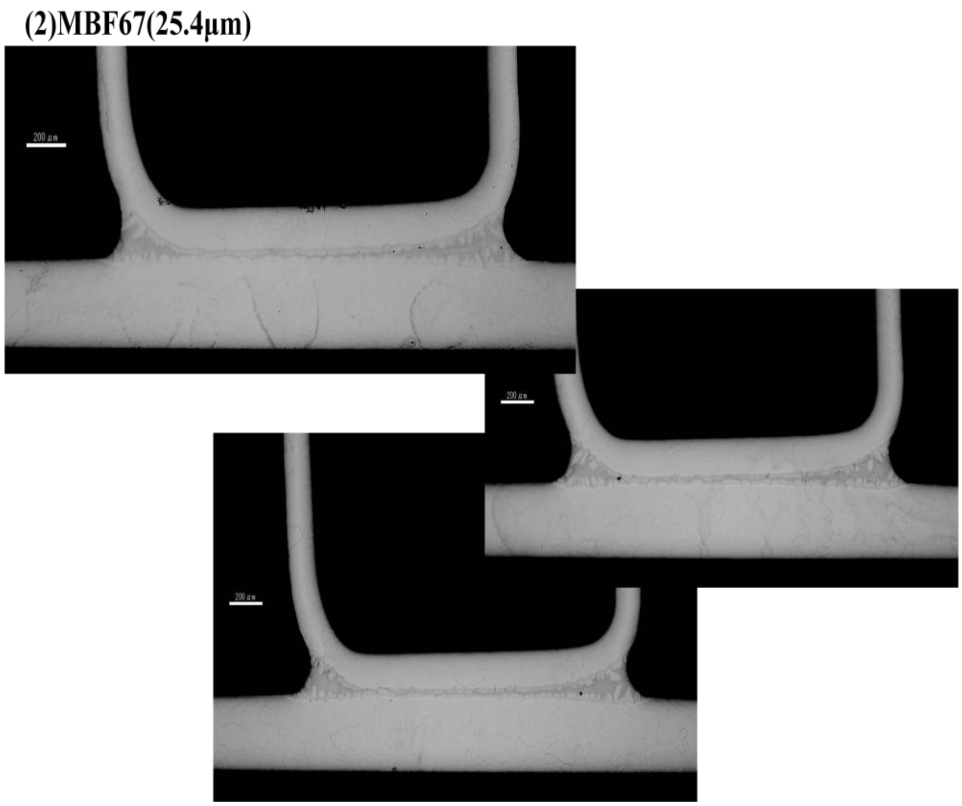

Figure 4: Cross section of corrugated stainless steel sheet brazed to flat stainless sheet by KYK® in their Oxynon® belt furnace with Metglas® MBF67 amorphous brazing alloy.

It should be noted that because the tighter controls on the amount of amorphous braze foil used and how it was placed there is a dramatic difference in the amount of base metal erosion versus using the brazing paste. There are also a significant number of voids in the joint brazed with paste compared with the amorphous braze foil which is almost completely defect free.

Amorphous brazing foil can easily be applied by either sandwiching the foil between two surfaces to be brazed, tack welded into place to prevent foil movement or an adhesive can be used to affix the foil in place.

Conclusion

While recent improvements in the speed and repeatability of braze paste application may make the technology more enticing, the impact on the braze joint should be properly evaluated. For instance, if you are designing a braze joint that you determine has a critical stack-up tolerance, then your best option is foil. If your joint does not lend itself to capillary action of the molten braze alloy and does not have an area for out-gassing then foil is your best option. There are other aspects of brazing that must be taken into consideration when designing your braze joint and determine which brazing alloy form to use for your design.

References

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