INTELLIGENT CONTROL SYSTEM FOR CONTINUOUS CASTING BASED ON WATER FLOW CONTROL IN THE SECONDARY COOLING

Goal of the project:

The primary objective of the research which will be made in this project is the development and implementation of the leading structure for the continuous casting process (on the secondary cooling zone) leading to eliminate quality defects and throw-outs, by adjusting the flow of the secondary cooling water. In the context of this objective it is proposed the synthesis and the development of some leading solutions for the continuous casting process using fuzzy logic, allowing to control flow of the secondary cooling water, by distribution areas. This necessity is imposed by the fact that nowadays control systems are rigid and are limited at a rigid repartition of the flow water in each area. An intelligent system has the capacity to eliminate this disadvantage of the nowadays systems by having the possibility to modify in real time this repartitions of the water flow taking into consideration what happens in the installation.

Short description of the project:

Leaving from the installations geometry with 3 cooling areas it was create 3 fuzzy regulators for each area separately, each one having 3 inputs. After the 3 fuzzy regulators was done was designed a fuzzy adaptive system which correlates the three cooling areas so that the water flow to be the same. For example if the water flow is lowed in the first area it will automatically increase the water flow in the second and third area so that it will be the same value of the water flow but the repartition on each area will be different.

Project implemented by

The proposed solution was implemented in the continuous casting process within S.C. Arcelor Mittal S.A. Hunedoara. The Continuous Casting Plant within the "Continuous Casting" section of the S.C. Arcelor Mittal S.A. Hunedoara is designed and manufactured by Manesman company and comprises five yarns for pipe billets with diameter Φ180 mm, Φ200 mm, Φ250 mm, Φ270 mm, Φ310mm or blanks for re-rolling with dimensions 240x270 mm, 310x280 mm.

Implementation period:

01.10.2015 - 30.09.2017

Main activities:

1. Analysis of the existing charts and databases. Practically, any continuous casting plant has a database containing the occurred events, the current operating mode and the casting recipes applied to various types of steel grades, all these leading to providing the data required to correctly approach the steps listed below.
2. Fuzzy Intelligent Systems Design. We must define the input and output variables and design the rules required to build the fuzzy controllers for each cooling area.
3. Testing and validation by simulation of the designed fuzzy controllers. Dissemination of results.
4. Realization of sensor interface for the process-driven data acquisition.
5. Software implementation of the fuzzy controllers on a PLC S7 300. The PLC is integrated in the wiring diagram of the continuous casting process. Modification of the SCADA system for observing the corrections made by the newly implemented systems.
6. PLC integration in the continuous casting plant, testing and validation of the proposed solutions, dissemination of the obtained results.

Results:

Experiments have shown that the proposed Fuzzy solution is extremely efficient and much higher than current flow control solution, and can be implemented relatively easily on any continuous casting installation without requiring any significant changes from the hardware point of view of the existing installation.

Applicability and transferability of the results:

Experiments were performed for 3 different profiles of the semi-finished product, namely Φ180mm, Φ200 mm, Φ 250 mm, but the same mark 20MN10. On a PLC identical to the laboratory used in the "Continuous Casting" Section of S.C. Arcelor Mittal S.A. Hunedoara, the completely created program (the classical / fuzzy method) was transferred. In the first phase, the PLC only had the role of recording, storing and processing the data in order to validate its proper operation, without being able to control the flow, cooling by the classical method. After validation of the proper operation, the PLC was connected to the system (making the connection with valves), then 3 sets of castings were made using the software.

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