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A Systematic Method of Analysis and Development of the Hierarchical Structure of the Study of Chemical-Technological Processes Using the Example of the Final Distillation of Vegetable Oil

Xabibov Faxriddin Yusupovich

Scientific researcher, Bukhara engineering technological institute, Bukhara, Uzbekistan, assistant professor Bukhara engineering technological institute, Bukhara, Uzbekistan

ABSTRACT. The study, analysis and synthesis of technological lines, chemical-technological processes on the basis of system analysis, taking into account the relationship between hierarchy levels, hierarchy elements, their input and output parameters, makes it possible to adopt the right direction in their study.

In the system analysis of any chemical-technological process, it is necessary to mentally divide it into constituent parts, and then study them, highlighting properties and attributes, tracing relationships and relationships, and also revealing their role in the whole system. In our example, the object of system analysis is the process of the final distillation of the misceella of cottonseed oil.

The authors developed a multilevel interrelated hierarchical structure for studying, analyzing and synthesizing the chemical-technological process of final distillation of cottonseed oil micelles, taking into account input and output parameters for each element of the hierarchical system.

According to the proposed method for studying chemical-technological processes, analysis starts from the lower level of the hierarchy, in which the process at the molecular level must be studied, in which the chemical composition, the physico-chemical parameters of the processed product, the higher upper sequence levels, elementary processes and undergoing processes in the interaction of phases. By combining the obtained, for example, mathematical descriptions of all the elementary processes and the processes into a general model, one can obtain a complete mathematical model of the whole process or apparatus.

KEY WORDS: Analysis, synthesis, hierarchical system, chemical-technological process, mixture of solvent and oil, black oils, distillation, vegetable oils, vehicle, final distiller, concentration of solvent, expense of solvent sharp steam, mixture, easily volatile component.

I.INTRODUCTION

The analysis of the systems and theory of the systems began to appear in chronology of science in the middle of the last century and continues to develop until now. The scientific researches executed with the use of analysis of the systems give effective results. The modern stage of analysis of the systems of technological processes is based on the system thinking in the analysis of research object. Thus for researchers possibility of going deep appears in the system stage-by-stage, since a primitive analysis to complicated, in addition system thinking it is possible will apply in all types of research [1].

II. LITERATURE SURVEY

The analysis of the systems on the basis of the system thinking of object gives an opportunity of study of process, being of his entrance weekend of technological parameters, intercommunication between them, and also acceptance of correct decision. It is possible to define his entry and output parameters of every making realization of analysis of the systems of process, for finding out of intercommunication between them, the subsystems of consistently interactive under processes as an internal hierarchy are created [2].

System thinking at the analysis of process (research object) it is possible to carry out in a next sequence:

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-Analysis is begun from the complete study of research (technological line or devices) object.
-Study the basic elements of technological line or device.
-Study basic processes.
- the entry and output parameters of the system and processes, participating in her, determine.
- Determine intercommunication of indexes. This inter communication can be set forth as the protocols shown in majority cases on the basis of mathematical models.

As a result of realization of study of research object, process of final distillation of vegetable oil on a foregoing sequence, we are work out his hierarchical structure consisting of five levels (picture 12)

A research object is a process of distillation of vegetable oil a leak in a vehicle – final distiller. By the basic entry parameters of process a leak in a vehicle are: entrance concentration of solvent a_{sol}^{in}, entrance expense of solvent G_{sol}^{in}, entrance temperature of solution t_{sol}^{in}, expense of entering steam vehicle G_{steam}^{in}, temperature of steam t_{steam}^{in}, pressure of steam P_{steam}^{in}. Basic data-outs it is been: expense of mixture of steams easily volatile component and steam G_{mix}^{out}, expense of black oil G_{oil}^{out}, temperature of going out a vehicle oil t_{oil}^{out}, eventual concentration of oil on an easily volatile component a_{oil}^{out}, common pressure in a vehicle $P_{general}$.

At next level of hierarchy determine elements executing certain functional tasks in the object of research – vehicle of final distillation of micelle of cottonseed oil, taking into account the sequence of motion of phases, processed product and sharp aquatic steam.

At research of process of final distillation of micelle of vegetable oil mentally we try to expose the functional tasks of every element of vehicle. In pipelines for entering vehicle of liquid and sharp aquatic steam, the flow of streams flows. Ins not due to narrowing of cross-sectional of stream of steam the increase of speed of him is arrived at and the same increases of kinetic energy orbefcient and to the further flow liquid on the next elements of construction. A contractor provides suction of acting liquid due to a steam-power and their partial interfusion. A mouth is intended for an increase to speed of appearing mixture of micelle and sharp aquatic steam due to narrowing of cross-sectional of stream. A diffuser is intended for organization of complete inters fusion of phases, providing intensification heat of mass-transfer between them. A cyclone performs the duty of completion heat of mass-transfer phase-to-phase and division liquid and steam phases [3].

IV. METHODOLOGY

Entering vehicle of the processed product of micelle of cottonseed oil comes true by means of pipe, here the entry parameters of product will be: initial expense G_{miss}^{in}, entrance temperature t_{miss}^{in} and initial concentration a_{miss}^{in} with such values of parameters a product will be included in a vehicle. Except a micelle object sharp aquatic steam will enter on a pipe line with a certain expense G_{shws}^{in} and by a concentration a_{shws}^{in}, not changing the values of pairs, will be included in a vehicle through a nozzle. A nozzle is intended for an increase to speed of steam, therefore expense of steam on included in him and on an exit G_{shws}^{in} identical, and flowrate w_{shws}^{in} on an entrance will differ from w_{shws}^{out} weekend. The further incoming streams of liquid and steam phase enter contractor, where to take place their partial. A contractor will have next entry and output parameters: initial expense of micelle G_{miss}^{in}, temperature of micelle t_{miss}^{in}, initial concentration of micelle a_{miss}^{in}, initial expense of sharp aquatic steam G_{shws}^{in}, temperature of steam t_{steam}^{in}, expense of mixture G_{mix}^{out} liquids and pair on an exit from a contractor, temperature of mixture t_{mix}^{out} on an exit, concentration of mixture a_{mix}^{out} on an exit. Then mixture of liquid and steam will enter the mouth intended for the rev up of mixture. A mouth will have next entry and output parameters: entrance expense of mixture G_{mix}^{in}, temperature of mixture t_{mix}^{in} on an entrance, concentration of mixture a_{mix}^{in} on an entrance, speed of mixture w_{out}^{in} on an entrance, expense of mixture G_{mix}^{out} on an exit from a mouth, and also temperature of mixture t_{mix}^{out} on an exit, concentration of mixture a_{mix}^{out} and speed of mixture w_{mix}^{out} on. Further mixture of sharp aquatic steam and micelle as phials with different diameters acts on a diffuser serving for organization of maximal surface of contact of liquid and steam phase, on this area of construction of object basic part of mass-transfer will flow phase-to-phase. A diffuser has next entry parameters: initial expense of liquid phase G_{fluid}^{in} on included in a diffuser, temperature entering to mixture t_{mix}^{in}, initial concentration of liquid phase a_{fluid}^{in}, initial concentration of steam phase a_{steam}^{in}, initial expense of steam phase G_{steam}^{in}, common pressure $P_{general}$; data-outs: expense of liquid phase G_{fluid}^{out} on an exit from a diffuser, temperature of mixture, concentration of liquid phase a_{fluid}^{out} on an exit from a diffuser, concentration of steam phase a_{steam}^{out} expense of steam phase G_{steam}^{out}, common pressure $P_{general}$. A cyclone assists development heat of mass-transfer phase-to-phase and them. Every making element of vehicle must perform the duty of setting. Initial expense of liquid phase G_{fluid}^{in} on

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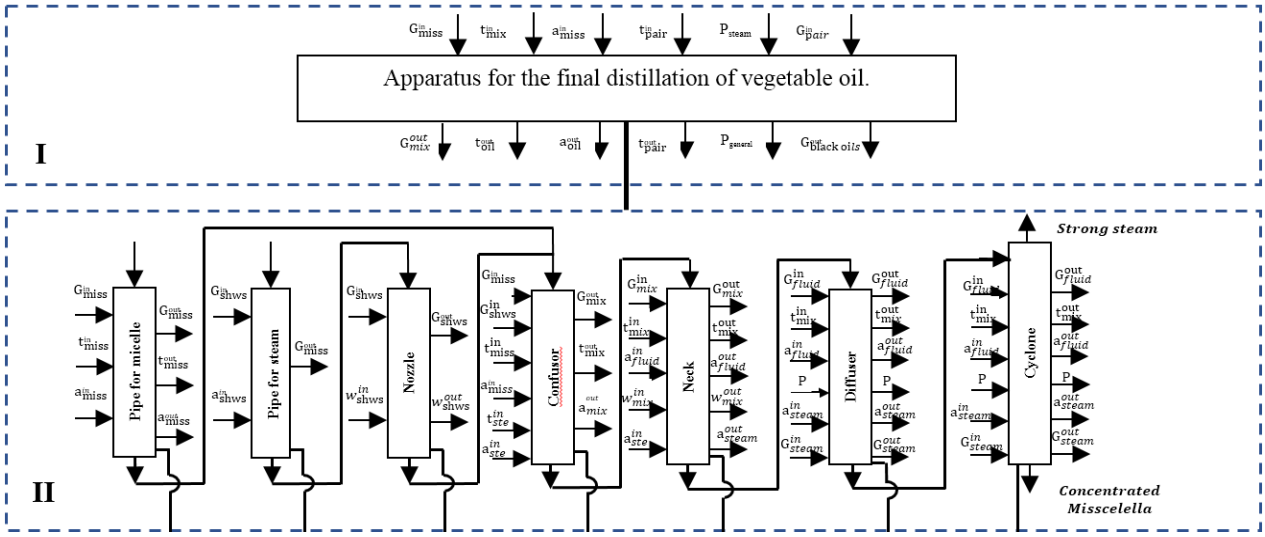
included in a cyclone, temperature entering to mixture t_{mix}^{in} , initial concentration of liquid phase a_{fluid}^{in} , initial concentration of steam phase a_{steam}^{in} , initial expense of steam phase G_{steam}^{in} , common pressure $P_{general}$; data-outs: expense of liquid phase G_{fluid}^{out} on an exit from a cyclone, temperature of mixture t_{mix}^{out}, concentration of liquid phase a_{fluid}^{out} on an exit from a cyclone, concentration of steam phase a_{steam}^{out} , expense of steam phase G_{steam}^{out} , common pressure $P_{general}$.

The next level of hierarchy assists determination of a leak basic processes on every element of making whole vehicle of final distillation. This every process will be analysis taking into account his entry and output technological parameters resulted on picture 12. These processes: flow of liquid, steam; change of speed of steam; partial interfusion of phases and vesiculation; change of speed of mixture of liquid and steam; complete interfusion of phases; division of phases.

The next level of hierarchy determines under processes a leak due to co-operation of phases taking into account entry and output parameters: change of surface of phials; change of composition of liquid phase; change of composition of steam phase; division of phases. At next level of hierarchy possibility of determination appears micro processes of a leak at co-operation phases, but the offered method of research is the system thinking in a difference from other and at this level takes into account entry and output parameters. These micro processes such as: heat exchange, mass-transfer, change of amount of heat and mass in phases, change of part pressures, a change of coefficient is mass of exchange.



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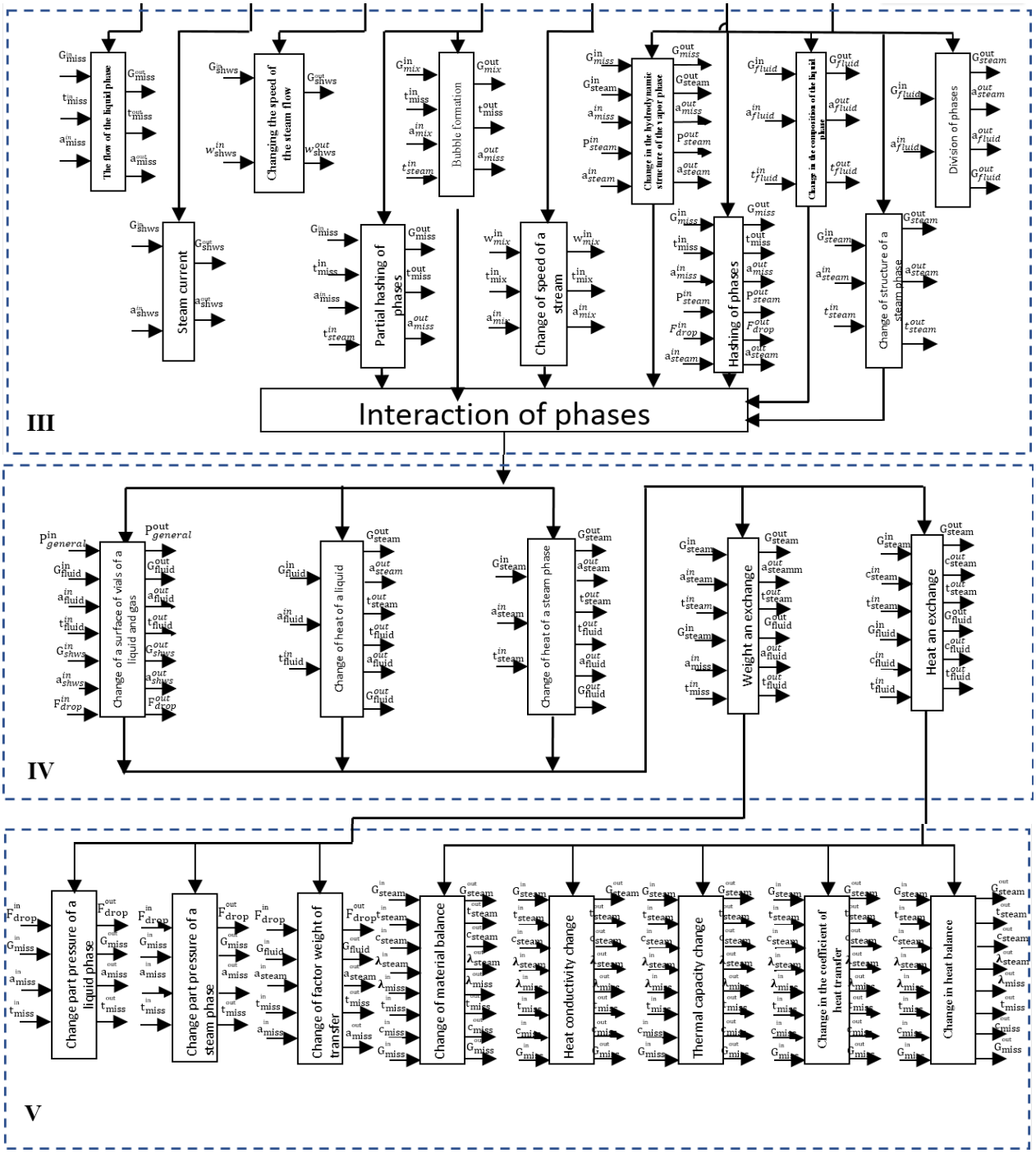

VI. CONCLUSION AND FUTURE WORK

It is yet possible to add a molecular level following dividing of basic elements into the elements, here data-outs previous the element will be an entrance for the following.

The method of the system thinking of study of technological lines and processes assists opening of all processes, under processes, micro processes and their inter communication. This account of entry and output

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technological parameters at every level and making the hierarchical system, and also beginning of study with a bottom level gives an opportunity of deep and detailed analysis of every parameter.

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