Investigations on Materials Used for Manufacturing the Rolling Rolls in Few Durability Experiments

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ABSTRACT

The aim of this work is to answer to as many questions possible regarding the quality of rolling rolls. In this sense, durability in exploitation is extremely current, both for immediate practice, and for the scientific research attributed to the rolls materials. This paper presents original experimental equipment for investigations of the durability of hot rolling rolls, which permits the evaluation of exploitation durability by studying the thermal fatigue phenomenon which appears in the case of rolling mills components. The exploitation durability is evaluated through thermal fatigue cycles up to crack point due to thermal fatigue for each condition and each type of studied material (steel and iron grades). The study on the hot rolling rolls thermal regime is a novelty from scientific and experimental viewpoint. In this sense, the purpose of this work is to present few directions concerning the quality improvement of the rolling rolls and suggests solutions meant to increase the durability of the rolls in exploitation and safety in the rolling process.

Keywords: Durability, Experiments, Manufacturing, Rolling Rolls, Thermal Regime

INTRODUCTION

Hot rolling mill rolls are the parts most subjected to wear in the rolling trains because the incandescent rolled material is deformed between the water cooled rolls, at temperatures of 1100…1150 0C. They represent a consumption of 0.8 kg/tone of rolled steel. It is noticeable that approximately 1 from 10 rolling rolls are removed from exploitation because of the thermal shock caused breakings, which cause accidental damage and stoppage, and the losses expand over the rolls cost, as well as production losses, disturbing the entire technological flux (Kiss, 2005, Toader, Pinca-Bretotean, & Plesa, 2004).

Up to this moment, there is no reference publication to minutely deal with the theoretical and experimental aspects of this theme of research (Kiss, 2005, 2008; Pinca-Bretotean, Kiss, Josan, & Tirian, 2005). Poverty of detailed research, theoretical and experimental, about the thermo-mechanical processes take place during

DOI: 10.4018/ijseims.2013010104

the plastic deformation between the rolling mills rolls, represents a factor that reduces the possibility of rational exploitation of rolling mills (Werquin & Caillaud, 1990; Lundberg, 1993; Kato, Yamamoto, Ataka, & Nakajima, 1992; Toader, Pinca-Bretotean, & Plesa, 2004). In the context of market economy is necessary a new evolution in the area of scientific researches, in the purpose of modernization of the equipment and metallurgical plants, using the most efficient solutions for obtaining aggregates with performances to the level of world technique (Kiss2005, 2008).

The durability in exploitation of the rolling mill rolls is little approached in the reference literature, both in Romania and worldwide. Up to this moment, there is no reference publication to minutely deal with the theoretical and experimental aspects of this theme of research (Kiss, 2005, 2008; Kiss, Alexa, Cioata, & Ratiu, 2011; Pinca-Bretotean, Kiss, Josan, & Tirian, 2005; Pinca-Bretotean & Tirian, 2006).

The lack of detailed theoretical and experimental research upon the mechanic and thermal process taking place during plastically deformation between the rolls constitutes a factor to reduce the possibilities of rational mill exploitation (Kiss, 2005, 2008; Kiss, Cioata, & Alexa, 2010; Toader, Pinca-Bretotean, & Plesa, 2004). In the context of present day market an evolution is necessary in the field of scientific research in order to modernize the metallurgical equipment, using the most efficient solutions to obtain performing aggregates on world level (Kiss, 2008; Schroder, 2000, 2003).

Currently, many aspects of the thermal regime of lamination are still not enough studied, and also, there are no efficient methods for the determination and adjustment of the rolling rolls temperatures from the industrial rolling mills. The intensification of the lamination process directly influences the rolls durability, these being the most solicited organs of machines from whole ensemble of the lamination equipment. The technological processes of the rolling rolls manufacture, as well as the quality of used materials have a quick extension, materialized in worldwide market competition, through exceptional qualities of rolls. The different high alloy ferrous products currently used in the manufacture of these rolls define an important chapter from the quality assurance of the industrial products (Kiss, 2005, 2008, 2009, 2010; Kiss, Cioata, & Alexa, 2010; Kiss, Cioata, Alexa, & Ratiu, 2010).

The research of durability in the exploitation of rolling rolls define experimentally an important chapter from the thermal fatigue of the organs of machines in the movement of rotation, in variable temperature mediums (Kiss, 2005, 2008; Toader, Pinca-Bretotean, & Plesa, 2004). The researches on the durability in exploitation of hot rolling mill rolls represent an important scientific and economical issue.

Hot rolling mills rolls work the in the variable compound solicitations, due to lamination process and which repeat to regular intervals of time. These rolls must be able to carry out extreme actions: very high thermal stresses and wear, along with mechanical stresses due to normal rolling loads (Kiss, 2008; Schroder, 2000, 2003). These actions lead to the development of cracks, which means that sufficiently high fracture toughness is also an important requirement. The research on durability in exploitation of hot rolling mills rolls assures relevant conditions for the appropriation of the research methods of the thermal regimes that are submitted the rolls or other organs of machines, that works in constant (symmetrical) or variables (asymmetrical) thermal solicitation conditions. All these phenomena (which are more or less emphases depending on the type and typical of rolling mills) are not taking into consideration in the classic calculus of rolls (Kiss, 2005, 2008; Toader, Pinca-Bretotean, & Plesa, 2004). If the study of the rolling rolls resistance is extended upon their durability, we must consider the whole complex of tensions with mechanic-thermal influences.

The research and the experimental application of an important number of thermal solicitations produced by the fields of symmetrical and asymmetrical temperatures over some samples of materials, obtained from rolling mill rolls, after the realization of the hot-rolling campaigns in the sectors of the roughing stands may constitute the originality of this research of such

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