

Results of new developments for efficient and intelligent equipment in vertical molding machines

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ABSTRACT

The competitiveness in the current foundry market pushes the companies to deploy cost saving programs over all activities. Among the points to be technically reinforced in the molding area, we have: foundry process optimization, energy consumption, resources consumption and environmental protection. According to current data in terms of energy usage share in an average foundry, 12% of energy consumption relates to molding equipment, and 60% of the cost relates with materials.

Increasing prices of electric power and raw materials together with demand for new technical casting solutions force the foundry to find out new ways of production where high efficient process, high accuracy and highly environmental friendly are challenges to face.

The present paper presents results and production data collected during two-year production of the new concept of electrical Vertical Molding Machine (e-VMM) proving its high energetic efficiency, high reliability, high accuracy on its performance and environmental friendliness.

Keywords: vertical moulding, Electrical, Efficiency, Accuracy Smart Casting.

INTRODUCTION

When we started with the project of installing an electric moulding machine at one of the Fagor Ederlan foundry plant we set up some technical targets, which gather the new technology advantages.

We initially defined those targets between both teams, from Loramendi and Fagor Ederlan, based on trials carry out in advance during the prototype phase.

From the foundry point of view, it was a challenge to produce complex steering knuckles in a vertical line and, on the other hand, from the machine builder point of view it was a challenge to reach expectations for

energy efficiency and high accuracy of the new technology.

Additionally, those common targets were defined in a simple way, which will later on allow us to measure, record them, and therefore recognise success of the project. That finally means proving the advantages of the new technology as per expectation.

EQUIPMENT AND TARGETS DEFINITION

A hydraulic moulding machine has been replaced by a new LORAMENDI electric vertical moulding machine, namely, e-VMM 5070B[®] together with an e-AMC[®] 18 m in length.

Speed of such a model was 400 molds per hour, although today a 500 molds per hour are already in production at other foundries.



Fig. 1. Electric moulding machine at Foundry

We have needed two years before we can present data and say that targets of the project have been reached by far in a stable way and therefore that this new technology offers to foundries new advantages the hydraulic one can not.

Target for the new equipment were as follows:

- Energy saving of 60%
- Cooling water saving. No water required

- Hydraulic oil saving. Not oil required. No oil waste management costs
- Less maintenance time. Machine Uptime > 95%
- Higher accuracy & casting quality. Mismatch < 0.2mm
- Lower noise level
- Cleaner work environment

RESULTS AFTER A TWO-YEAR OPERATION

After a two-year operation and 2,000,000 moulds produced, we have recorded parameters and average values shown as follows:

Energy saving of 60%

Energy consumption per mould has been recorded and actual values are 0.182 KWh/mould for the hydraulic version against 0.064 KWh/mould for the electrical version, resulting a 65% energy saving

Cooling water saving

Due to “servo-engine-configuration” machine instead of “hydraulic-unit” one, there is no cooling water required and therefore a 4,800 litre/hour saving has happened. This point is of great importance, as cooling water consumption in an industrial environment needs special treatment before sending back to the network or, alternatively, be used within a water closed circuit

Hydraulic oil saving

Here again, due to “servo-engine-configuration” machine instead of “hydraulic-unit” one, there is no hydraulic oil involved. That means a 7,000 litre/year (e.g. Renolin type) and 880 litre/year (e.g. HLP46 type) savings have happened. Once again, waste oil management becomes of great importance within an industrial environment following European rules for the environment after oil usage.

Less maintenance time. Machine uptime > 95%

After recording machine stops during these two years, the average of uptime for the electrical moulding machine has been of 96.12%. Here we consider the percentage of the machine available time when it was operational, excluding from this value stops that may have happened due to peripheral equipment such as pouring unit, sand plant unit, cores supply, finishing line or any other.

Higher accuracy & casting quality. Mismatch < 0.2mm

The already reported mould hardness homogeneity in this LORAMENDI equipment (see article from 71st WFC Bilbao 2014, “A new concept in efficient vertical moulding lines”) due to unique system for chamber filling and the squeeze of the mould, now it is incorporated the mismatch values of < 0.145mm.

Unlike hydraulic technology, electric one allows us to perform “à la carte” programs on speed & force. Higher precision on position, speed and accelerations when dealing with moulds squeezing, sorting out and conveying as well as performance concerned to the core setting are a reality today, resulting on a more accurate castings production and new capabilities to reduce flash and finishing operations on castings.

Lower noise level

Today, noise level of the machine is lower than 80 dB and further reduction are on going today.

Cleaner work environment

The fact of avoiding hydraulic oil and its inherent leakage control and repair is giving place to a cleaner work environment.

Spare parts consumption

Although there is not enough working hours to assess precisely consumption of spare parts in such an electrical machine, preliminary data show huge potential reduction on them. Less number of parts and robust mechanism design (rack and pinion assembly and so on) has wear out extremely little. Therefore, they keep performance without replacement up today.

Future developments

Today, Industry 4.0 concept consists of big data collection, fast processing and feeding back to equipment to reduce scrap and anticipate maintenance jobs. The electrical vertical moulding technology is in the best condition to perform diagnosis and welcome several sensors, which later on will supply required data for the mentioned concepts.

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