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RESEARCH ABOUT THE VIBRATION PARAMETERS FOR A COLD ROLLING MILL MACHINE

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ABSTRACT

By using the equipments of vibration measurement we can fight against the damages (strip undulation and thickness variation on the length) who is show in while of mill work. The amplitude of vibration parameters determine the apparition of patterns on laminated strip.

The researches about the vibration parameters are essential for a product quality. To directly introduce by a milling program, the roll force and the other parameters, these must be in correlation with amplitude acceleration, frequency and velocity vibration.

KEYWORDS: cold rolling mill, strip, vibration, prediction, undulation.

1. Introduction

The monitoring by vibration for a cold rolling mill is very important because we can see in time the malfunction of parts (box gear, coupling, engine…). In the same time it is possible to verify, by comparing an initially signal with a work signal the good functionally of rolling mill. The roll forces have an important influence on the deformation resistance ($R_{p0,2}$), thickness (H_i and H_o), backward and forward tension (T_b and T_f), friction coefficient (μ), and other constants.

The first four factors (thickness and tension) are constant and impose and it is important do not exist variations. These variations can be registered by vibration monitoring system.

The rolling mill stands, press a strip of steel using upper/lower rolls to a desired thickness.

The gap between upper/ lower rolls determines how much pressure or force is applied. Force, thickness, speed and tension are measured while the strip is processed.

The parameters predictions involve many other factors whose exact relations are not well understood and the mathematical model is far from perfect.

Recent studies about the roll force tension and coil width prediction were made in improving of a mathematical model

The rolls forces, the coil tension, the coil width and the speed sheet were measured with specifically tools and than we draw the next curves by a mathematical model prediction.

Another way for controlled the good functionary at the cold rolling mill for strip is to do a monitoring by vibration for the moving parts of mill machine.

2. Monitoring system by vibration. Experiments.

The system configuration used for measuring and enrolled of vibration parameters (displacement, velocity, acceleration, and frequency) are shown in figure no 1.

This system work like an alarm which automatically determines the incident that has occurred on basis of measured values and notifies the operator accordingly, a diagnostic function to estimate check times from past measurement data, and a database of apparatus repair times.

The measurement system have the next parts: accelerometer, amplifiers, signal selector, measuring, sequencer and display like in figure no. 1.

The system displays this information graphically on the screen.

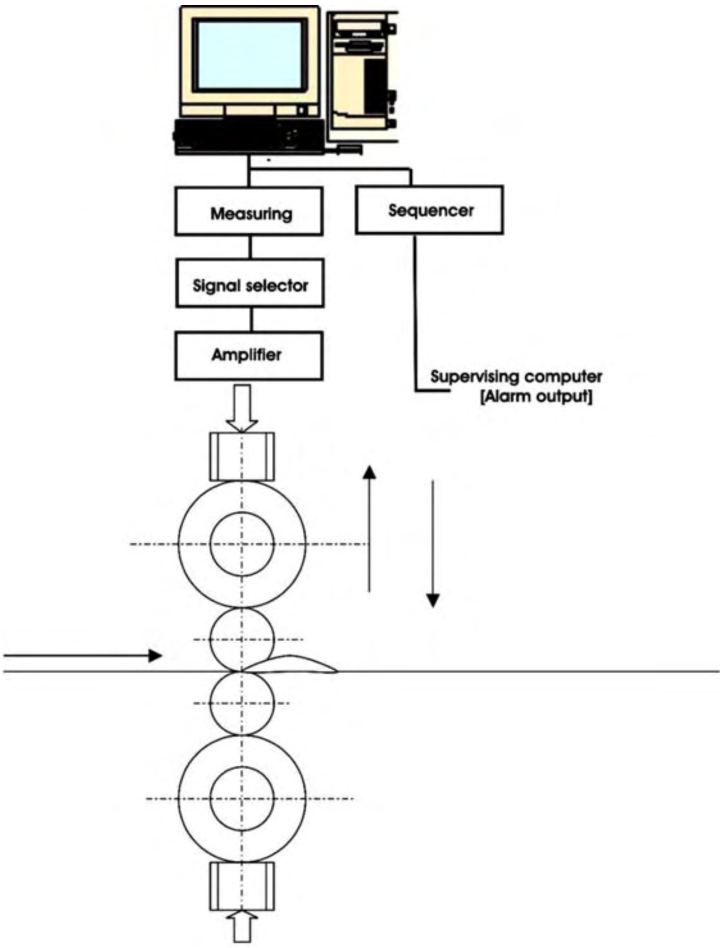

Fig.1. *The vibration monitoring system (accelerometer mounted on each stand)*

In the next figure (no.2) it is shown a parallel registered for each of five stands. It observes that the highest level of vibration is registered at stand number five.

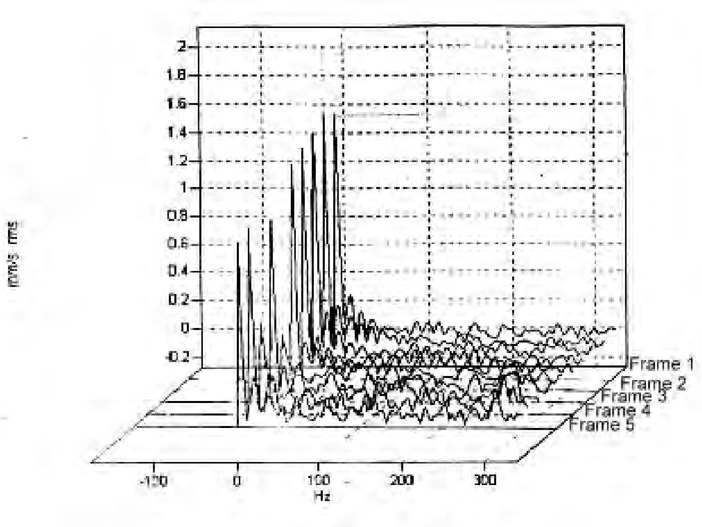

Fig.2. *Level of vibrations registered at each stand of the rolling mill.*

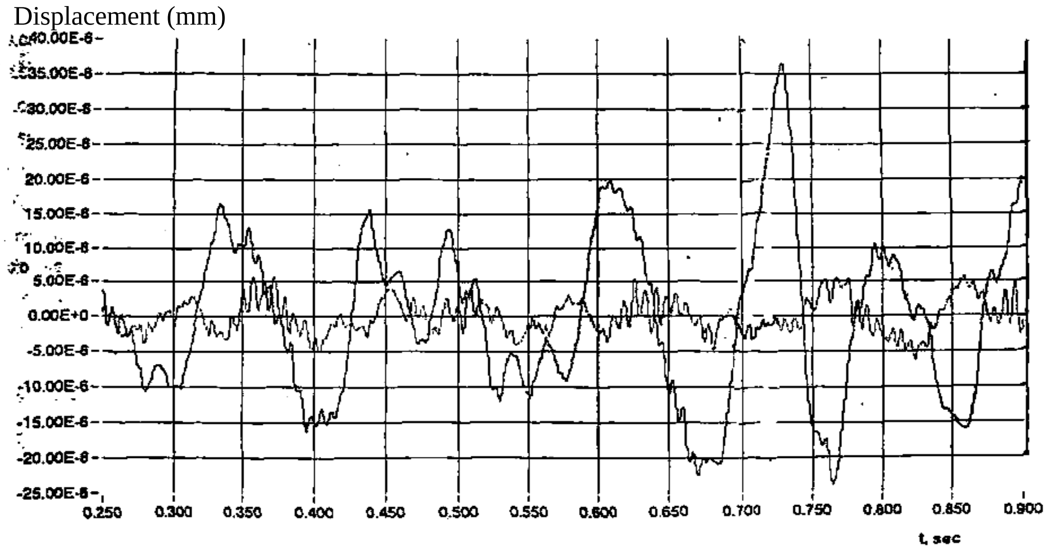

Fig.3. *The gap between the beginning of work period and after six month function (power spectrum).*

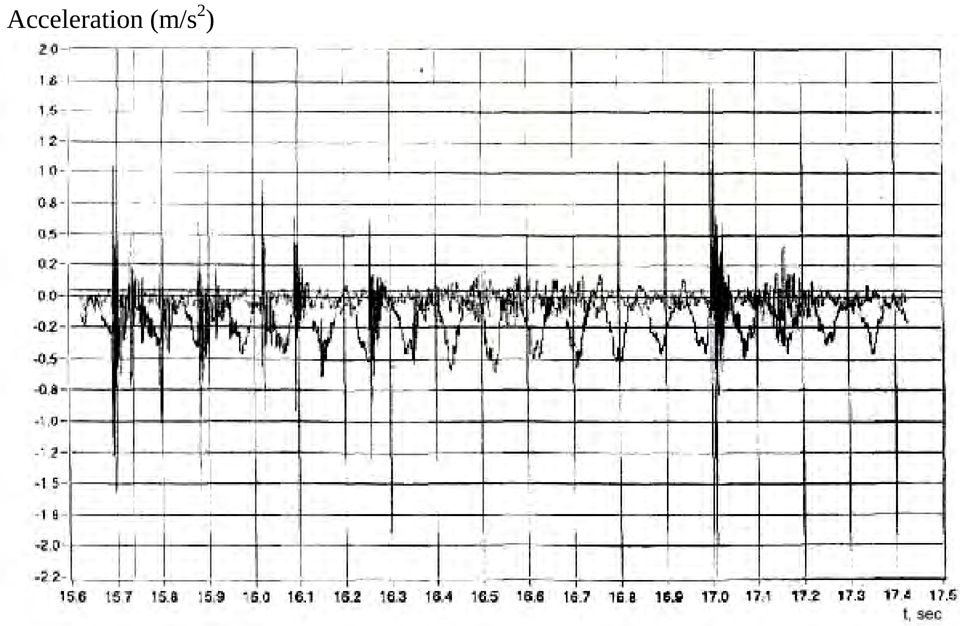

Fig.4. *Comparing between the basic acceleration signal (measured) and the signal after six month work.*

In figures 3, 4 we show (partially) the recordings by comparing the parameters of vibrations at the beginning of work period and after six month in function. Because the wear who appears in bearings, box gear, bar of coupling, the amplitude of vibration increase and determine the “out” of initially work parameters for the cold rolling mill machine .The model directly predicts all work parameters, while the corrective model produces a correct coefficient, which is then multiplied to the mathematical models prediction. Additional variables which were not used in the mathematical model were found to be necessary for the substitutive model only.

The networks of parameters (forces, tensions between stands(cages), speed, can be easily retrained if necessary as all the data from the processed coils are automatically saved in a workstation located next to the process computer.

The retraining period does not have to be fixed such as monthly or yearly .It will be more proper to determine it dynamically by monitoring the trend of prediction error.

The-network models are planned to be used in daily operation. One difficulty is to estimate the monetary savings resulting from the improved quality and decreased off-gauge.

Using the network of parameters-based roll force –prediction models show that the prediction errors of the currently used mathematical model reduced by 30-50%. The substitutive model directly predicts the roll force, while the corrective model produces a correct coefficient, which is then multiplied to the mathematical models prediction.

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The networks of parameters (milling process force, tension between cages(stands) have a potential to improve the accuracy of the computation be substituting or correcting the mathematical model.

From the effectuated experiments it can conclude the fact that, the highest values for displacement, velocity, acceleration and power spectrum (on the direction of the action system) have been recorded at the3, 4 and 5^{th} frame of the rolling mill machine (the causes that determinate these important values for the measured made are great tension into the strip between mill cages ;high speed of strip while the milling process or the variation of those ;abrupt change for the rolling mill work parameters; types or different quality for the emulsions used in work; the decrease of reduced number when the strip pass between the work rolls; unpredictability for one of work parameters.

At rolling mill's speed between 600 – 1250 m/min and frequencies of vibration measured that do not excel hadn't recorded of marks, undulations and abrupt variations of the strip thickness after milling process.

At vibration's frequencies between 450 – 1150 Hz, we observed undulation at strip's surface with the gap between 2- 40 mm, big wear of shell of work rolls and into the bearings of work rolls.

4. Conclusions and results

After this study we can extract the next conclusions:

-the vibrations are in each equipments and installations of cold rolling mill by different type.

By an ample study and perform experiments – with modern gear – it result a series of aspects:

- the quality of surface and geometry of cold rolling strip;

- the correct command of milling process

- the prominence of causes and the oscillation's effects, vibrations, shocks, etc. – owing the own system of rolling mill cages and the parts of kinematics action fluxes;

- the fix measures for control, decreasing, command ;

- the increase of productivity, the reduce of costs ;

The experiments made between 2005-2006 at a number of over 100 coils of cold milling strip, which in fact were measures and vibration's analyses, the have been established the following series of characteristics frequencies:

- vibrations in series of frequency between 5-90 Hz, for coupling, couplings bars, gear boxes with defects into their bearings;

- vibrations in series of frequency between 125-300 Hz for the strip which is being milling, for the gaps of positioning system, the wears into the backup and work roll bearings, lubricant used;

- vibrations in series of frequency between 500-980 Hz, wear's afferents accentuated backup and work rolls shell of these encampments, determination the appearance of hallmark and undulation on the surface of strip.

The experiments in the functionality for rolling mill machine show the tendency of vibrations amplitude at the increase of milling speed. We record a increase of milling speed with 50% at each cages of the rolling mill, the vibration's amplitude record a increase 35 % at each cage) by the other way, at strip with small breadth and with high toughness is manifested the same tendency of increasing of vibrations amplitude.

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