Using simulation software in composites industry

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Abstract. The aim of this paper is to describe the use of simulation software in the manufacturing industry. We used the simulation by the final separation of the fabric from waste tires. Waste tires are the main components in the manufacture of new composite material. Advantage of the simulation program Witness is in the field of possibility to choose the right technology process of final purification. Simulation of the final purification techniques, the material flow and working times each of operation was identified by the radio frequency identification tech-nology (RFID). This method saves financial resources in the enterprises, and es-pecially decreasing the work time required for pre-production stage for the manu-facture of composite materials.

Keywords: Witness, simulation, RFID, waste tires, composite, production

1 Introduction

Technological processes are important part of the production system. The be-haviour and functioning of those systems cannot predict with certainty, because belonging to a group of determined probability systems [1]. If we say in use of in-creasing the efficiency, then it is generally to minimize costs and maximize bene-fits. If we want to know the exact behaviour of these systems, we would need to know mathematically describe them, or observe the behaviour of the real object. [2].

By our experiment was used Witness simulation program. Witness simulation environment consists of four basic parts. The basic menu includes a panel neces-sary for working with files and functions associated with modelling activities. The project panel shows the progress of the work with the model through a tree struc-ture [2], [3]. The section entitled modelling window has a squared base, which fa-cilitates positioning the imagination department. At the bottom of the working en-vironment is a panel element. The panel element is used by form the model. The elements are arranged according to type as basic, transportation, data, delivery equipments, graphs and statistics [2].

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Using storage elements on the desktop and indicating links we create a material flow. To create links between elements should be marked the first element of in-terconnection, the part of visual rules, select the rule interconnection (e.g. pull) and mark the second element may be in the process pushed or pulled by the nature of activities of the workplace where there is a buffer, it is where works must wait either subject to a minimum amount of time, or standing on the condition of the maximum amount of time for a public user. [3] Other most frequently used ele-ments include conveyor within the material flow and we, on the transfer material. [4], [5]

2 Materials and Methods

Using Witness simulation program we simulated the preparation process of composites manufacture (Fig. 1, 2, 3) [5]. Important is to used cleaning process of fabrics from used tires. After cleaning, was prepared a composite material from waste tires. The composite consists of two components, namely the waste tires fabrics and thermoplastics material- polyvinyl butyral (PVB), which is a product of car windshields recycling, where the security is added as the film. [6], [7]

The following Table 1 describes parameters of the various operations of com-posite manufacture based on the waste tires. Table 2 describes the parameters for the pressing plates.

3 Witness simulation program

Based on the input parameters we achieved the following results which are inter-preted by means of tables and graphics they have also been developed views of the workspace simulation program with simulated processes. [5], [7], [10] The follow-ing Table 3 shows values for components that enter the process, namely fabrics and PVB. Working times was obtained using data capturing by RFID. After ho-mogenization we have another product, a mixture. After mixture pressing we have gained a final product. Average working value on the machine by each process for a particular component (fabrics and PVB) is 81%.

The following graphic representation (Figure 4) describes values for each compo-nent entering the process, esp. for fabrics, PVB, mixture of PVB and fabrics and finally a composite.[8] Average time for PVB and fabrics by material input use is 100% for each component. [9] For the part “Material in process” is too important

these components. The other key factors (work in process, entered, shipped, etc.) are in this technological process insignificant.
The following Table 4 presented statistically processed data for individual ma-chines, through which the separation of the components of the fabrics. Vibrating machine was one, the operation of separating the fabric was carried out 3 times in an interval of 15 minutes.
Figure 5 shows the statistical data dependence to individual processing equipment. The graph shows that most use of the equipments in this analysis is a vibration screen machine, usability is 87,80 % and the second equipment is pressing ma-chine whose usefulness is 83,74 %. On the other hand homogenization machine [10] it is used to 55,28 %, the apparatus used to form the composites, on their ho-mogenization. The whole mixture mass is prepared in mass with different % ratio of fabrics for the particular composite.

Table 5 includes of statistical data processing for individual laboratory operations performed by the operator, i.e. the worker. Laboratory equipments for separation, by vibrating screens is 36,59 % of the total working time (123 min for the work-ing time) in fulfilling their material homogenization machine is the machine by 44,72 % (Figure 6).
Average job time means the time duration of each operation. The separation dura-tion is 15 minutes, with 55 minutes of homogenization, between itself kneading and pressing [11], does not carry worker in any occupation, at last operation which is in preparation for compression and selection composite form working it is an average of 20 minutes.
Table 6 presented statistical data for the conveyor that was used by manipulation from pressing machine, when we have the finished product [13] to the warehouse where they stored our plates before further analysis that will follow after compos-ite manufacture. [12], [13] The table shows that the inactivity of the machine for the total time is 123 min. In percentage is it 97, 56 % due to the fact that with con-veyor work is envisaged only for the manipulation from the press equipment to the warehouse.
In the following Figure 7 is presented the approximate layout of the workplace, where will be technological process of separation realized and composite manu-facture too.
The working time as an input parameter for individual operations was needed too. It was also necessary to set an amount that in the working process. [14], [15] The simulation was realized for 50% of the fabrics component and 50% of PVB (100 g fabric and 100 g PVB). The simulation was designed for one product, on one test plate with the size 68x150x3 mm.
Working times used by simulation process are defined as operating time - the time needed for each operation and setting-up time, is the time for heating and cooling.

4 Conclusions

The advantage of this paper is the application of simulation program by the technological process of manufacture a composite material, esp. in separation process including.

- The aim of this paper was to increase the efficiency of the manufacture process. In addition to displaying the workplace with a particular ma-chine equipment was examined the utilization of individual machines with the technology.

- The use of components of the process input, further usability workforce- worker who work by the equipment and ultimately the usefulness of con-veyors that are used for the transport of finished products to warehouse.
- The simulation program is used when choosing the appropriate technol-ogy for the separation of undesirable constituents contained in the fabric of waste tires.

- Simulation has predicted operating time, i.e. the time required for each operation lead time, i.e. the time for heating, cooling etc.. We obtained the overall view for work time equipment and each time value that is necessary to carry out the necessary operations using by composite manufacture.

Acknowledgements

Research reported in this paper was supported by EU Structural Funds within the project ”Promotion & Enhancement of Centre for Research on Transportation” ITMS code 26220220160.

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Figure 1. Fabrics from used tires [5]

Figure 2. Recycled polyvinyl butyral [5]

Figure 3. Pressed composite material [6]

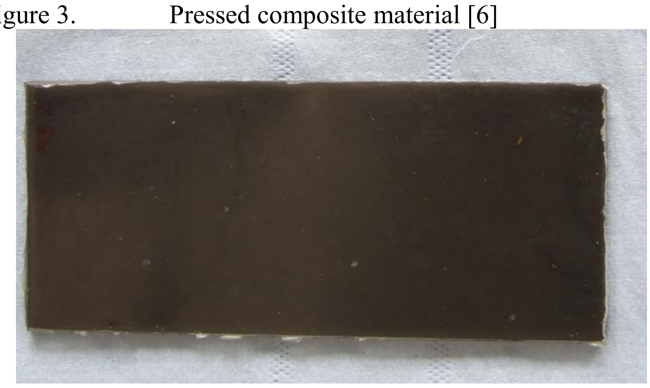

Figure 4. Statistic of materials in process

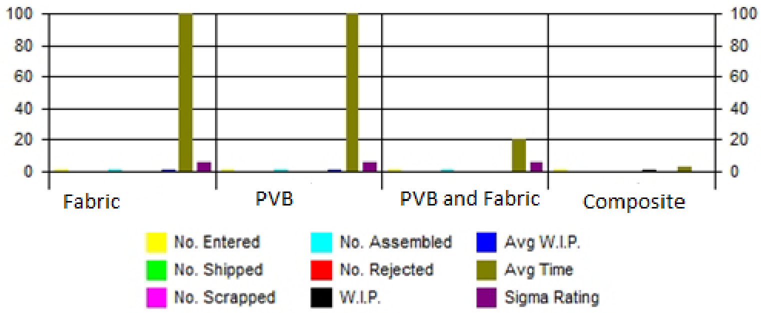

Figure 5. Machine statistic

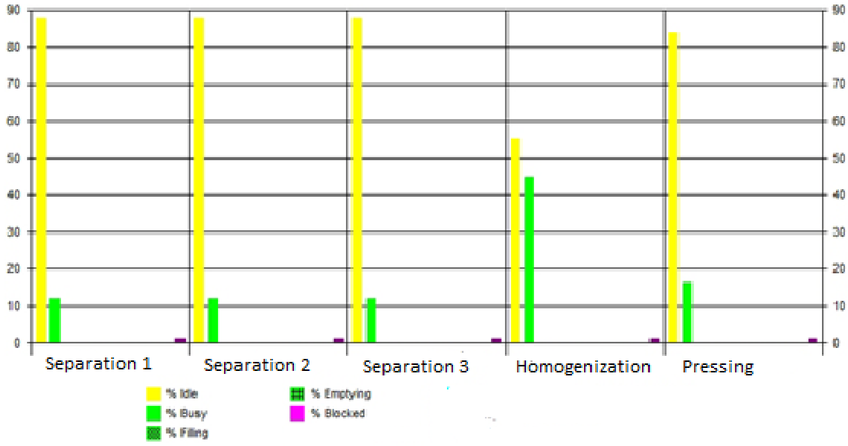

Figure 6. Graphical dependence of manpower by each technological operations

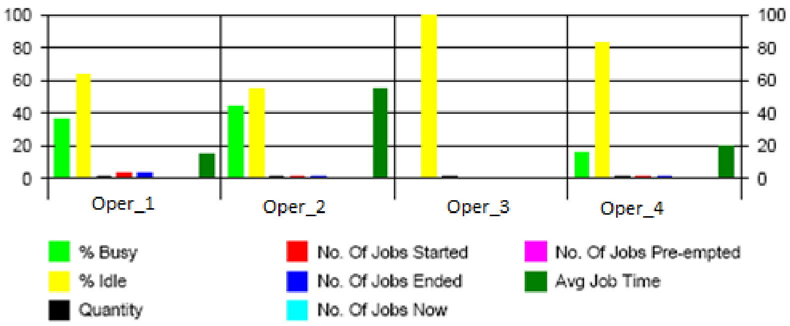

Figure 7. Material flow simulation of composite manufacture

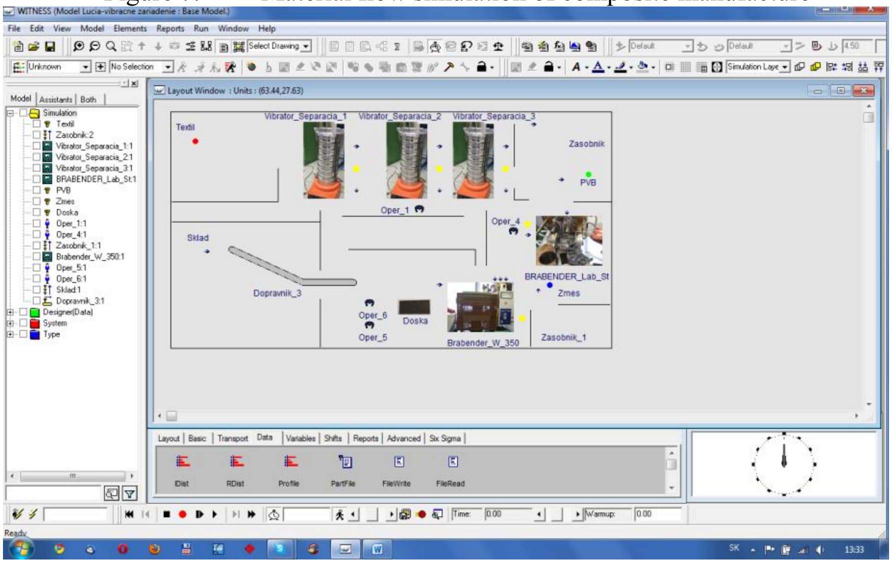

Table 1. Homogenization parameters for input material

Parameter	Characteristic
Equipment	Brabender Lab Station
Pre-heating in [min]	10
Work temperature in [°C]	150
Homogenization PVB in [min]	25
Homogenization temperature PVB in [°C]	150
Homogenization PVB and Fabrics in [min]	30
Homogenization temperature of mixture in [°C]	180

Table 2. Pressing parameters

Parameter	Characteristic
Equipment	Brabender W 350 E Laborpresse
Work temperature in [°C]	150
Pre-heating in [min] and temperature in [°C]	25
Pressing temperature in [°C]	150
Cooling in [min]	30

Table 3. Part statistics parameters

Name	Fabric	PVB	PVB and fabric	Composite
Input materials	1	1	1	1
No. of materials	1	1	1	0
Work in process(W.I.P.)	0	0	0	1
Avg. W.I.P .	0,81	0,81	0,16	0,02
Avg. Time	100,00	100,00	20,00	3,00

Table 4. Statistics parameters for test equipments

Name	1.separation	2.separation	3.separation	Homogenization	Pressing
No.of Operation	1	1	1	1	1
% Idle	87,80	87,80	87,80	55,28	83,74
% Busy	12,20	12,20	12,20	44,72	16,26

Table 5. Statistics parameters for process operation

Name	Operator 1	Operator 2	Operator 3	Operator 4
% Busy	36,59	44,72	16,26	0,00
% Idle	63,41	55,28	83,74	100,00
Quantity	1	1	1	1
No. of Jobs Started	3	1	1	0
No. of Jobs Ented	3	1	1	0
Avg. Job Time	15,00	55,00	20,00	0,00

Table 6. Statistical parameters for the conveyors

Name	% Empty	% Move	Total on	Avg. Size	Avg. Time
Conveyor (to the store)	97,56	2,44	1	0,02	3,00