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# Wykorzystanie dźwięku emitowanego przez pracujący piec elektryczny oraz wahań poboru mocy czynnej do wyznaczenia optymalnego momentu rozpoczęcia podawania spieniacza do pieca.

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# Utilizing Sound Emitted by a Working Electric Furnace and Fluctuations in Active Power Consumption for Determining the Optimal Start Time for Introducing Slag Foaming Agent

Abstract

The continuous pressure from consumers of steel products to lower costs compels manufacturers to seek new, more cost-effective methods of steel production. Contemporary technologists are exploring ways to shorten process durations, reduce raw material consumption, lower energy usage, and minimize resource consumption. Their focus has shifted from the entire process to its individual components.

This doctoral dissertation centers on the slag foaming process, a critical stage in steel production within an electric arc furnace. Proper slag foaming yields several positive outcomes, including:

• Reduced power-on time

• Decreased electricity consumption

• Diminished use of refractory materials

• Decreased slag foaming agent consumption

To leverage these advantages, the slag foaming process must commence at the right moment. Starting too early leads to the foaming agent jet hitting unmelted scrap, causing the agent to be sucked into the dust collector. On the other hand, introducing the foaming agent too late results in significant heat losses and increased consumption of refractory materials. Identifying the optimal time to introduce the foaming agent is the primary goal of this study.

All research conducted to pinpoint this optimal time has been categorized into four groups:

• Research to determine the frequency of sound emitted by a working electric arc

• Research to ascertain the sound level at which the introduction of the foaming agent should begin

• Research to establish the magnitude of the coefficient of variability of active power consumption, below which the introduction of the foaming agent should start

• Conducting industrial smelting runs to verify the results obtained in previous stages.

To conduct this research, a comprehensive measurement system was developed, equipped with an SVAN971 sound level meter, a 7052E microphone with an integrated SV18 preamplifier, and a sound level meter controller with software for communication with the furnace control system.

Based on the measurements obtained from the constructed measurement system and data recorded by the furnace control system, graphs were created illustrating the course of smelting runs. The analysis of these charts and the conducted statistical analysis allowed for assigning the desired values at which the foaming agent should be introduced.

These values were implemented in the control program of the Siemens S7-300 system. The outcome of 48 conducted research smelting runs confirmed the research hypothesis and the effectiveness of the applied methodology.