THE PROJECT TO INCREASE THE EFFICIENCY OF PRODUCTION LOGISTICS

[1]Andrea ROSOVA, [2]Tomasz MALKUS, [1]Martin PASKA, [3]Peter TREBUNA, [1]Peter IGNACZ, [1]Petra PLESKOVA

[1]Technical University of Kosice, Institute of Logistics, Slovak Republic, EU
andrea.rosova@tuke.sk, mpaska@centrum.sk, pignacz@groupe-bel.com, pleskova.petra@gmail.com

[2]Cracow University of Economics, Department of Process Management,Poland, EU
małkust@uek.krakow.pl

[3]Technical University of Kosice, Faculty of Mechanical Engineering, Slovak Republic, EU
peter.trebuna@tuke.sk

Abstract

The aim of the contribution is to introduce the project and to point out the possibilities of using computer simulation for the needs of more effective production logistics. Like many other tools and methods, logistics also greatly contributes to maintaining the company's competitiveness and resilience to external factors such as the crisis, inflation, falling demand, and so on. One of the key methods for maintaining balance is material planning. The most significant group, which, at the same time, forms the most relevant part of the material flow are raw and other materials and corporate work in progress and finished products. All the types of working objects are used throughout enterprises in certain amounts, internal structure, direction and with certain frequency. For a better imagination of the production proces, concrete production of fireclay bricks, the simulation model as the project for the production of fireclay bricks was developed in Tecnomatix Plant Simulation. As a basis for creating simulation served the model of the manufacturing process in the chamottera. Due to the high production capacities of the chamotary, it has been found that for the efficient production of a limited quantity and especially the firing of the building, a narrow place of the entire production process of the fireclay is the mill.

Keywords: Project, logistics, production, simulation model, efficiency

1. INTRODUCTION

The process simulation models are very efficient tools for detecting the bottlenecks in the process course and for improving the process parameters. Neither costs nor negative impacts are connected with interfering in a simulation model of a production line, unlike to interfering in the operation of this line. To develop the proper simulation model, both theoretical knowledge (technique of simulation, specific simulation systems) and practical experience (description of the system, its elements and their mutual interactions and links) are necessary [1]. The course of the simulation is to be monitored in every phase. It is possible to determine impacts on total function of the system from the changes that occur at the output of the simulation model. A need for simulation models is based therefore on an opportunity for experimentation with a system without interfering in the real one. The model allows an engineer to try a number of process variants, to find the optimum process conditions and to design new process routes without any need for additional investment. The respective changes may have a significant impact on profitability of the production, market position of the company and satisfaction of its customers [1]. Simulation has a lot of applications in various branches. Simulation of systems allows to experiment within virtual objects (some of them do not exist at all). The simulation can provide answers to a lot of important questions as for example: “How will the system behave after introduction of some changes? Where are the bottlenecks in the system?” [2].

2. METHODS

2.1 The process analysis of production of fireclay bricks

The company manufactures its products on the basis of an order from the customer, PULL system. Depending on the assortment, the production cycles for the production of fiberglass are 1 - 2 weeks and for the production of the building 3 - 4 weeks. There is also an exception when it is produced by the PUSH system, ie in the warehouse, especially in the winter, when it is considered to be a higher requirement for an additional assortment, building fireclay, which serves for the lining of fireplaces, chimneys, etc., which is more demanding during this season. The paper deals with the manufacturing process shown in **Figure 1**. In addition to burnt production, the enterprise also deals with other types of production, which are represented in the model of the entire production process of the plant [3].

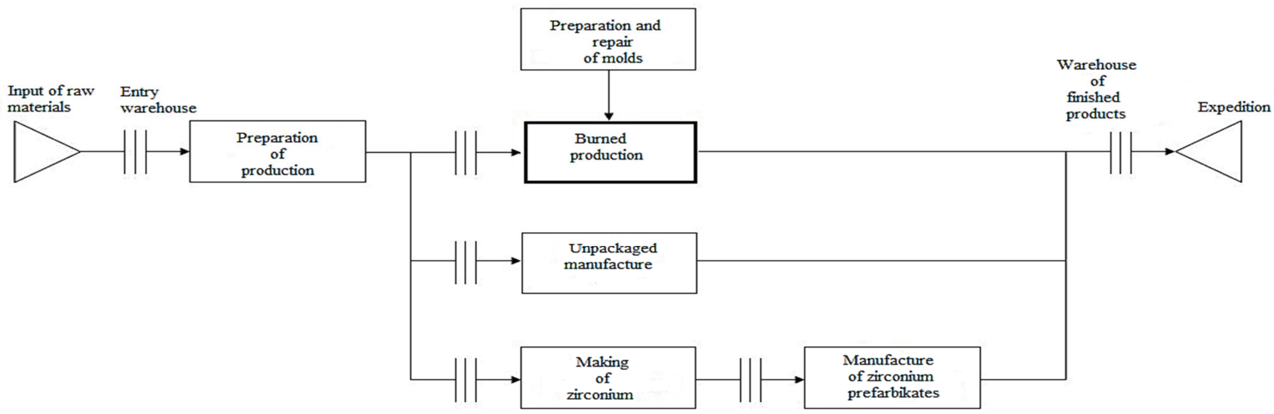

Figure 1 Formalized scheme of the company's production activity [3]

For a better imagination of the production process of fireclay bricks, a simulation model for the production of fireclay bricks was developed in Tecnomatix Plant Simulation. As a basis for the creation of the simulation, the model of the production process was used by the chamotary (**Figure 2**). First, a basic model consisting of individual input raw materials, containers, equipment, transport routes and tunnel cars [3].

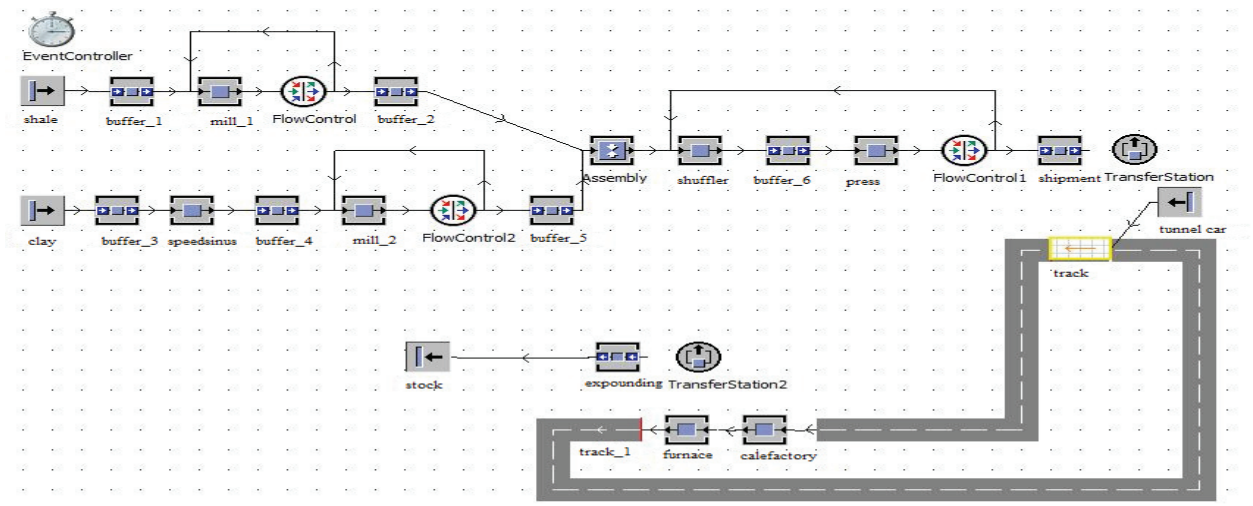

Figure 2 Simulation model of fireclay bricks production [3]

For the production of the required products it is necessary that the feedstock is delivered to the raw materials store and then stored in the storage bins. After storage, it is necessary to have the individual feedstocks adjusted to the required moisture (clay) and the required fraction (grain thickness). The modification of the moisture content of the clay is carried out in the speed kiln of the clay and the treatment of the fraction of the grains takes place in the individual mills. After this treatment, the raw materials are transferred to a mixer, which mixes the feedstocks into the desired mixture [7]. After checking the quality of the mixture, the mixture is transported to the press where it is formed into the desired shape, using suitable molds and presses. After molding, the bricks are deposited on a tunnel wagon, through which the moldings are driven into the tunnel heater, where they are dried to the exact required residual moisture. After drying, the tunnels are pushed into the tunnel furnace, where the firing itself builds. After drying and burning, finished products are produced. These products are transported to the intermediate storage where quality is checked. If the quality of products meets the standards, the goods are stored in the warehouse of finished products prepared for dispatch to the consumer [3,4]. Due to the high production capacities of the chamotary, it has been found that for the efficient production of a limited quantity and especially the firing of the building, a narrow place of the entire production process of the fireclay is the mill. To produce 5 tones of the mixture, which corresponds to the capacity of the blender per hour, 3 tons of cake and 2 tons of clay are required for the production of common chamotte. The capacities of equipment for the production of this product are balanced up to the press, where the capacity for the original mold is 61.6 % smaller than for other devices.

3. RESULTS

Due to the high production capacities the production process of fireclay bricks, it has been found that for the efficient production of a limited quantity and especially the firing of the building, a narrow place of the entire production process of the fireclay is the mill. Therefore, most of the proposed measures will be aimed at increasing efficiency in this section of the production process [7]. More efficient molding can be achieved by the application of multi-form molds where the press and pressing forces of more modern presses such as Laeis 2000 and Laeis 1250 are better utilized, in the production of common fireclay is currently used a form with 4 nets, as show in **Figure 3** and in **Figure 4**. Rotate the nest to the narrower side to gain space for the next two nests. This would mean that the number of moldings from 4 to 6, as shown in **Figure 5** and **Figure 6**. [3,7].

Figure 3 The mold currently used [3]

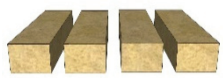

Figure 4 Current state of molding[3]

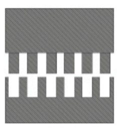

Figure 5 The Proposal of molding forms [3]

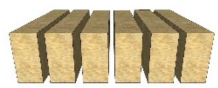

Figure 6 Suggested state of molding[3]

To produce 5 tones of the mixture, which corresponds to the capacity of the blender per hour, 3 tons of cake and 2 tons of clay are required for the production of common fireclay. The capacities of the equipment for the production of this product are balanced up to the press, where the capacity for the original form is 61.6 % smaller than on other devices, and the show in **Table1**. [3,8].

Table 1 The capacity of the equipment [3]

Device / activity	Performance	Device / activity	Performance
Milling of fire clays	3 t/hr	Milling of clay	2 t/hr
Fast drying of clays	5 t/hr	Mixer to form a mixture	5 t/hr

The narrow location of the production process is displayed using the Sankey's diagram in the simulation. The Sankey's diagram shows the flow pattern of the material flow. A narrow place is created at the workplace of the mill and show in **Figure 7**. [3,9].

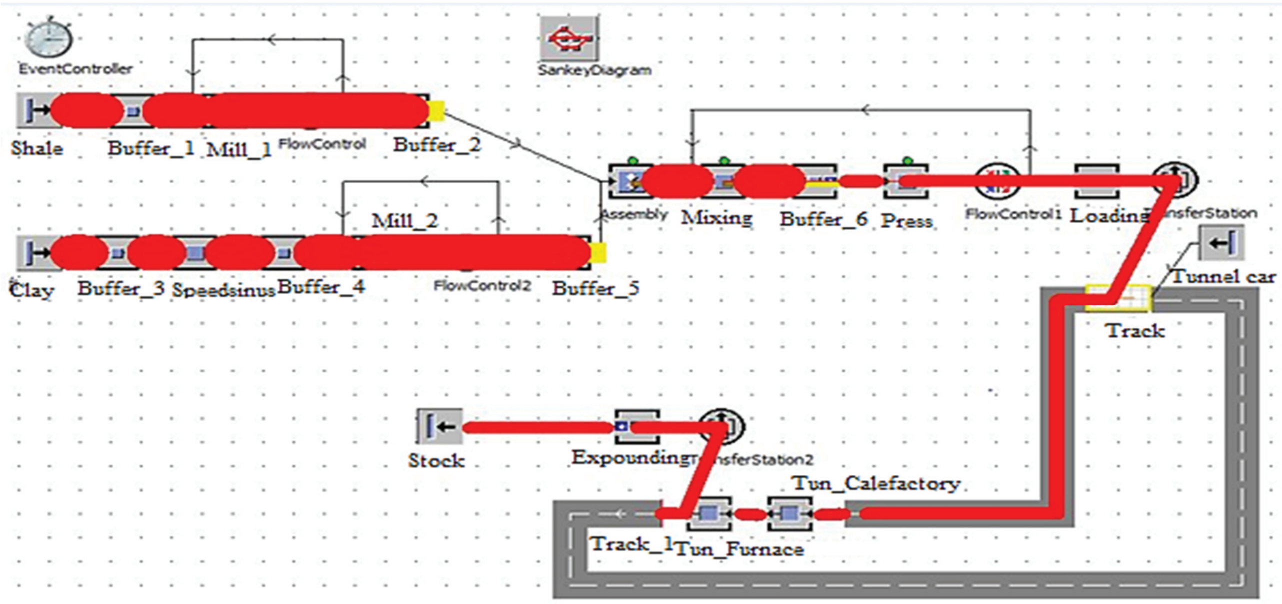

Figure 7 The Sankey's material flow diagram using the original mold [3]

One pressing cycle during compression ordinary fireclay lasts 30 seconds. If we use the currently used molding mold, shaped with 4 openings, 4 moldings are pressed per compression cycle. One molding has a weight of 4 kg, so 16 kg of molding is molded per compression cycle. With continuous production 24 hours, this would mean that the press presses 46,080 kg of stack (received without time losses in the transport of raw materials) and show in **Figure 8** [3,10].

Simulation time: 1:00:00:00.0000

Cumulated Statistics of the Parts which the Drain Deleted

Object	Name	Mean Life Time	Throughput	TPH	Production	Transport	Storage	Value added	Portion
	Storage Fireclay brick	7:33:18.2990	42800	1783	0.01%	0.75%	99.24%	0.01%	

Figure 8 Statistical data for the production of fireclay bricks in 24 hours using a 4-hole mold [3]

With the proposed change in the number of holes from 4 to 6, 6 pieces of 24 kg pieces would be pressed for the same press cycle. The capacity of the press would increase to 57.6 % compared to the original 38.4 %. For production in 24 hours, this would mean 69,120 kg of construction (counted without time loss in the transportation of raw materials). Using a 6 - hole mold, production increases by 50 % and with the show in **Figure 9** and **Figure 10** [3,11,12].

If this principle of increasing the number of holes was applied to most forms, it would have a positive impact on the acceleration of production and hence the cost reduction due to the shortening of the tunnel kiln operation time. Examples of manufacture after increasing the number of holes of the most widely used molds are shown in **Table 2**. [3,13]. When multi-form molds are introduced, the production per day increases by about 40 %. This reduces the number of tunnels fired from the tunnel kiln within the planning cycle from 42 tons to 30 tons [3,14].

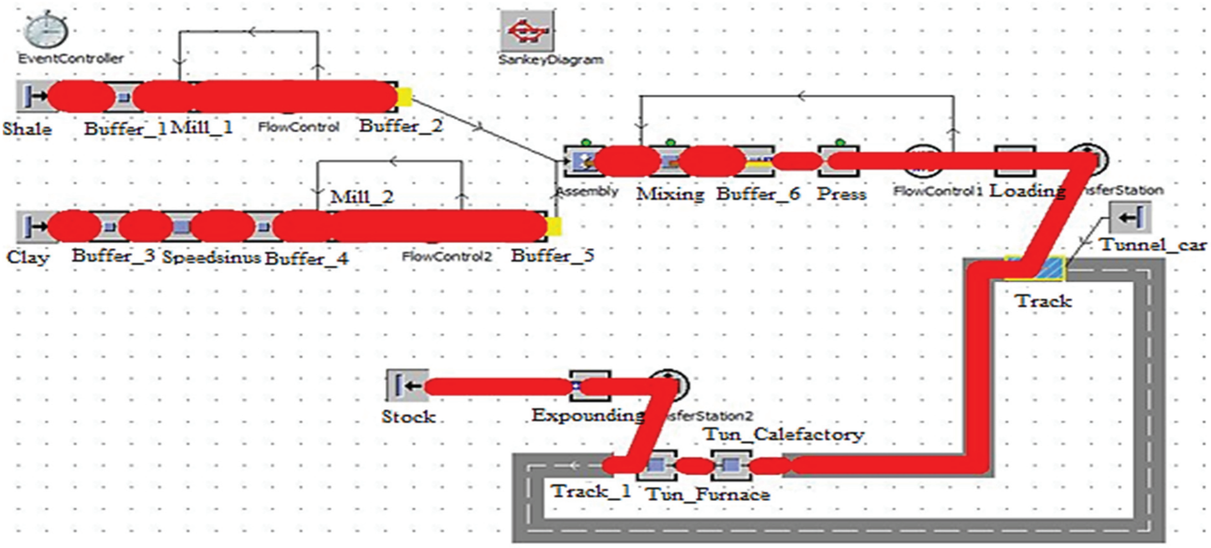

Figure 9 The Sankey's material flow diagram using the proposed mold [3]

Simulation time: 1:00:00:00.0000

Cumulated Statistics of the Parts which the Drain Deleted

Object	Name	Mean Life Time	Throughput	TPH	Production	Transport	Storage	Value added	Portion
Storage Fireclay brick		5:15:56.5667	65000	2708	0.01%	0.72%	99.27%	0.01%	

Figure 10 Statistical data for the production of fireclay bricks in 24 hours using a 6-hole mold [3]

Table 2 Production examples after increasing number holes molding mold [3]

Form name (positions)	Current production (t / day)	Performance after adjustment forms (t / day)	Difference
LP230/5	8	10	2
+3KK	5	8	3
C-30	4	8	4
15-0	9	11	2
C25	8	11	3
Together	**34**	**48**	**14**

4. CONCLUSION

The company manufactures its products on the basis of an order from the customer, PULL system. Depending on the assortment, the production cycles for the manufacture of fiberglass are 1 - 2 weeks and for the production of the building 3 - 4 weeks. There is also an exception when it is produced by the PUSH system, ie. in the warehouse, especially in the winter season, when it is expected with a higher demand to an additional assortment such as, for example, building fireclay, which serves for the lining of fireplaces, chimneys, etc., which is more demanding during this season [3,15]. After a thorough analysis of the process of the production process of fireclay bricks, it has been found that this process can work more efficiently. Therefore, a number of measures have been proposed to reduce production costs, accelerate production, or lead to an increase in the technological level of the workplace [3,15]. Introducing multi-hole forms. Multi-mold forms would increase the production capacity of the mill, which would lead to an acceleration of the entire production process of the sham boiler. The design solves the introduction of a multi-bore mold at various positions and a change of the pressing surface when the original pressing surface is changed to a smaller area using a different molding area. Application will increase the performance of molded bricks are shown in **Table 3**. [3,16].

Table 3 Formulation of conclusions from proposals to make production more efficient [3]

The proposed measures	The benefits		Negative impacts
	Economical	Non-economical	
Application of multi-hole molds	- Acceleration of production which would allow to produce about 40-60 % more product for the same time as before, leading to shortened time of operation of the tunnel furnace, and it would have a positive impact on cost reduction.	- Accelerating the production process. - Reduce the impact of a narrow spot the mill, on the production process. - More efficient use of press equipment.	- High investment costs for the production of new types of molds.

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