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3D Model of T-Shaped Inductor for Induction Brazing

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GOAL OF THE STUDY

Induction brazing technology faces difficulties very often when different sizes of assembly details should be joined together. While the heating effect is achieved by application of high frequency alternating field, material properties and sizes are critical to main process parameters. Some empirical calculations are possible to have a rough estimation about energy needed for reaching the desired temperature but for detailed design of the induction equipment it is not quite enough.

METHODOLOGY OF THE INVESTIGATION

In current report we will present results of 3D modeling of induction brazing process over relatively complex copper pipe assembly with T-shape construction. Because of its surrounding environment, it can't be processed by using of standard or modified helical coil. It is necessary an open-end induction coil to be considered for this application. It is known that such kind of coils have non-symmetric structure of resulting electromagnetic field. This sometimes can be used as an advantage because field can be concentrated in area is desired to be heated. Two types of coils are considered and compared, and results are used for solid proved choice of proper application of the implementation.

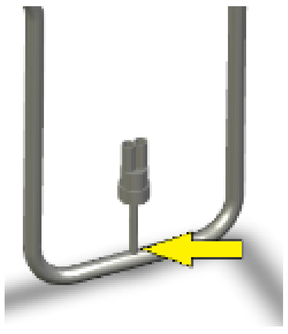

Fig. 1. Brazing Assembly

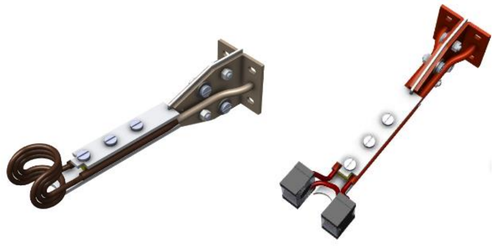

Fig. 2. Brazing Coils

MAIN RESULTS FROM THE STUDY

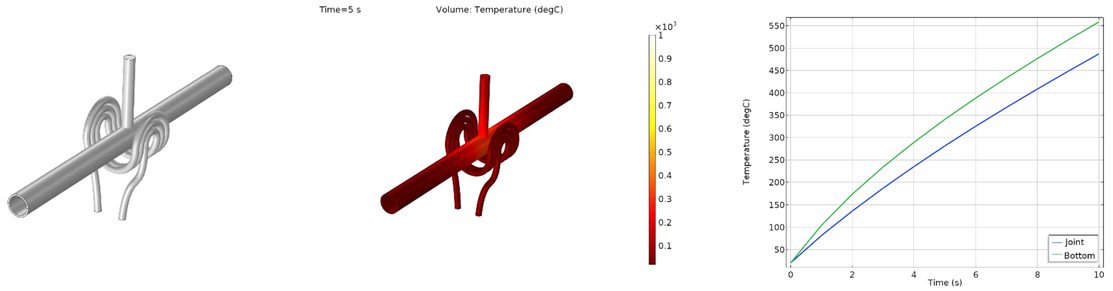

Fig. 3. Coil 1 Study

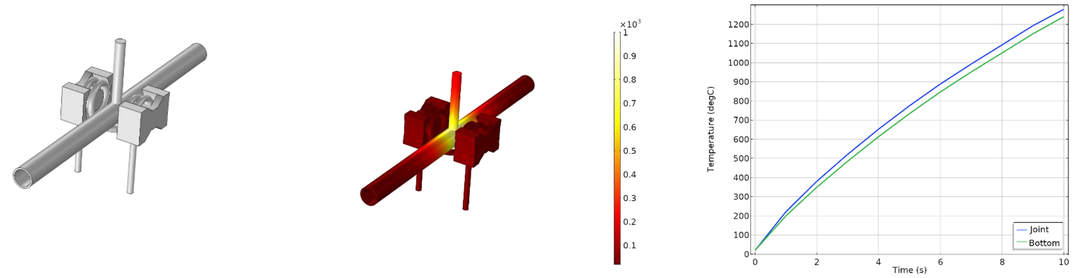

Fig. 4. Coil 2 Study

Fig. 5 represents temperature graph of two study points. ***Joint*** is point taken at the contact between the two pipes. It is most important parameter of the process while this is operating temperature of the brazing alloy. For modeling simplification, brazing alloy is not shown into the geometry, and it is assumed that its temperature is equal to that of the contact area. It can be noted that even after 10s of heating, joint point doesn't reach target temperature. ***Bottom*** point is point on the opposite side of the bigger pipe. It is interesting because it is located into the most active part of the coil – strong magnetic field.

Proper choice of the coil always comes with a lot of design considerations which have to be taken. In case presented above, more complex coil 2 seemed to be correct one. This is because thanks to 3D modeling it was shown the hidden magnetic field structure and found the reason of different performance of both coils.. Article presents more detail and considerations related with the magnetic field and power requirements.

CONCLUSIONS

Presented studies demonstrate practical usage of 3D modeling approach in application design and development of induction brazing coils. Visualized results can be used as a solid basis for next step of realization of the certain task. Using of this technique not only reduces time and resource spent but gives strong instrument for more deep and detailed analysis of the industrial process of induction brazing. In case of T-shaped brazing joint it is vital to find proper coil shape and its size. Thanks to numerical modeling in 3D space, we can analyze and improve all critical parameters of the process and prevent unliked effects like overheating. In the same time power and process time management are also revealed.

ACKNOWLEDGMENT

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