Acta Simulatio - International Scientific Journal about Simulation
Volume: 3 2017 Issue: 2 Pages: 11-15 ISSN 1339-9640

Received: 12 June 2017
Accepted: 28 June 2017

MANUFACTURING SUPPORT OF FLOAT-SINK METHOD USING SIMULATION TOOLS

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Keywords: manufacturing, float-sink, simulation, Witness

Abstract: Technological processes are an important part of the production system. Behavior and the functioning of these systems can not be predicted with certainty as they belong to a group of probability-determined systems. If we wanted to know the exact behavior of these systems in advance, we would have to know them mathematically or observe the behavior of the system on a real object. Simulation processes does not prohibit experiments outside the actual object, without real intervention, even without the real existence of the system being investigated. In examining systems it is primarily about gaining new knowledge about their state, structure, behavior, it means obtaining useful information.

1 Introduction

Simulation is an experimental method based on experiments using a computer system model. It is a representation of the functioning of a system or process [1]. Through simulation, a model may be implanted with unlimited variations, producing complex scenarios. These capabilities allow analysis and understanding of how individual elements interact and affect the simulated environment. By our research being used the Witness simulation software [1],[2].

The top panel above contains the menu needed to work with the file and functions associated with modeling activities. The project bar shows how to work with the model using a tree structure [3].

The part called "modeling window" has a square base, which facilitates the imagination of the layout of the workplace [4]. At the bottom of the workspace there is an element panel. The element panel is used to create the model.

Elements are sorted by type:

- Basic,
- Transportation,
- Data,
- Transport facilities,
- Graphs,
- Statistic [2].

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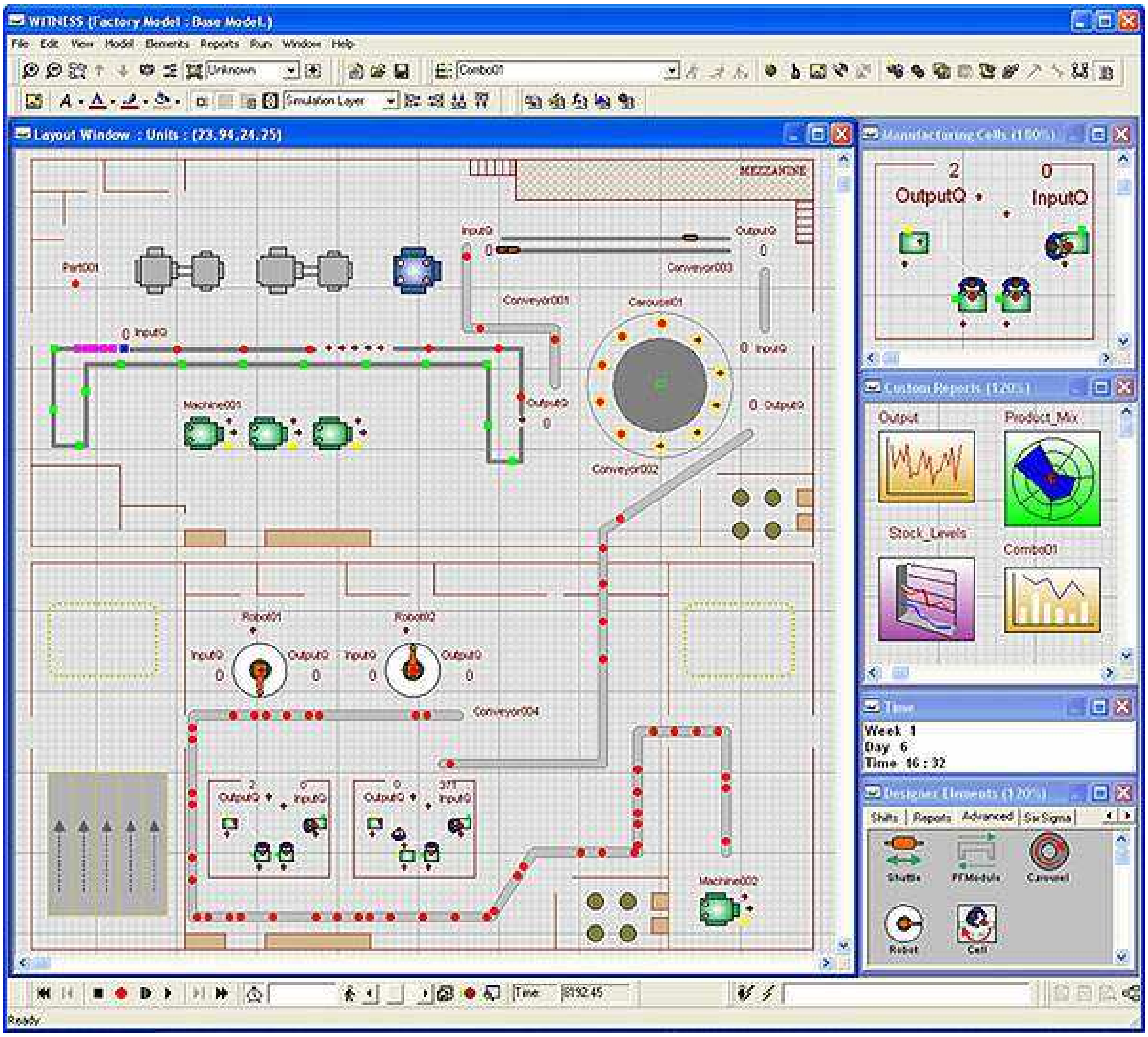

Figure 1 Witness software environment [7]

2 Float- sink method

Before starting the simulation[4], the basic data for each method was summarized. The input parameters were the times for each operation. The working time of Float-sink method is 35 min, it is also necessary to determine the amount of input into the process. In this case, the simulation was solved at a ratio of 50:50 input components, 50% of fabrics component and 50% of PVB The whole simulation is for one product, for one test board measuring 68x150x3 mm. The times entering the process are defined as:

- Operating time - what is the time needed for each operation
- Setup time - time for heating and cooling [5]

Besides the method of cleaning the fabrics component itself, the entire process of the manufacturing process of composite material production was simulated. In the following Table 1 [5] , [6] the basic characteristics are described for each operation of the cleaning of fabrics from used tires. Table 2 [6] is a description of the test sample after molding conditions.

Table 1 Characterization of manzfacturing process

Laboratory conditions	***Characteristics***
Machine	Brabender Lab Station
Pre-heat machine [min]	10
Working temperature [°C]	150
Homogenization of PVB [min]	25
Homogenization temperature PVB v [°C]	150
Homogenization of composite [min]	30
Homogenization temperature of composite [°C]	180

3 Simulation software Witness

The float-sink method is based on the density differences of the individual components that we want to separate [5]. In this method the separation time (30 minutes, for the separation method itself) was entered as an input parameter,

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The following Table 2 [6] shows the statistical data for individual components. The input material was fabric from used tires and recycled polyvinyl butyral (PVB). These two raw materials were homogenized in the kneading machine to form one mixture- a composite. From the composite there were also pressed plates for next laboratory testing.

Table 2 Statistical data for individual components of the manufacturing process[6]

Name	***PVB***	***Composite***	***Test sample***	***Fabrics***
No. Entered	1	1	1	1
No. Assemble	1	1	0	1
W.I.P.*	0	0	1	0
Avg. W.I.P.	0,73	0,23	0,03	0,73
Avg. Time	63,00	20,00	3,00	63,00

*W.I.P. –Work In Process

Figure 2 [6] below is a graphical representation of the individual components entering into the process. The final product a test sample from composite is molded in the laboratory press machine under the prescribed conditions.

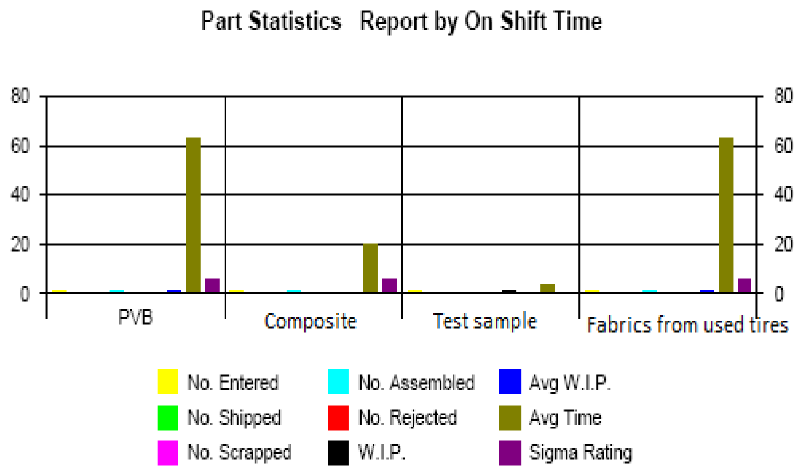

Figure 2 Part statistics data for manufacturing

The following table 3 [6] is a statistical data processing for individual machine equipment using the Float-sink method. From the following is to know the yield of the kneading machine in this operation is 63,95%, whereas the machine for separation itself is used only at 5,81%.

Next figure (Fig.3) [6] shows the machine statistics as a report after simulation.

Table 3 Statistical data for laboratory machines

Name	***Kneading machine Brabender***	***Euro star IK (Float-sink machine)***	***Laboratory press Brabender***
No.of Operation	1	1	1
% Idle	36,05	94,19	76,74
% Busy	63,95	5,81	23,26

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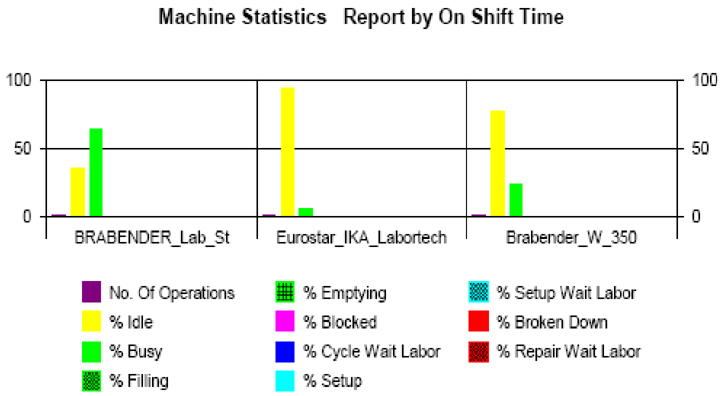

Figure 3 Part statistics data for machine

Table 4 [6] shows fabric cleaning operations and its actual implementation through an operator-worker. It can be seen that the average working time of the operator is between separation technology and the addition of individual components (fabrics and PVB) to the kneading machine, 55 min. At the start of the separation, the total operator handling time is 5 minutes. When preparing a homogenized mixture, the weighing and preparation of the molding takes an average of 20 minutes.

Table 4 Statistical data for operators

Name	*Operator 1*	*Operator 2*	*Operator 3*	*Operator 4*
% Busy	5,81	63,95	0,00	23,26
% Idle	94,19	36,05	100,00	76,74
Quanity	1	1	1	1
No. of Jobs Started	1	1	0	1
No. of Jobs Ented	1	1	0	1
Avg. Job Time	5,00	55,00	0,00	20,0

Figure 4 [6] is a representation of dependence for individual operations performed by the operator.

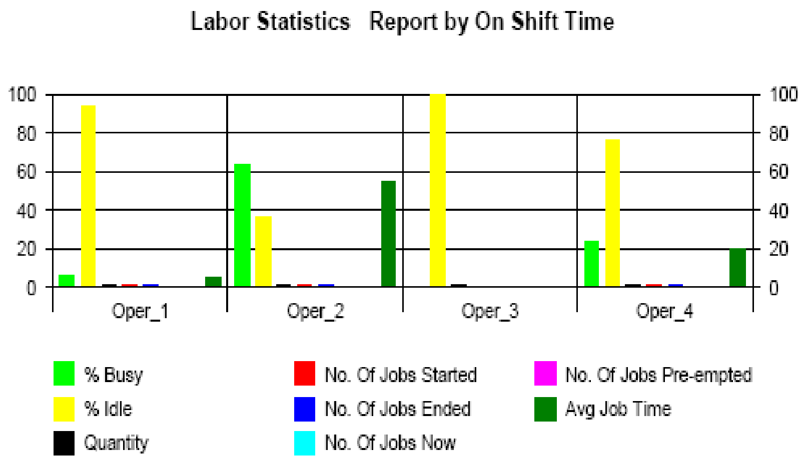

Figure 4 Labor statistics data for operators

Emptying the machine is before each operation. Machine utilization is 96,51%. The machine is in motion about 3,49% of the total time required for this composite material production process.

The figure 5 [6] is simulated manufacturing process of composite materials used float- sink methods by cleaning of fabrics from used tires.

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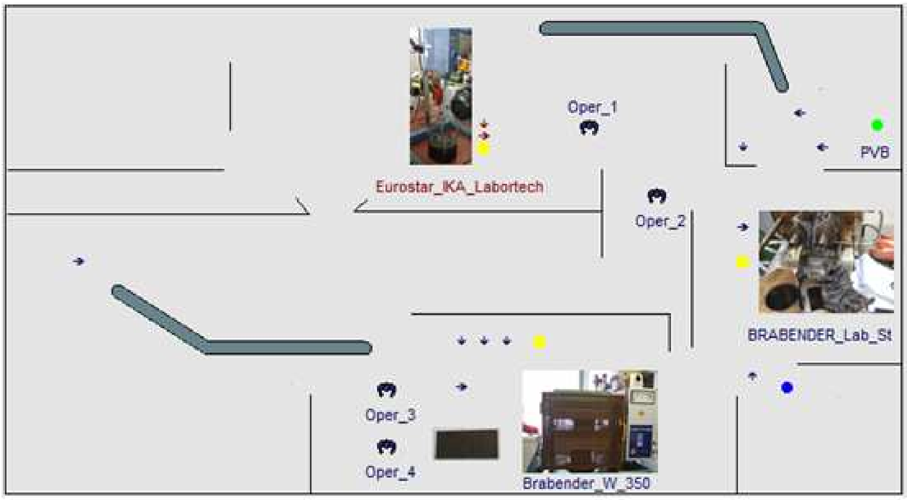

Figure 5 Simulation of manufacturing process used Witness software

4 Conclusions

Finding optimal solutions by manufacturing processes that are based on the use of the model are know in the literature as "Simulation-based optimization" or "Optimization via simulation". The basic simulation model is used in the search for optimal or best solutions.

References

[1] Jerz, V.: *Simulácia a optimalizácia v procese prijímania rozhodnutí*, Bratislava: SjF STU 2009. (Original in Slovak)
[2] HAINES, P. J.: *Thermal Methods of Analysis Principles, Applications and Problems*, Blackie Academic& Professional, London 1995.
[3] BARRY, C.M.F.-ORROTH, S.A.: *Processing of thermoplastics*, In: Harper, CH.A.: ModernPlastics Handbook, USA, 2000.
[4] LAW, A.M.: *Simulation Modeling and Analysis*, McGraw-Hill Companies 2007, p. 768, 2007.
[5] KNAPČÍKOVÁ, L., HERZOG, M., ORAVEC, P.: Material characterization of composite materials from used tires, *Výrobné inžinierstvo*, Vol 2010, No. 4, p. 31-34, 2010.
[6] KNAPČÍKOVÁ, L.: Optimalizácia technologických procesov pri zhodnocovaní plastov, Dizertačná práca, FVT TUKE, 2011.
[7] Lanner Group: Witness the Proven Route to Business Benefits [online]. [cit. 2017-01-14]. Available on http://www.lanner.com/en/witness.cfm>, 2017.

Review process

Single-blind peer reviewed process by two reviewers.