Renewable Energy and Power Quality Journal (RE&PQJ), ISSN 2172-038 X, No.9, 12th May 2011, Reference Paper: 338

Power quality analysis of Gas Metal Arc Welding process operating under different drop transfer modes

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Abstract. This work deals with power quality analyses related to the effect of different drop transfer modes in Gas Metal Arc Welding (GMAW) processes. The different drop transfer modes of GMAW process could be classified into: short-circuiting, globular, spray and pulsed. The correct choice of GMAW parameters is essential for optimal performance of the welding process. On the other hand, optimal parameters (from the point of view of the welding process) can lead to different power quality problems on the *AC* side of the local electric utility, according to the desirable transfer mode. In this sense, some power quality analysis based on metering results related to voltage fluctuations, harmonics and interharmonics will be presented to investigate the relationship between power quality problems and GMAW process operating under different drop transfer modes.

Key words. Interharmonics, harmonics, voltage fluctuations, GMAW, drop transfer modes.

1. Introduction

Gas Metal Arc Welding (GMAW) is one of the most common welding processes in industrial facilities around the world. Four types of GMAW drop transfer modes are identified and characterized by the size and frequency of the droplets, namely, short-circuiting, globular, spray and pulsed-spray. Depending on the mode, a specific electrical load take places, presenting intermittent behavior and causing some power quality disturbs at the local power systems, such as voltage fluctuations and flicker, and harmonics and interharmonics. However, the current literature does not clarify how much this disturbances can affect power quality. One reason for that could be the difficulties of determining this influence. Thus, the aim of this work is obtain the power quality analysis of GMAW process in different drop transfer modes.

2. GMAW drop transfer modes

The GMAW drop transfer mode is associated with many factors, including current level, wire diameter, arc length, voltage level, specific power supply characteristics and shielding gas. The importance and main characteristics of each transfer mode is presented in several sources [1], and they can be summarized in Fig.1. The three first transfer modes are classified as natural modes, while the fourth mode is considered as controlled mode, according to Scotti *et all* [2]:

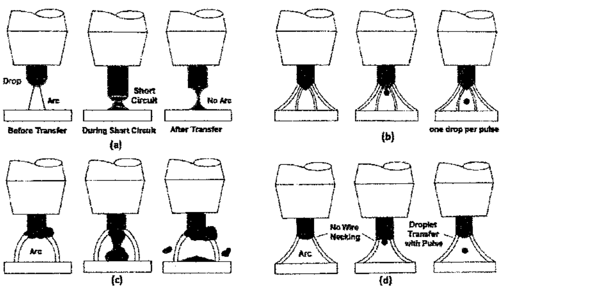

Fig. 1. GMAW drop transfer modes. (a) Short-circuiting, (b) Pulsed, (c) Globular and (d) Spray.

A. Globular drop transfer mode

GMAW with globular drop transfer mode is often considered the most undesirable of the four major GMAW variations. As the weld is made, a larger diameter ball of molten metal from the electrode tends to build up at the end of the electrode, often in an irregular shapes. When the drop finally detaches, mainly due to the gravity force, it falls to the workpiece, leaving an uneven surface and often causing spattering. As a result of the large molten droplet, the process is generally limited to flat and horizontal welding positions [2][3]. Electrically speaking, during this mode the current oscillates to high and low according to the process of the drop growth (progressively arc length shortening).

B. Short-circuiting drop transfer mode

In short-circuiting (or short-arc) GMAW, molten droplets form at the tip of the electrode, but, instead of dropping to the weld pool when their critical size is reached, they