Lack of fusion in MIG/MAG welding of pressure vessels - a process study

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Abstract

MIG/MAG is the dominating welding method in the manufacturing industry since 15-20 years. The main reasons for that is the relatively high productivity, possibility for automation and low cost for the welding equipment and the filler material.

However, for more demanding applications such as pressure vessels the MIG/MAG method still has a quite bad reputation here and there. The most frequently mentioned reason for that is said to be the fact that lack of fusion type defects are more common in MIG/MAG-welding than with many other welding methods. Lack of fusion type defects are also said to be hard to detect in welds with common NDT-techniques such as X-ray and ultrasonic.

A literature review and some interviews with people in the pressure vessel manufacturing industry were made with the purpose to investigate the background for the bad reputation and to give inputs for practical welding trials. After the literature review practical welding trials were made to confirm the conclusions that were found in the literature review. These trials were made both in horizontal and 15-30° vertical down position. Both conventional experimental design and DoE were used.

Remark: *) DoE = A common term which are an abbreviation for “Design of Experiments" and means a developed form of statistical approach to planning of experiments.

It was found that the results from the practical trials more or less confirmed what was found in the literature review and the interviews. Some important conclusions from the literature review, the interviews and the practical trials are mentioned here:

• A high and consistent weld quality can be achieved with the MIG/MAG-method if the welding is performed with approved welding procedures and under controlled conditions.
• The weld position seems to have a strong significant influence of the occurrence of lack of fusion defects. Welding in horizontal position normally give welds that are free from lack of fusion defects. Welding in vertical down position is more sensitive in this respect.
• The process parameter stick out seems to be of less importance with respect to the occurrence of lack of fusion defects.
• The material type, arc type and welding gun angle seem to have significant influence of the occurrence of lack of fusion defects. Short arc is more likely to produce lack of fusion defects compared to spray arc.