OPTIMIZATION OF THE QUALITY PLAN IN SAINT-GOBAIN MONDEGO, SA - A CASE STUDY

Paulo Ávila, Polytechnic Institute of Porto, Portugal, psa@isep.ipp.pt
Goran D. Putnik, University of Minho, Portugal, putnikgd@dps.uminho.pt
Catarina Sá, Saint-Gobain Mondego, SA, Portugal, Catarina.sa@saint-gobain.com
João Contente, Technologic Scholl of Vale de Cambra, Portugal, jpcontente@sapo.pt

Abstract: The quality plan is one of the most important documents into the quality management systems. It brings to the system how the quality control should be done in order to assure the product quality and the customer's satisfaction. Nowadays the production systems have to continue to improve its performance in order to be more competitive and the quality plan has to follow this trend too. In this work we will present a case study developed in Saint-Gobain Mondego, SA, whose goal was to improve the quality plan in order to reduce the product non conformities and simultaneously the costs associated with the quality.

The present work makes firstly a presentation of the enterprise production process and an overview of how the quality controls it is performed during the process. After that, we will characterize the problem that Saint-Gobain proposes to study; our propose to decrease the problem; the tests effectuated and the analysis of the results; and the final conclusions about this case. How we will see, there are strong signs that the proposal tested will bring quality improvement associated with a cost reduction and consequently better satisfaction for the customer.

Keywords: quality improvement; quality plan; quality costs reduction; customer satisfaction continuous improvement.

1. INTRODUCTION

The Saint-Gobain group was born in France by order of the King Luís XIV in 1665. It was created by Colbert, with the goal to produce the mirrors of the Versalhes Palace. Since that, the company has developed others activities and has been implemented in several countries. Nowadays the Saint-Gobain is a multinational group that produces and distributes materials of high technology in the area of the glasses. In Portugal, the Saint-Gobain Mondego, since 1987, dedicates to the production and commercialization of package glass (e.g., bottles) in the following colours: amber, white, cinnamon and green.

As a quality certified enterprise by NP EN ISO 9001:2000, beyond others certifications[1], Saint-Gobain interprets adequately the principle of the continuous quality improvement as it is described in the NP EN ISO 9000:2005 [1]: "consists in increase the probability of customers satisfaction and other interested parts". Not only described into its mission of integrated politics, but also in quotidian worries and actions, as this case study will demonstrate.

The work proposed into the case study has a goal to promote the improvement of the quality plan, more concretely into the phases where the quality control is manual and not automatic, i.e., the final control quality, in order to evaluate the frequency of this control.

2. PRODUCTION PROCESS AND QUALITY CONTROL

A schematic description of the production process and quality control is illustrated in figure 1. Soon after, we will resort to the figure to explain globally its process flux. We are in the presence of a continuous production system, or line production, that is reconfigured (setting up) when the product changes.

After the reception of the raw materials (point 1 of the figure) and its quality control (paragraph a of the figure), the production process begins with the preparation of the composition or vitrified mixture (point 1 of the figure), composed essentially by sand, limestone, oxide of sodium and broken glass, into the mixer machine (*preparation of the composition activity*).

Secondly the composition is driven until the continuous fusion stove (point 2 of the figure), at approximately 1500ºc, where will be produced the glass in fusion state (*fusion activity*). During this

[1] Environment certification by NP EN ISO 14001:1999; Security certification by OHSAS 18001:1999; EMAS registration according to the CE 761/2001 regulation.

phase components will be added to give the colour and opaque degree of the glass and the process is controlled (paragraph b of the figure).

product characteristics susceptible of being controlled automatically (*automatic control activity*).

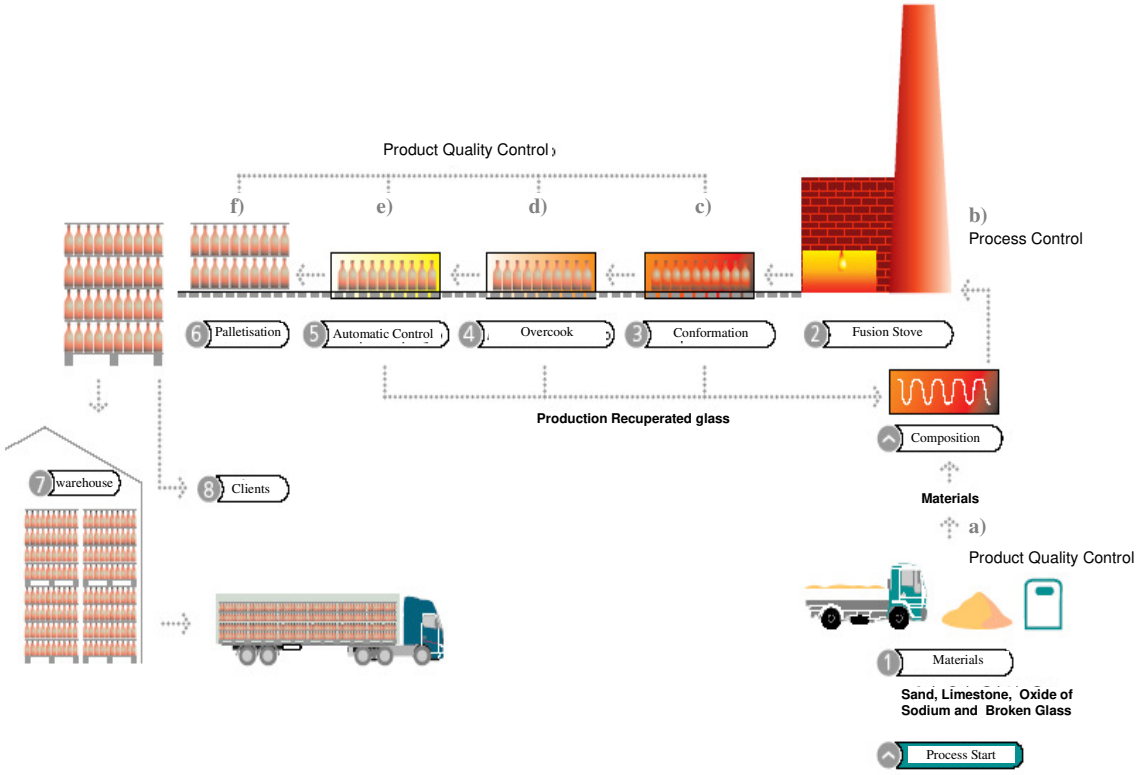

Fig. 1. Saint-Gobain production process [2].

Then, this glass is empty trough the feeders, in a drop form, to the conformation machines (point 3 of the figure). Where with an automatic process, involving flows of air and compression we got the final form of the desired product (*conformation activity*). Immediately at this phase the product is target of a dimension control (interior and exterior) of the type pass or not pass trough the use of gauge (paragraph c of the figure).

Afterwards, the product is overcooked (*overcooked activity*) to permit the slowly cooling until the ambient temperature into overcooked ark of the type of tunnel (point 4 of the figure). It permits to alleviate the tensions. The products are heated until the temperature of tensions relaxation, maintained at this temperature during the necessary time and cooling controllably until the room temperature. Immediately at this phase the samples of the product are collected and submitted to physic essay in the laboratory in order to evaluate the capacity, the minimal thickness and overcooked degree (paragraph d of the figure).

In the next step all the products pass trough several automatic control machines (point 5 of the figure) in order to proceed at the control of several

However, because of other characteristics of the product it could not be automatic controlled and because this control needs, for each type of product, to be adjusted during the production process, during the palletization (point 6 of the figure) there is a final control of the product. This control is manual and it depends substantially of the controller experience and is made by sampling control methodology according to the dimension of the lot production.

Then the product is ready to go to the warehouse (point 7 of the figure) or to go directly to the clients (point 8 of the figure).

3. PROBLEM CARACTERIZATION AND FORMULATION OF PROPOSALS OF IMPROVMENTS

Of course, as we said before in the introduction chapter, the principal Saint-Gobain input to develop the study that we will present, it was to look for the continuous improvement inside its production system (pro-active attitude). However, it is necessary to analyse the production data and to identify an opportunity and then perform the cycle PDCA (Plan, Do, Check and Act). We can say that: at this point of our work we were in the phase Plan.

So, first we have analysed the following data[2], related with the client satisfaction degree:

- the deterioration commercial index sense 2004;
- the number of clients complaints, sense 2004, distributed by a set of motives or non conformities;

With this data we could verify that there was some stability in spite of the number of reclamations related with critic non conformities has decrease significantly sense 2004 until 2007.

Secondly we have analysed the data referring with the production results for:

- The process revenue (quantity of good units produced / quantity of units launched to the production) by the set of colours.

In this analysis we have identified that the products of white colour were the worst in process revenue.

Thirdly we have analysed the:

- revenue of the products class A for the white colour, resulted from the Pareto analysis considering the tax of production during two campaigns of the stove producing the white colour;
- tax of production for each class A products of white colour.

We have verified that doesn't exist a correlation between the process revenue and the tax production, It means, that the products that we produce more have not necessarily the best revenue. Otherwise, most of the products have almost the same revenue, i.e., the dispersion of the values of the revenue is small.

Fourthly we have analysed the:

- the quality control plans for products class A;
- the registers of the controls results (namely the final control);
- the verification on the field (plant production) the activities of control.

After that we have concluded the following:

1. The control plan for each product it was been well applied, i.e., the plan was accomplished by the controllers;
2. The final control it is a sampling control and is defined according to the Military Standard 105D [3] and according to the acceptance or specifications of the client;
3. The frequency of the final control (sampling control) is at least once a turn (turn of 8 hours) and we have verified that: (1) if the acceptance criterion are satisfied, the next sampling is performed only in the next turn; (2) If the lot is not accepted, all the lots produced since the last final control are rejected and until the next lot is accepted, all of the lots produced have to be controlled; after that is repeated the first proceeding.
4. During each turn are produced 200 to 400 lots of products (depending of course of the product type), with 500 to 1500 units of products (depending of the product too);
5. During the initial phase of the production of one product, so and so corresponding at the production of the first 20 lots of products, the process is in phase of adjustments in order to setup adequately the production process (including the automatic control);
6. In the initial phase of the production (referred in the previous point) we have verified that the final control was realised only one time per turn, save if the first control do not accepted the lot. However, in several cases the lots were not controlled sequentially, but with intervals between them.
7. When happens the existence of production intervals between the final production control, referred into sixth point, the feedback of the final controller to the production is too late because during that period we could have produced without quality, even maintaining the others controls. As a note, we cannot forget that the automatic control is adjusted for each type of product and for that it needs production time. On the other hand not all the product characteristics can be automatic controlled.

After the detailed analysis presented before we have questioned the following: Have we margin to promote an alteration to the final control of the quality plan? Our answer was affirmative and we have proposed to test the following:

- *During the first 20 lots produced (the identified as critic for the set up production) in the beginning of one product production can we obtain better results than those we got now if we make a continuous sampling control?*

Of course that when we talk about better results we should think about two kinds of performance measures: the production performance and the cost performance [4]. The second one means the evaluation of the amortization investment. The first one, the improvement of the production performance, only makes sense if investment made is amortized in useful time.

[2] This data could not be presented because it was classified as confidential information of Saint-Gobain enterprise.

4. EXPERIMENT AND RESULTS ANALISYS

"The continuous improvement should be based into analysis of facts" [5]. To implement that it is necessary to define performance parameters, quantify them, to define new objectives, to plan, implement and to control the actions that permit to get the objectives and further to compare the results obtained with the objectives. Based on this statement, that is consensual in our days, but more correctly/easily interpleaded by enterprises with quality certification, we advance to the experimental phase with a single restriction: It was impossible to wait for the products class A of colour white because we could have to wait a year or more, to develop the experimental phase.

So, we have decided to advance to the production of one mouth and analyse the results. It was precisely what we did. During a mouth we follow the first twenty production lots in the final control and recorded the total of lots rejected to compare with the previously lots rejection without the frequency of the final controls proposed in this work.

During a month we analysed 12 different types of final products produced in one of the two lines of Saint-Gobain Mondego production and compared the lots rejections, before and with our final control change proposed. The values were collected in a format of the table 1, whose data are concerning simply for one of the products studied.

Product Model: Bord. Elite 75		
Last Four Productions Dates	**Machine:**	**Lots Rejected**
09-06-2006	23	0
17-11-2006	23	0
02-04-2007	21	2
02-04-2007	13B	2

Average of lots rejection during the last four productions:		**1**
Ours lots rejection 03-01-2008	21	**7**

Table. 1. The Average of historic lots rejection and our lots rejection with the final control alteration proposed [6].

For the previous historic results we have calculated the average for the data of the four last productions for each product. In some cases we had to obtain the values sense 2004, but for the majority of them it was sufficient the data from 2006 (case of the product of table 1). It is important to refer that for the products analysed the data collected doesn't show a tendency (decrease or increase), the values are quite at random.

For all the products data, Figure 2 shows the quantities of lots rejection, for the two situations, in order to permit a better comparison.

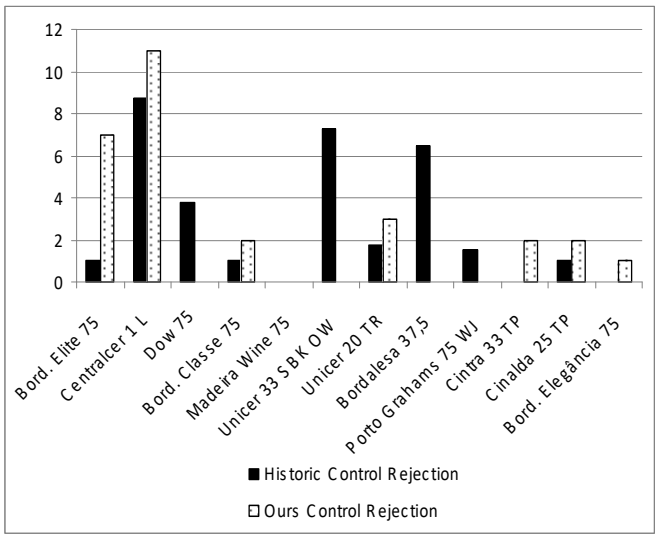

Fig. 2. Comparison of the lots rejection per product, before and during the experimentation for all the products produced during a month [6].

Analysing the collected data we have verified that:

- The final results are not positive for all the products. There were previous productions that never had a lot rejection in the first twenty lots produced but now they did;
- The opposite is also true. It is a good indicative because we infer that when the controls are more frequent, the defects are detected earlier and the process can be corrected earlier, avoiding so the rejection of lots produced;
- However as is possible to verify in the figure 3, that contains the final average values of the results, for our control we obtained a rejection value bellow the anterior standard, almost 0,4 lots rejection less per product during the first 20 lots produced.

At this point of our study, we could say that the production performance had good signs to be validated, i.e., with the experimentation we had verified less lots rejection. Nevertheless, we had to verify the cost performance, as we said at the beginning of this chapter. It was what we did with the direct production costs involved in our experience. We evaluated the direct labour costs of the final control and compared with the costs[2] reduction of the production (resulted from the difference of the lots rejection) and verified that the last ones covered the first ones.

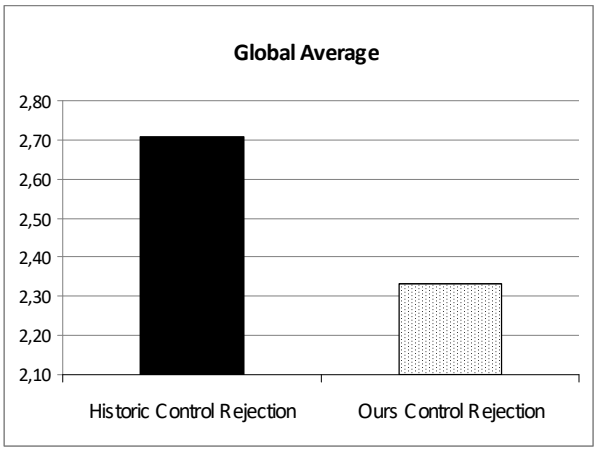

Fig. 3. Comparison of the lots rejection average, before and during the experimentation [6].

After the previous performance analysis we could say that our proposal has good signs to be implemented, but we proposed more. We picked the historic claims associated with the products tested, resumed in table 1, and verified that in a

total of 8 claims received until now (the last productions will could still have any claim) 5 of them (written in bold in table 2) can be associated with a deficient final control. Of course that when we say can be, it means that there is a strong probability, but we know that there is some subjectivity, beyond that we know the claims content and performed its analyses.

We expect that with the increase of the final control during the first twenty lots production, the clients claims would decrease. If it happens, what we believe, the costs associated with the non quality can decrease. One part of these costs can be quantifiable, but the other part, related to the client satisfaction could not. It is true that the opposite is valid too. For that reason, our cost performance can achieve better results and simultaneously our production performance too.

In spite of this we weren't able to make the analysis of the potential claims of our production controls, because it needs some mouth until Saint-Gobain receive the claims, it will be useful to compare with the previous claims, and establish a comparison. Of course that we believe that the number of the claims will be less than in the past, but is something that the enterprise should be pay attention to the next mouths.

Product Model	Claim	Production Date	Claim Reason
Bord. Elite 75	No		
Centralcer 1L	Yes	07-08-2007	Palette downfall
Dow 75	No		
Bord. Classe	No		
Madeira Wine	**Yes**	**31-01-2006**	**Error in the labels and rupture in the filling up line**
Unicer 33 SBK OW	**Yes**	**28-11-2006**	**Rupture in the filling up line**
	Yes	**16-08-2007**	**Rupture in the filling up line and palette downfall**
Unicer 20 TR	Yes	31-05-2006	Palette mixture from other model
Bordalesa 37,5	**Yes**	**12-02-2007**	**Rupture by infused**
Porto Grahams 75 WJ	**Yes**	**08-02-2006**	**Bad engraver of the heraldic bearing and error in the labels**
Cintra 33 TP	Yes	06-09-2005	Model changed
Cinalda 25 TP	No		
Bord. Elegância 75	No		

Table. 2. Historic claims associated with the priors products productions [6].

5. CONCLUSION AND FURTHER WORK

Trough the previous figures showed in the last chapter and from the analysis made, it is possible to verify that in global terms there is a reduction of the number of rejected palette, from 2,71 to 2,34 and less risks in the future to receive claims respecting the products production of our study. Besides, this is a matter that the enterprise should follow in the next mouth to establish a comparison more truthful between the previous claims and that ones that could appear.

After that the enterprise should test the the alteration of the control plan to other production products, more precisely to the products class A of the white colour, where we expect that the results will be still more significant.

Also, with this work we show that there are forms to promote the continuing improvement, even inside multinational groups enterprises, since they are interested, which is the case of Saint-Gobain Mondego.

As a final conclusion we have verified that there are strong signs that in the future the enterprise passes to control all the final lots through the sampling plans defined for each product, during the stating phase of the production process (normally the 20 first lots) and not the maintenance of the actual procedure, once per turn.

References

[1] NP EN ISO 9000:2005. Quality Management Systems – Fundamentals and Vocabulary.
[2] Saint-Gobain (2007) *Environment Declaration of 2007*.
[3] Military Standard 105D
[4] Ávila P. (2006). Methodology of Analyses and Improvement of the Production Process, *Lesson of the Concourse of Coordinator Professor*, Superior Institute of Engineering of Porto.
[5] NP EN ISO 9001:2005. Quality Management Systems – Requirements.
[6] Contente, J. (2008) Optimization of the Quality Control Plan in Saint-Gobain – *Traineeship Report,* Technologic school of Vale de Cambra.

THANKS

We would like to thank Saint-Gobain for all of its interest and support to perform this work inside its facilities.