IMPROVING THE ASSEMBLY PROCESS OF THE CAR EVAPORATORS BY DETAILING PRODUCTION LINE OPERATIONS

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Rezumat. *Această lucrare urmărește îmbunătățirea procesului de producție al evaporatoarelor auto prin aplicarea metodelor de îmbunătățire specifice în vederea sincronizării locurilor de muncă și creșterea productivității, punând accent pe analiza procesului de asamblare și pe implementarea meteodelor de analiză și îmbunătățire ale acestuia .*

Abstract. *This work-paper aims to improve the production process of the car evaporators, by applying specific improvement methods in order to synchronize jobs and increase productivity, emphasizing the implementation of its methods of analysis and improvement.*

Keywords: Product improvement, Assembly process, Production line, Process analysis

1. Introduction

This theme aims to improve the production process of evaporators, by applying specific improvement methods in order to synchronize jobs and increase productivity.

The study focuses on analyzing the assembly process and implementing methods for its analysis and improvement.

The objective of the theme is to analyze the influence of improving the production process on the organization and operation of an assembly line.

In the study we followed:

- description of the technological process of assembling the evaporator;
- presentation of the initial situation of the assembly line;
- presentation of the problems identified on the assembly line;
- detailed analysis of the assembly line using the DAM method;

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- Improving the assembly process of the evaporator using the modification of the technological system.
- presentation of the resulting situation of the assembly line;
- comparative analysis of the states of the 2 lines: initial, respectively result.

In order to improve the process, it was necessary to analyze the entire evaporator assembly line. We performed the analysis of the activities and especially their durations in order to be able to highlight the blocking positions.

The basic function of any industrial enterprise is the production function, in which all production activities are carried out with the aim of obtaining products useful to society.

The concept of production process can be defined by the totality of actions carried out consciously and organized by the employees of an enterprise, made with the help of machines, equipment or installations, in order to transform raw materials / materials / other components into products / works / services with a certain market value.

For a complete definition of the production process it is necessary a characterization both from a socio-economic and technical-material point of view, as follows:

- from a socio-economic point of view, the industrial production process can be defined as a set of cooperative relations established between the participants in these processes, and as a set of concrete ways of transmitting between these participants the physical results of their work.

- from a technical-material point of view, the production process can be defined as a process of combining labor, raw materials and productive capital.

From a systemic point of view, the production process can be considered the set of activities through which certain input elements are transformed by the factors of production into products. Obtaining products is the purpose of the production process.

The structural elements of the production process according to the two sides, technical and organizational are:

- technological process (from a technical point of view)
- work process (from an organizational point of view)

According to other authors, there is also a third element of the structure of the production process (Fig. 1.), namely:the natural process is present only in certain production processes [7]

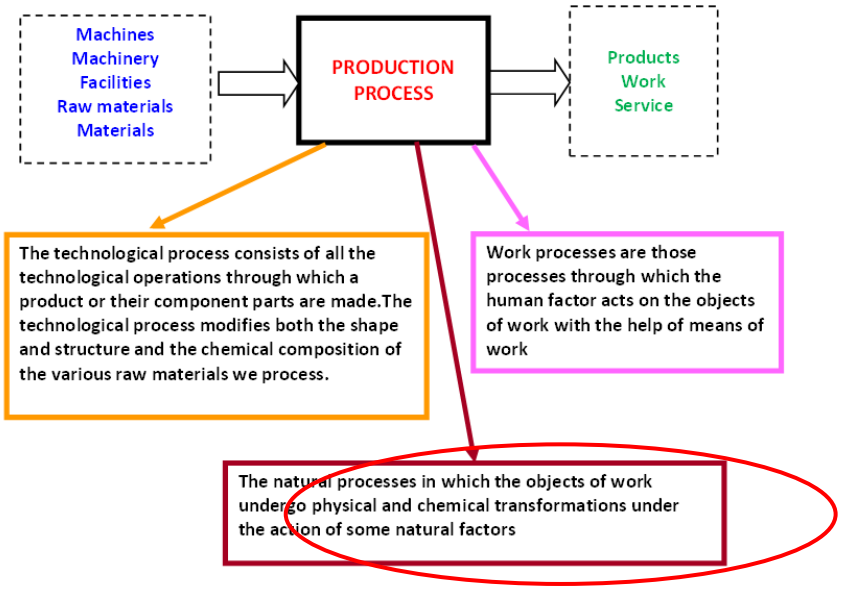


Fig. 1. Production processes and its components [7].

These types of production processes are organized and led by people and in which the interaction between certain elements, called resources, takes place.

These resources are:

• material resources that can be structured in: objects of labor, means of production;
• HR;
• energy resources;
• information resources.

The technological process comprises a succession of technological operations (physical, chemical, mechanical) correlated with each other and with the means of work, necessary for the execution of a product or a part of it.

The realization of the technological process for a product, requires the modification of some characteristics of the raw materials or materials, namely:

-modifications
- of form
- of dimension
- of aspect
- of structure
- of chemical composition

Conventionally, technological processes in industrial engineering can be grouped into three categories, associated with distinct manufacturing stages:

- technological processes of semi-manufacturing;
- technological processing processes;
- technological assembly processes (Fig. 2)

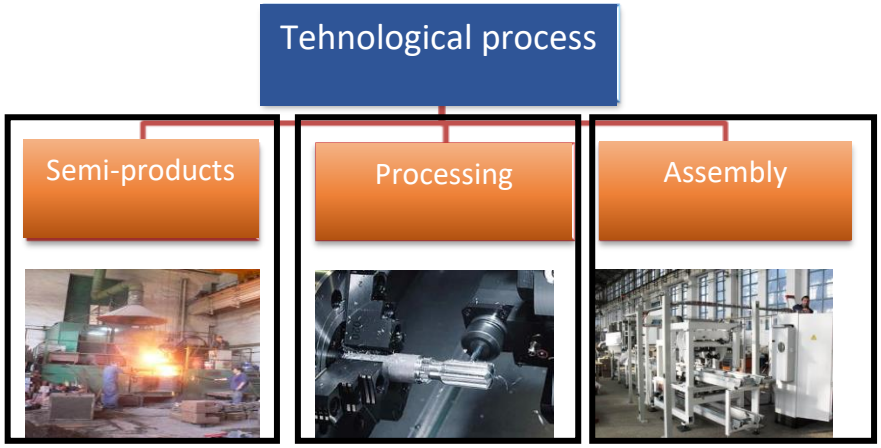


Fig. 2. Grouping the technological processes.

Technological semi-manufacturing processes are the processes in which the material, which has a general purpose, is transformed into a semi-finished product (casting, deformation, sintering, welding, etc.).

The technological processing processes are those in which the shape, dimensions or relative positions of the geometric characteristics of the semi-finished product are modified to obtain the finished part. After this process, the resulting product can operate in mechanical systems (turning, milling, volume deformation, stamping, bending, etc.).

Technological assembly processes are the processes in which two or more products are properly combined resulting in an assembly type product. Usually, these processes follow the processing. This can be considered the last stage of making a product, but there are also cases in which they are made in parallel.

The technological process of assembly consists of a series of operations that refer to the placement and fixing of the parts that make up a product, in their relative positions, to ensure the normal operation of the machine or machine.

The component elements of the technological process are defined as follows:

- the assembly operation is that part of the technological process which ensures the assembly of the parts of an assembly unit, carried out by a worker or a group of workers, at a single workplace. During the assembly operation, a number of joints are executed, ie joints of two neighboring parts, each joint constituting a phase of the assembly operation;
- the phase is therefore the part of the assembly operation that is performed on a place of joining the parts of a product, using the same tools and devices and applying the same working methods. The phase is performed by several manipulations;
- handling is the basic action of the worker performed during the preparation or execution of the assembly process. For example, manual or mechanical movements,necessary to bring the parts and devices to the place of assembly, position them and fix the parts to the place provided for in the whole product.

The assembly process comprises all the operations of joining the parts, checking their relative position and receiving after the final assembly, with the aim of obtaining a product that fully corresponds to the activity for which it was designed [7]

The labor process represents the activity through which the human factor (individual / collective) acts on the labor objects (raw materials / materials) with the help of labor means, in order to obtain material goods (Fig. 3).

Fig. 3. The human factor

Each of the two categories of processes that generate the production process, the technological process and the work process, are made up of several structural elements between which there is a close interdependence.

The structural elements of the work process highlight the actions carried out by the operators within the production process for the execution of the technological

operations. These actions take place when the operations of the technological process are performed non-automated, involving the participation of the operator. The structural elements of the work process are: work cycle, activity and movement [6].

Movement is the structural element that underlies the description of the technological process of work. It is the simplest element of work, consisting of a move and is the result of dividing work into small, homogeneous, repeatable, easily identifiable and quantifiable modules.

The activity represents the determined and complex action performed by the operator for the preparation of the necessary conditions for the execution of a technological phase or technological operations. An activity consists of a succession of work elements and is performed at a workplace. Any activity is associated with a duration.

The work cycle represents the set of activities performed by the operator to perform a technological operation or several technological operations at a workplace.

Decomposing the work cycle of an operation into activities and activities into work elements is useful for:

proper organization of the workplace and the production process as a whole;

determining the time norms for each operation;

establishing work tasks for the operators involved in the process.

The degree of detail of the work cycle depends to a large extent on the degree of inaccuracy imposed by the determination of the time norm.

The natural process is found only in some industrial branches and consists in physical, chemical, biological transformations, etc. of the objects of work under the action of natural factors, without the direct participation of man. Some examples of natural processes that take place in productive sectors of the national economy:

- in the textile industry: melting processes for obtaining Liberian fibers, drying materials;
- in the food industry: fermentation processes;
- in the furniture industry: wood drying processes.

2. The current stage

The evaporator is a subassembly consisting of several components having the disaggregation structure according to the Figure 4:

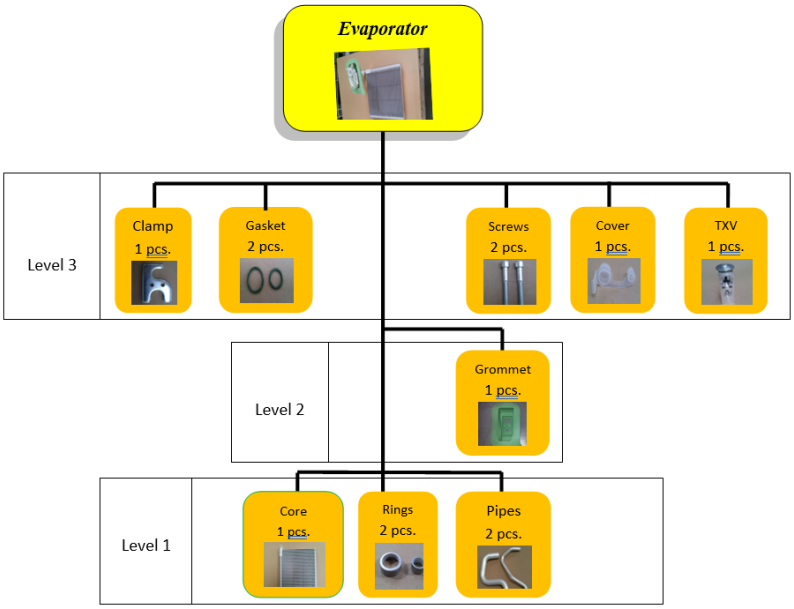


Fig. 4. Evaporator disaggregation structure.

The functions that evaporators provide to the vehicles in which they are mounted are:

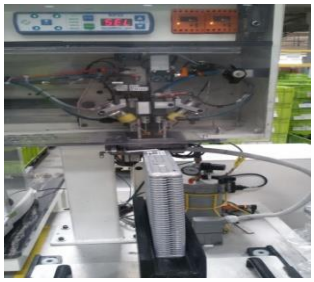
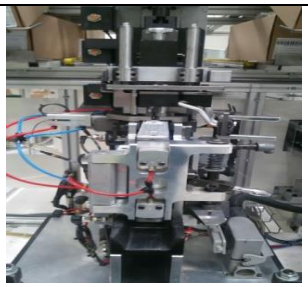
- cooling and drying of the air entering the cab of the machine,
- reducing the humidity level in the cabin
- demisting the windshield.

Fig. 5. Details of air conditioning system.

The production process in the case of the evaporator is a technological assembly process that consists of a series of operations that refer to the placement and fixing component by component in order to obtain the evaporators (Fig. 5).

The detailed representation of the production process will refer to its structural elements, thus specifying the operations, the time on each operation, the assembled components and the technological system. This detailing will be done in the form on a summary Table 1.

Table 1. Detailing operations and components to be assembled

Nr. Operation	***Name of operations / duration [sec]***	***Detailing operations / components to be assembled***	***Photo technological system***
Operation 1	Grease the body inlet-outlet holes 13''	- automatic grease of holes made with the help of the 'Glue Depozit' technological system,	
Operation 2	Crimping inlet-outlet pipes 13''	- manual assembly of rings, pipes on the lubricated body, - automatic crimping of pipes on the body by pushing using the 'Pusher' technological system, - subassembly 1 is obtained	
Operation 3	Assembling the grommet on pipes 14''	- manual assembly of the grommet on the pipes of subassembly 1 performed with the help of the technological system 'Grommet Station' - subassembly 2 is obtained	

Operation 4	Flange, gasket and TXV assembly 17''	- manual assembly of components: clamp, gaskets and TXV on subassembly 2 made with the help of the technological system 'TXV Station' - subassembly 3 is obtained	
Operation 5	Helium test 12''	- automatic testing of possible liquid leaks from the evaporator performed using the 'Helium machine' technological system	
Operation 6	Final control 13''	- automatic testing of the final position of the TXV performed with the help of the technological system 'Customer representative'	

The form of production organization in this case is the organization in flow, on the assembly line, having specialized jobs in order to perform certain assembly operations, the ultimate goal being to obtain evaporators.

The characteristics of this assembly line are:
- dividing the assembly process into 6 approximately equal operations in terms of time, respectively workload;
- operations are performed on 6 workstations;
- the grouping of operations on the workstations was done according to the rhythm of the line;
- specialization of jobs;
- performing two operations on each job;
- placement of workplaces in the order imposed by the execution of assembly operations, ensuring a one-way movement for the evaporator: greasing, crimping, grommet mounting, clamp, gaskets, TXV, helium testing, final control;
- execution of operations continuously, at a free pace;
- the movement of the work object from one workplace to another is done manually, by the operator.

These types of lines consist of jobs in which several operators work who perform several operations at several workstations/machines on a single type of product.

6. Conclusions

During this research, the process of assembling of the evaporators was analyzed, starting from its initial situation.

From what we have analyzed throughout the paper, we have concluded that a comprehensive evaluation of the process can determine the main types of losses encountered in it. These can be improved by applying new methods of process analysis such as diagrams, with which we have a graphical description of the technological process through an objective and detailed observation.

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