Chapter 4

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USING THE STATISTICAL TOOLS IN MACHINE´S CAPABILITY EVALUATION – PART 2

Abstract: The pressing machine for operation injection was considered as incapable. Therefore it was necessary to apply correction actions to make the machine capable. We applied following correction actions: regular monitoring of machine´s capability, mainetance and repair actions, setting the machine to the middle of tolerance zone. After correction actions were calculated values of scrap index for finding if the pressing machine is capable to produce in demanded parameters. The scrap index was 0,728%, which is lower than four months before (in the period from November till March this index was 3,096%). So we can consider the machine as capable.

Key words: capability indexes, machine, production, scrap value

4.1. Introduction

Based on the results presented in part no. 1, we propose and apply in the production process of injection molding by the ENGEL corrective and preventative actions, which get a production machine into the process of capability. As the preventative actions recommended maintenance activity. It means all activity around machines and equipment. The basic goal of maintenance is working on capability of machines and equipment in production.

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Capability of the facilities evaluates through scrap indicator. Observed indicator represents the percentage of scrap, which comes from production of whole quantities of the wrong parts.

4.2. Proposal of corrective actions

For the security situation company has an incapable injection machine and we propose to follow this procedure of preventive actions. During the proposal, we focus more on a prevention. The whole proposal is based on regular monitoring capability and maintenance. Figure 4.1 is shown the proposal by separate phases of realization.

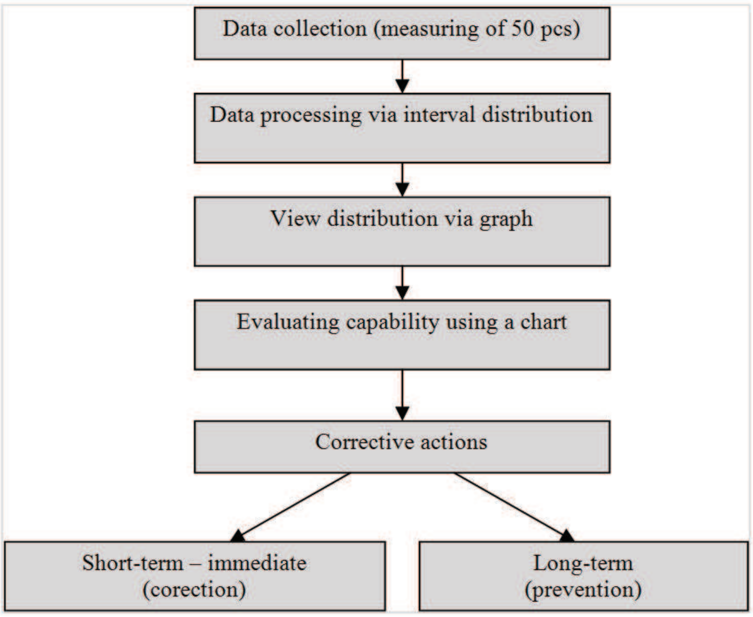

Fig. 4.1. Proposal of corrective actions.

Source: own study

4.2.1. Regular collection of data

We recommend to carry out preventive maintenance based on equipment condition. The equipment condition is evaluated by the capability index of production machine (injection machine Engel). Regular data collection will be determined for the capability of the machine. During the measuring and also calculation of indexes propose use a next chart as a guide for illustration device condition (Figure 4.2).

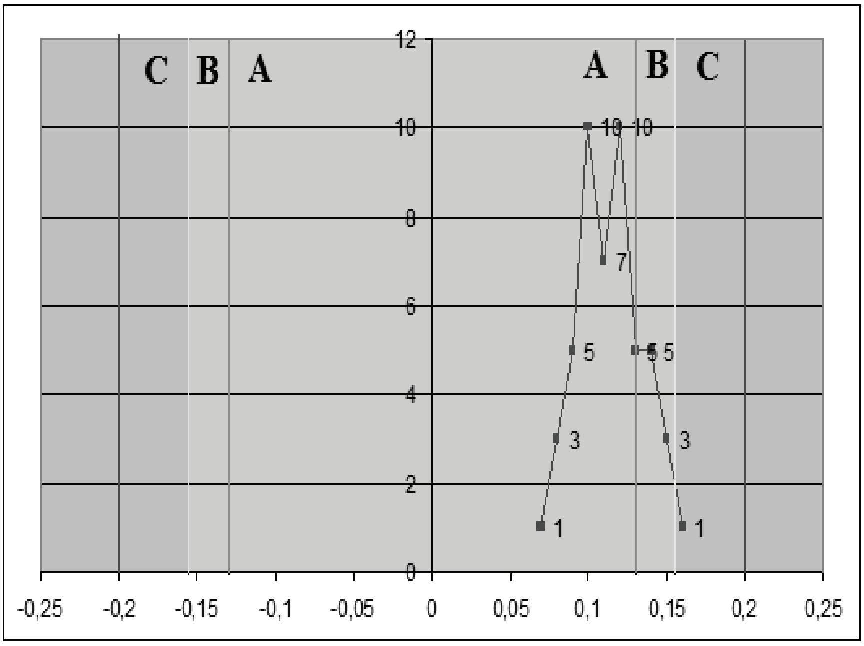

Fig. 4.2. Proposed graphical figure of device condition.
Source: own study

The basis of the proposed chart is a tolerance (USL – LSL). In this case, the values of tolerance limits designated by customer USL = 0.2, LSL = -0.2. The tolerance field is the curve, which shows the absolute frequency in each interval. The curve characterizes the variability of the measured values and also average. In the figure 2 is the curve, which corresponds with measuring from part 1, where the capability index of injection machine was C_{mk} less than 1.67. The chart can be used as a guide for deciding corrective actions, because tolerance is divided into several areas of capability.

4.2.2. Long-term corrective actions

As a long-term corrective action – preventive, area B, recommend maintenance. It is a complex of works to ensure the ability of machines or equipments and also their overall economical running. These activities include cleaning, lubricating and other regular actions before exact maintenance of the machine.

4.2.3. Short time – immediate actions

In this part of the article, we debated the specific issue, which was described in part 1.

Critic capability index of injection machine Engel was 1.52 and standard deviation was 0.018917. Injection machine was not capable, however variation was satisfactory. Injection machine produced products, which value oscillated by $\bar{x} = 0.1138$. We wanted to reach improvement by use reparations. The value of quality characteristic should be equal $\bar{x} = 0$, since it is middle of tolerance. We wanted to reach only movement of line on the value 0, like we can see in the Figure 4.3, because the variation of injection machine ($C_m = 3.52$) was respectable.

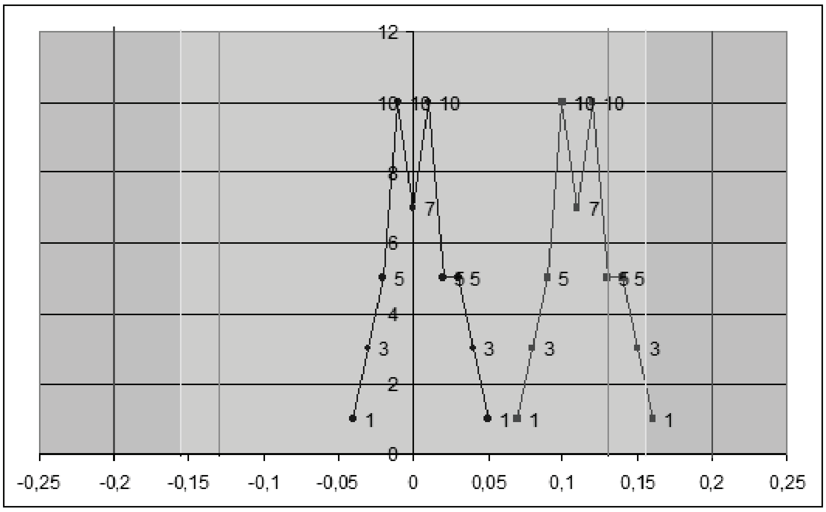

Fig. 4.3. Potential movement of line.

Source: own study

Analysis of the causes

We utilize Ishikawa diagram on the analysis of causes of nonconformity of injection parts. The observed issue was greater size of injected parts - defect of direction. Solved team determined the causes and sub-causes, which are shown in the Figure 4.4.

We utilise Pareto analysis too, on the differentiation of important and insignificant causes. We can see Pareto diagram in Figure 4.5.

During the analysis, we applied Pareto principle. Important causes were marked via ratio 80:20, as in the plot. Just parameters like molt temperature T_F, melt temperature T_T and holding pressure p_d impact the production process during injection molding on the injection machine ENGEL.

Rule of 80:20 was used to determine the major causes of errors as shown in the graph.

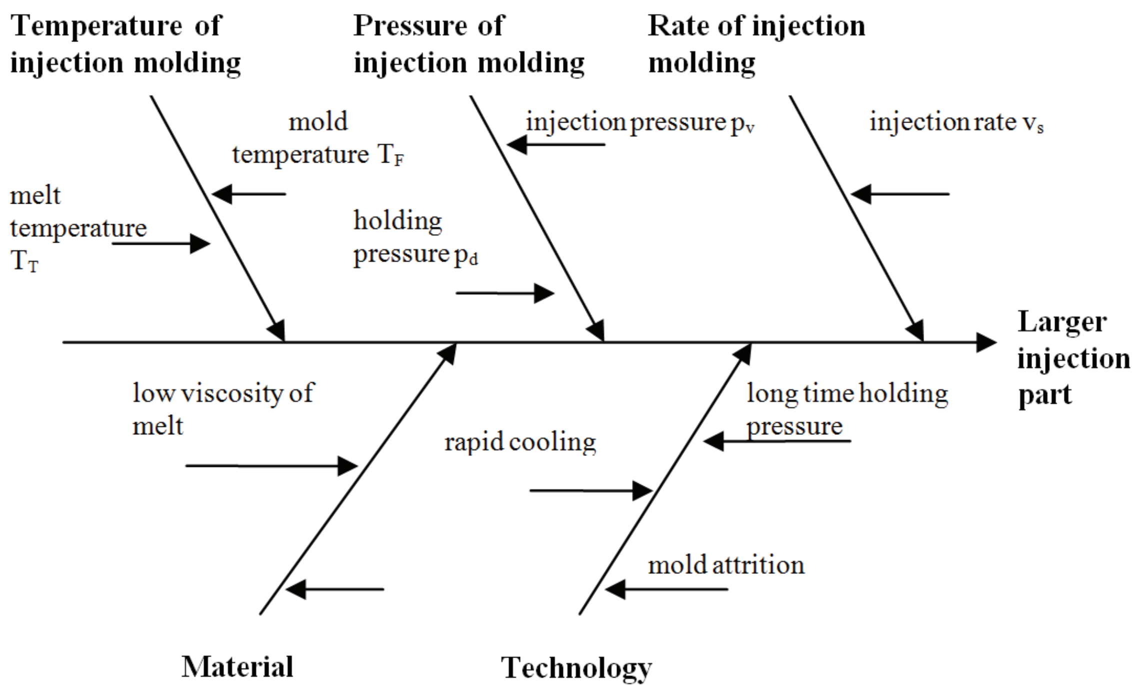

Fig. 4.4. Ishikawa diagram.

Source: own study

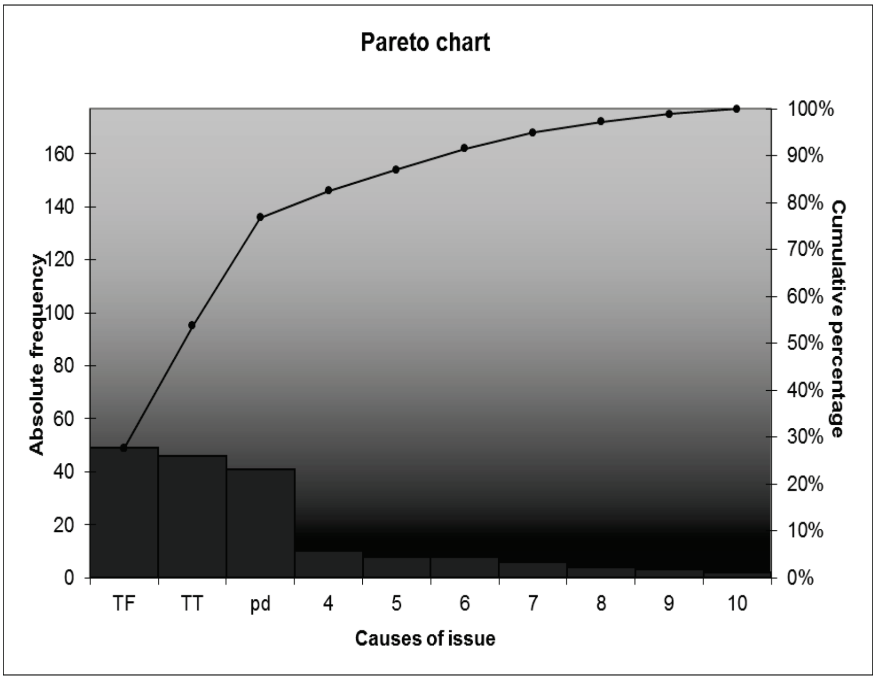

Fig. 4.5. Pareto analysis.

Source: own study

Parameters of melt temperature T_T, mold temperature T_F and holding pressure p_d, the most influences the manufacturing process injection molding.

4.3. Results and discussion

The proposed parameter changes were implemented. Capability of injection molding machine ENGEL was evaluated again after increasing the melt temperature, mold temperature reducing the holding pressure into optimal value default by a technician. New measured data processed in the proposed diagram which can be seen in Figure 4.6.

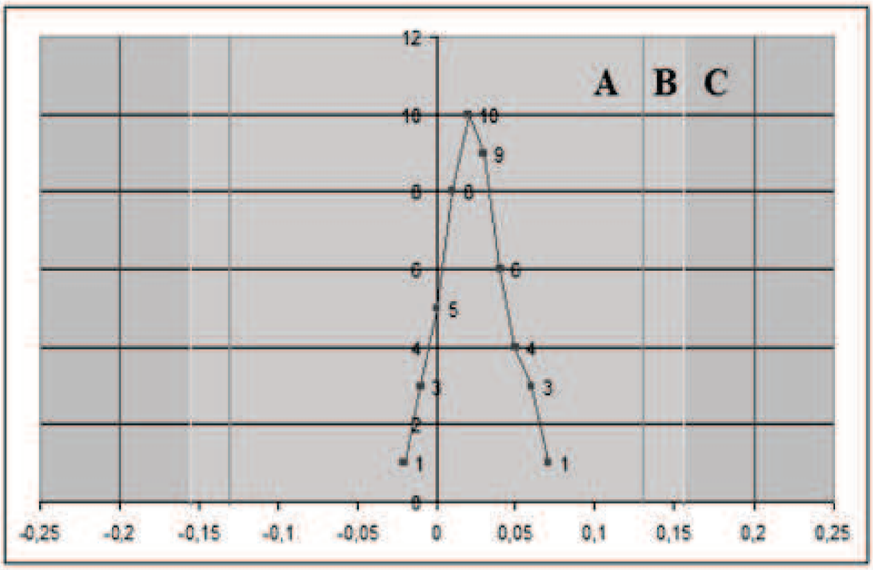

Fig. 4.6. New measured data.

Source: own study

All measured data are contained in the field A. Injection molding machine ENGEL is capable.

We used indicator of scrap for evaluating the proposed solutions and the benefits to the organization. Indicator of scrap represents the percentage of scrap generated in the production of all manufactured parts. Scrap in the period from November to April is shown in the Figure 4.7.

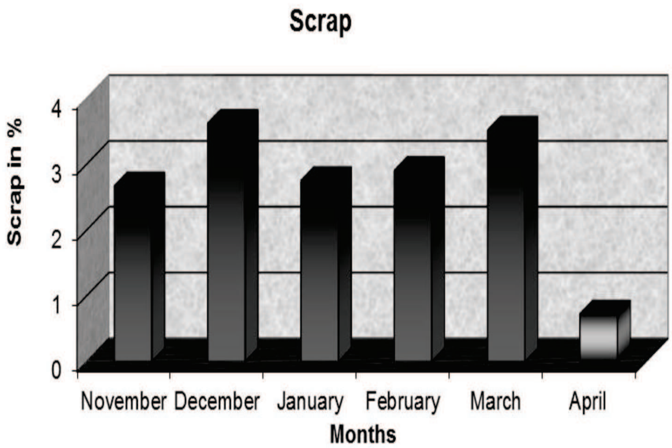

Fig. 4.7. Development of the scrap of injection molding machine ENGEL.
Source: own study

Development of scrap of injection molding machine Engel is shown in the bar graph. The average monthly scrap in the period from November to March is 3.096%. After the change of parameters of injection molding machine in April the scrap was reduced to the value 0.728 %, this means scrap decreased by 76% compared to the average monthly scrap.

Injection molding machine ENGEL produces more accurate injected parts and less scrap than in the previous period.

4.4. Summary

During the monitoring of the capability of injection molding machine we came to the conclusion that the production facility is not capable. The main objective was the analysis causes of the adverse situation and subsequent recommendation of corrective measures to eliminate it. Realization of corrective measures demanded minimum costs. Implementation of corrective actions brought very positive contribution to society. The scrap of injection molding machine was reduced by 76 %.

Acknowledgement

This paper was prepared with the support of the project VEGA No 1/0448/13 'Transformation of ergonomic programs into the management structure through integration and utilization of QMS, EMS, HSMS'.

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