Chapter 20
Data Mining Experiences in Steel Industry

Joaquín Ordieres-Meré
Universidad Politécnica de Madrid, Spain

Ana González-Marcos
Universidad de La Rioja, Spain

Manuel Castejón-Limas
Universidad de León, Spain

Francisco J. Martínez-de-Pisón
Universidad de La Rioja, Spain

ABSTRACT

This chapter reports five experiences in successfully applying different data mining techniques in a hot-dip galvanizing line. Engineers working in steelmaking have traditionally built mathematical models either for their processes or products using classical techniques. Their need to continuously cut costs down while increasing productivity and product quality is now pushing the industry into using data mining techniques so as to gain deeper insights into their manufacturing processes. The authors' work was aimed at extracting hidden knowledge from massive data bases in order to improve the existing control systems. The results obtained, though small at first glance, lead to huge savings at such high volume production environment. The effective solutions provided by the use of data mining techniques along these projects encourages the authors to continue applying this data driven approach to frequent hard-to-solve problems in the steel industry.

INTRODUCTION

Iron and steel making industries rely on the quality of their products for survival. In their ceaseless need of quality improvement, engineers are more than happy to accept any helping hand the new technologies might lend to this otherwise mature and traditional activity. Engineers have traditionally used classical techniques to develop mathematical models to predict the behaviour of a product or process. Now,

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they are turning their eyes to data mining techniques so as to gain deeper insights on the manufacturing processes in order to develop strategies to cut costs down, to improve the quality and to increase the productivity.

The data mining approach is becoming increasingly popular because of two concurrent factors that seem to work in tandem. Firstly, the capacity to record data from the industrial processes has experienced a fast growth in the last years. As a consequence, day by day we have more and more information on the manufacturing processes stored in databases. ISO 9000 quality principles recommend adopting a factual approach to decision making, and having a database of the real facts is surely amongst the best approaches to accord with ISO principles. Nevertheless, as the data sets grow in size, the information overload might make more and more difficult to extract useful conclusions. Thus, the use of data mining tools capable of handling such massive data sets becomes mandatory. Secondly, the relationships amongst variables from industrial processes are, most frequently, non linear and thus explicit models might be hard to obtain. This compels the practitioner to based on data models as opposed to analytical models based on explicit equations. Fortunately, thanks to the development of increasingly faster computers this based on data approach is nowadays a feasible solution to otherwise difficult to solve frequent problems in industry.

This chapter reports some of the results obtained by the EDMANS (Engineering Data Mining And Numerical Simulations) group in optimizing a hot dip galvanising line at one of the ArcelorMittal spanish factories (Avilés). Several data mining techniques were successfully used in these projects, e.g. neural networks, expert systems and decision trees, in order to improve the control systems, to extract hidden knowledge and, thus, obtain improvements that mean huge savings in economic terms due to the large production volume.

BACKGROUND

Galvanized steel is a product experiencing a growing demand in sectors like the automotive industry, domestic appliances manufacturing and construction industry, due to its anticorrosive properties. As the requirements of the clients are increasingly harder to meet, companies pursuing to lead the market need to follow a continual improvement strategy covering every stage of the galvanizing process (Tian, Hou & Gao, 2000; Fabrellas, Ruiz, Martínez, Sanz, & Larrazábal, 2002; Díaz, Cuadrado, Diez, Rodríguez, Obeso & Rodríguez, 2003; Rendueles, González, Díaz, Diez, Seijo & Cuadrado, 2006). Two are the key aspects that determine the quality of the product (Schiefer, Jörgl, Rubenzucker & Aberl, 1999; Tenner, Linkens, Morris & Bailey, 2001; Domínguez, Miranda-Ariz & Salvador, 2002):

- The anticorrosive properties conferred by the zinc coating. The protection against corrosion requires that the zinc layer has uniform thickness. A strict control of the base metal surface preparation, the temperature, composition and homogeneity of the coating, the speed of the band and the air flow throw the blades is mandatory.
- The mechanical properties. They basically depend on the chemical composition of the steel, the rolling process and the thermal treatments before immersion in hot liquid zinc.

The five works reported here are focused on improving both the anticorrosive and mechanical properties. First, we tackle the problem of measuring the mechanical properties of galvanized steel coils.