Abstract

Handling and Evaluation of Electrostatic Hazards

Ph.D. thesis by Endre Balog

Information concerning the existence and severity of hazards caused by electrostatic charging phenomena is often uncertain and unreliable. Complexity of electrostatic charging itself, and complexity of industrial processes that include electrostatic charging could be the main reasons for this "fuzziness". Fuzzy logic proved to be a powerful tool to handle difficulties that had arisen from complexity and lack of knowledge. Through the investigation of possible damages fuzzy logic based techniques help to get a clearer picture about the level of risk, and therefore more reliable decisions can be made on the necessary actions to be taken to increase safety.

In the thesis a novel approach to risk management is presented in the field of electrostatic hazards. It is a case orientated approach, which is based on a customized risk management strategy defined by the risk taker itself, and the properties of possible damages. The possible protection methods can be applied in order to prevent a level of risk, which is higher than what was predefined by the risk taker. This approach provides a comprehensive picture about the tools of handling electrostatic hazards and gives a solid basis for the practice to determine the optimal protection methods.

Fault diagnosis systems, the main protection method of industrial electrostatic processes are analyzed in details. The properties of diagnostic problem in case of industrial electrostatic processes are examined and compared to a human operator's mental capability. Based on this comparison, I define the notion of complex electrostatic systems, where a human operator can hardly manage to solve the diagnostic problem. Using fuzzy inverse reasoning I demonstrate a possible solution for the fault diagnosis of complex electrostatic systems, which fulfils the criterion of a reliable diagnostic system.

The risk of electrostatic hazards of a specific arrangement is in direct connection with expected damage frequency. The key for reliable determination of damage frequency is the frequency of connected static parameters. These are calculated on the basis of physical measurements, which were carried out under certain conditions. In order to be able to handle the difference between the conditions (location, time, accuracy, arrangement, etc.) of measurements and the conditions of the examined object, I introduced the notion of reliability and relevancy of measurement data. With the help of these variables defined in the form of fuzzy numbers, the accuracy and lack of our knowledge in the risk calculation can be taken into consideration.