Analytical method of Identification of an Object Automation on examples of Floatation of ores of Precious Metals

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Abstract—In this study the problems involved in questions of identification of an object automation were deeply analyzed. These problems were formed as differential equations and the coefficients of these differential equations were determined. In this process a combination of models of elementary objects were used and the information related to the object of automation detension was processed. Further, the analytical identification of an object of automation in different stages was done by using multistage analysis for the identification of an object automation by applying a concept of movement of information or movement of a signal in the object. Using this information, the sequence of performance of a research is also determined. The capacity of information is also obtained by hirarchical steps. For the purpose of the study three models were used viz. A computer model by using the liquid capacity of a Hydraulic capacitor installation with a Hydraulic Reservoir concept, finally a rather complex model of Heat exchanger with a stream shirt with a three element approach and finally a Floatation Device using six transition process for liquid phase, gaseous phases. It was found that the maintenance of a component at the beginning of process decreases almost hyperbolic, and the maintenance of useful components in a gas phase increases, consistently beginning from initial to the maximum value in each layer then begins hyperbolic to decrease at the end of process, concentration of components in a liquid and gas phase will be close to zero.The received results allow to develop a control system of process of flotation in the periodic mode and also it will be possible to calculate a theoretical bubbling cube of the floatation device.

Index Terms—Object automation, Floatation of ores, Precious Metals, Computer models, Elementary objecst, Movement of information, Sequence of performance, Hydraulic capacitor, Hydraulic reservoir, Heat Exchanger, Floatation device, Transition process, Liquid phase and gaseous phase, Control system of process, Concentration of process, Floatation in periodic mode, Theoritical bubbling of cube of floatation device

1 Introduction

Questions of identification of dynamic property of objects a large number of works is devoted, results problems of identification of mnozhestvo object of automation from this are carried out and solved.

Initially questions of identification of an object were considered in determination of coefficients of the differential equation on the basis of a curve of transition process of an object of automation. For determination of coefficients differential the equation are recommended and it is used various ways.

The second type of identification of objects use of a combination of models of the elementary objects can consider – standard links.

The way of analytical identification of an object of automation by the information analysis of definition of character of an object of automation is offered. It consists in consideration of an object of identification from the point of view of passing and information delays in him.

Thus, definition of movement and transformation of information with her delay in object of identification is offered. In this case information entrance to object of automation, detention and processing of information in object of automation and in the subsequent a release of information from object of identification is considered.

2 Stages in Analytical identification of object of automation

Then, analytical identification of an object of automation has the following stages:

1) Full studying of an object both system, and process in system is carried out;

2) Input and output parameters of an object of automation are defined

3) From among the general input parameters the operating parameters are specified, from among output parameters the operating parameters are specified;

4) For a simple object studying for one capacity is enough, for a difficult object the dynamic structure of an object is defined. Is defined object elements, the consecutive entrance system of an object is carried out by the multistage system analysis. In each hierarchical structure is available the elements having certain capacities from the point of view of information delay.

5) Since elementary capacities depth of a hierarchical step, is formed mathematical and computer models, by analytical identification of the chosen object element;

For convenience we conducted a concept movement of information in an object or movement of a signal in object of automation.

The way of the multistage analysis of system offered by us, including systems of automation, and a multistage way crea-

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tion of mathematical and computer model of objects of automation allows to identify more precisely objects of automation by application of an analytical method of identification.
In what essence of an analytical method of identification? It is in what against the background of studying of an object of automation analytical is defined in the way equation coefficients, the curve of transition process of an object will are used modeling for implementation of definition of adequacy to the received mathematical and computer model at the end.
For analytically identification of an object, it is recommended the performance of a research following the sequence:
1) Object of automation from a point sight to a static and dynamics of process is thoroughly studied. An object consists of two indicators: the first is a system, the second process occurring in this system, т.с. the chosen process.
2) For this object is defined input, output parameters, both system, and process.
3) From among output parameters the operated parameter is defined, from number input parameters the operating parameter is defined.
4) If the system one capacitor, then for this system is carried out analytical identification, representing model of an elementary object of a link inertial.
5) If an object difficult then is carried out the multistage system analysis. The first decides a step on the elements representing elementary capacity. If elements of the first a step can also be dismembered on other elements, and then is defined these elements, and each element will also represent itself elementary capacity, etc. It proceeds before possible deepening in system. In each subsystem i.e. in each element there is the process. Considering indicators of system and entrance, output indicators of process the computer model for an element of the gentlest hierarchical step is formed.
Identification of an object begins the gentlest hierarchical step. For each separately chosen element which is capacity for information.
Is defined by an analytical image coefficients of mathematical and computer models. Here for each capacity two indicators are defined:
1) it is coefficient of an indicator of strengthening of capacity and
2) average time of stay of information in this capacity. Such question it has partially been used in works of the academician Kafarov V. V. and his pupils, and some other scientists. Then, was are used a possibility of definition of inertia of an object of automation in the form of average time stay of a signal in the device.
Uniting computer models of elements of the gentlest hierarchical step, transition to elements higher hierarchical automation of an object is carried out. Theoretical calculations are shown on concrete examples.

3 EXAMPLES

3.1 Hydraulic Capacitor installation

It is easy to make a Bol based mathematical and computer model to analyize the methods of identification for objects, for example, it is possible to consider liquid capacity for the floatation device where level is regulated. By the offered technique the computer model is formed.

1. Object of automation is studied. In this case on drawings the schematic diagram of an object - capacity for liquid is shown

Hydraulic reservoir is provided in the form of a black box, the idea is used long ago by scientists on automation. In this reservoir there is one input parameter x is an expense of "Q" of the arriving liquid, sometimes the second input parameters can consider an expense, the leaving liquid, one output parameter y is the level (H) of liquid of reservoirs. Then hydraulic reservoir can be provided the simplest model of an inertial link of the first order.

where:

Here T - the average time of a pribivaniye of information, V-object amount - information reservoirs, Q-an expense of input information in an object automation

Then, for determination of coefficients of the equation it is possible to consider movement and accumulating of information in this reservoir. Input information is an arriving liquid - its expense, output information - urovnyazhidkost height in reservoir of an object. Accepting that, on all height width of reservoir will have identical value, a ratio of the maximum height of level of liquid to the maximum consumption of the arriving liquid is coefficient of strengthening of an object k. Opening, closing a consumption of the arriving liquid it is possible to manage object of automation. Other important parameter is fixed time of an inertial link or inertia of an object "T". A ratio of amount of the contained information in hydraulic reservoir to an expense of the arriving information, i.e. to a consumption of the arriving liquid will characterize the average time of a pribivaniye of information

3.2 Heat Exchanger

For the analysis and modeling of the heat exchanger with a steam shirt:

1) Object of automation, the heat exchanger with a shirt is studied. Apparently in this object - in the heat exchanger with a steam shirt liquid heats up, and to a shirt of the heat exchanger the heating liquid arrives. In a heat exchanger shirt liquid, completely mixing up, gives the heat to a heat exchanger wall, the heat exchanger wall transfers thermal information to liquid in the heat exchanger.

This object consists of three elements. Input, output parameters of an object are determined. For the main primary object input parameters is the consumption of hot liquid, tem-

perature hot liquids, a consumption of cold liquid and temperature of cold liquid. Besides, input parameters is system indicators - a physical object it is the device sizes in the form of the surface of heating the heat exchanger transferring heat from hot liquid to cold. And output parameters of an object is the consumption of the cooled hot liquid, its temperature, temperature of the heated liquid and its expense. Sometimes it is possible to consider as input parameter pressure, as in a heat exchanger shirt, and an internal part of the heat exchanger. It is necessary to determine the managing and managed parameters.

The managed parameter is temperature of the heated liquid which is going out of the heat exchanger. And managing parameter is the expense hot liquids in the heat exchanger.

Transition to the following hierarchical step shows that, the system of an object consists, from three elements which to consist of the reservoirs detaining information. It is the first element - or a so-called shirt of the heat exchanger. The second element - the heating wall. The third element is an internal part of the heat exchanger where the heated liquid contains.

Is accepted conditions that each capacity has hydrodynamic structure of flows of complete agitation of the arriving information. Teplovayainformation, in the heating camera completely mixing up, it is transferred to the heating wall. Thermal information of an izgreyushchy wall transfers internal a part of the heat exchanger, to liquid which is in the heat exchanger. In that case each element can beat is described differential by the equation of first order, an opisaniyem module of the elementary inertial link. Then, for the first capacity the gain amount expressed by the relation of maximum temperature of liquid in the heating camera is defined on the maximum expenditure that makes gain amount of this capacity. And the volume of liquid of the liquid heating kamery razdelyaemy one expenditure hotter which was in this capacity makes inertia of an object т.с. it is called, sometimes, average time punching of liquid in a heat exchanger shirt. Thus, it is possible will provide the equation of computer model of such element. The second capacity is a data capacity of a wall. The gain amount is defined ratios of change of maximum temperature to a wall to change by maximum temperature of the heating liquid. Inertia of an element is defined by holding of thermal information to a wall to the coming warmth from liquid in the heating camera. Thus, this element is characterized differential by the equation of the first an order too.

The third element — this liquid which is in the heat exchanger subject to heating. The coefficient of strengthening is characterized by a ratio of the maximum deviation of temperature of liquid in the heat exchanger to the maximum deviation of temperature of a wall of the heat exchanger.

Thus, the computer model of this device is characterized by consecutive connection of three capacities.

3.3 Floatation Device

The working area of the floatation device it is possible will present in the form of a bubbling zone where air through liquid being bubbled carries away with itself valuable components on a mery pridvizheniye of air top. It is consistently saturated, valuable components. Here it would be necessary to write, to the equation of private derivatives for air saturation. The decision requires transition to approximate calculations. They bulkinesses We decided bubbling to consider a zone much zonal. For this purpose the bubbling zone is represented divided into several mental layers. Physically there are no layers the case therefore we call them as if layers, and so quasilayers. Each quasilayer has the entrance, output parameters. For further calculation everyone could divide a layer on liquid a phase and a gas phase. But so far the research on saturation of gas to be in a difficult condition. We pass to determination of input and output parameters for each reservoir. For each reservoir - a quasilayer input parameters is the air consumption, concentration of valuable components in air and weight to a liquid phase in a quasilayer and concentration of valuable components in liquid.

If to create model for i - that layer, then then she can be used also to other layers. Association of mathematical models of quasilayers will allow to make mathematical and computer model for a bubbling layer.

Bubbling layers input parameters is the pulp expense, concentration valuable components in a pulp, a consumption of air and concentration of valuable components in air. Honey agarics the pulp expense, concentration of a pulp, a consumption of air and concentration of valuable components in air will be output parameters. Valuable components of the air restirring in up from bubbling zones pass into a foamy zone. They remain in a foamy layer, and air to leave the device. It is possible the model for each zone consists computer, then to constitute computer model for the working area of the floatation device.

For drawing up the equation of process in a quasilayer the hydrodynamic structure of full hashing liquidly - a gas phase is accepted. Then the equation of an inertial link of the first order in a look is used:

$$T + y = k x$$

x – input parameter an air consumption, at – output parameter concentration of a valuable component, k - coefficient of strengthening of a quasilayer, T - the coefficient characterizing inertia of a quasiobject - a quasilayer.

And for the system consisting of several quasidevices the mathematical description in the form of several equations is constituted:

$$T1 + y1 = k\ 1x1$$
$$T2 + y2 = k\ 2x2$$
$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots..$$
$$Tn + yn = k\ nxn$$

Coefficients for various devices of flotation are determined. Let's allow for the t device FPM 6 and 3, accepting amount working m3 zones 16, accepting the maximum consumption of air of 36 cubic meters an hour, from passport data. The average time of stay of air in this device of 233 minutes is determined, and strengthening coefficient is accepted by this device equal 1.

Then, transitional process, i.e. weight exchange from liquid

to a gas phase is characterized by the standard equation a lot of transfer:

The analytical model on the basis of the equation of material balance is formalized. In dynamics of material balance has been written down in such look. Computer display of the right part of the mathematical description of mass-exchanged process in a quasilayer expression in a look:

Here – concentration of valuable components in the air which is coming out a layer, – concentration of valuable components in the air entering a layer, – coefficient of the gases characterizing a state, – coefficient a lot of return from gas liquid, – quasilayer volume, x – concentration of a valuable component in liquid.

Process in the chosen quasilayer in computer model in such look

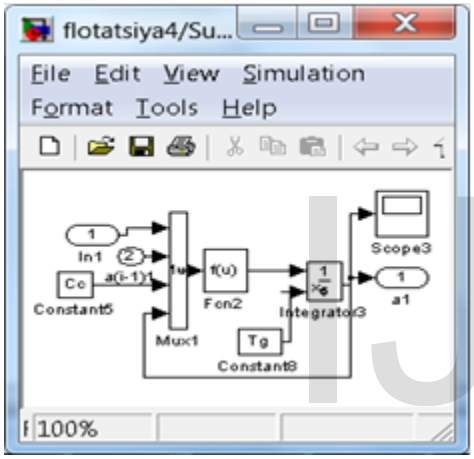

Fig. 1. Computer model of process in a quasilayer of a gas phase of an object of one-stage flotation

Thus, the computer model of a gas phase for the chosen quasilayer is made on the basis of material balance. Apparently, from the drawing contents or concentration of substances in a liquid phase, concentration of substances in a gas phase, coefficients transformation and initial concentration for a gas phase enters here.

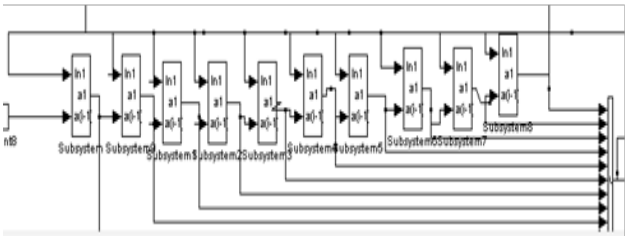

Fig. 2. Computer model for a gas phase

In further uniting computer models of all elements, i.e. mathematical models of subsystems the computer model for a gas phase of a bubbling cube of the floatation device is received. (Fig. 2.)

Here it should be noted that, the liquid phase for each quasilayer has a general characteristic, i.e. obshchiyepokazatel. Considering that, cubed the floatation device there is almost full hashing of liquid, then concentration of a valuable component in all parts of the device it will be identical.

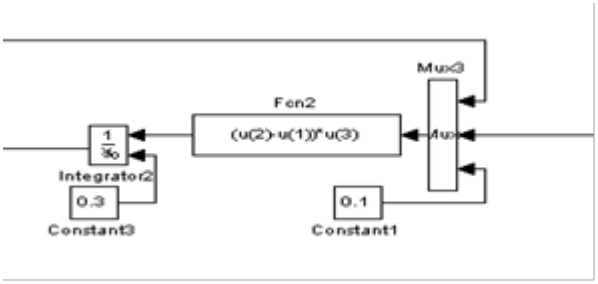

Fig. 3. Computer model of process in a liquid phase of an object of one-stage flotation

Including models of a gas phase and including model of a bubbling cube the computer model for a bubbling cube of the floatation device is received. Here in dependence of the entering parameters there will be (concentration, equilibrium concentration swore in a gas phase) valid concentration of material in a liquid phase also entry conditions, i.e. initial value of concentration in a liquid phase. Here the integrated model characterizing consecutive change of concentration valuable components as liquids and in gas, but to quasilayers is received.

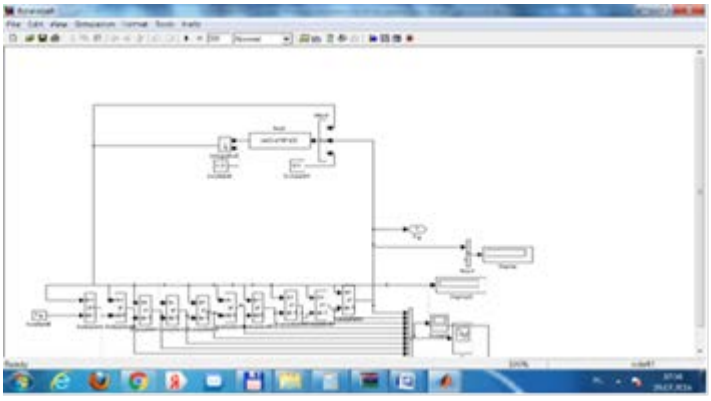

Fig. 4. General computer model of an object of one-stage flotation

Now for work of this computer model, it is necessary to be set by entry conditions. As entry conditions there can be a coefficient a lot of return, an expense, initial concentration, amount, density and other indicators.

On a basis which it is constituted it we have a computer idea of all entry conditions, they are shown in the figure 5.

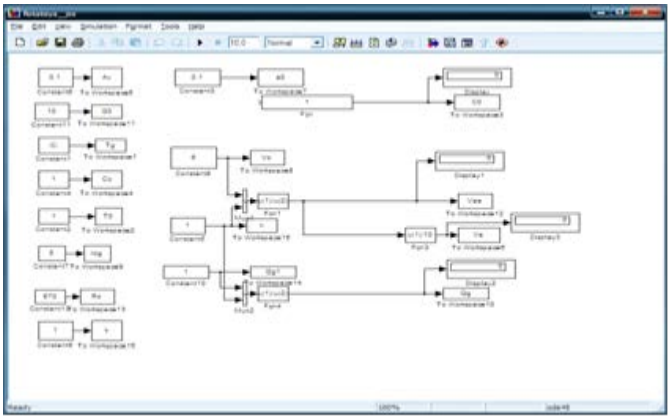

Fig. 5. Computer representation of all initial conditions

Originally for input of basic data, it is pressed the START-UP button in the unit of basic data, then passing into computer model of an object. Switching on a computer process model by means of the START-UP button, on the screen of the monitor to appear transient phenomenon.

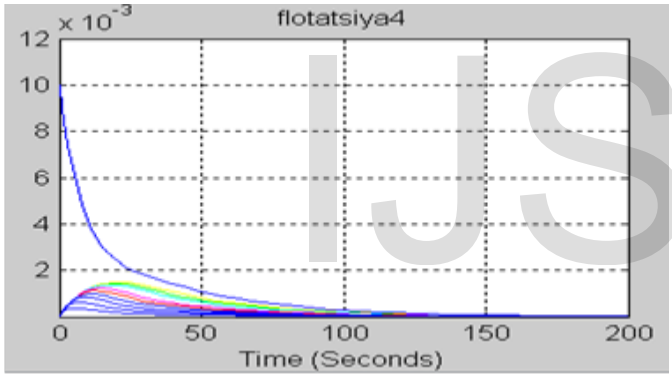

Fig. 6. Transition processes in a liquid phase

In this case for periodic operation of a borbatazhny cube (Fig. 6.)

4 Conclusion

Apparently, from the drawing of 6 transition processes in a liquid phase it was found that the maintenance of a component at the beginning of process decreases almost hyperbolic, and the maintenance of useful components in a gas phase increases, consistently beginning from initial to the maximum value in each layer then begins hyperbolic to decrease at the end of process, concentration of components in a liquid and gas phase will be close to zero.

The received results allow to develop a control system of process of flotation in the periodic mode. And also it will be possible to calculate a theoretical bubbling cube of the floatation device.

5 References

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