power reduction of the artificial fracturing of the indigenous layers of the ornamental rock, in comparison with the absence of such activities and events, or the crossovers of the alluvial and out-weathered mining rocks of the hydraulic fracturing crack;

4. The blasting replacing of the alluvial and the out-weathered mining rocks by the interburden arrangement from the viscous fluid, having intercepted them from the indigenous useful mineral resource, will be promoted to be reduced the harmfulness of the stripping operation production, their safety improving, and also the cost – cutting companies and enterprises on the labor health and safety, as well as the environment protection;

5. The energy of the falling weight load is lost in the minimum degree, when shock fracture of the models previously pristine;

6. When the shock fracture models, having previously disturbed by the crack hydro-fracturing, the energy of the falling weight load is lost, in the collisions of their upper and lower parts, as well as their upper parts rebounding from the bottom ones, as less massive from more massive ones. As a result of the double energy loss of the falling weight load, the total number of the debris and their fragments at the shock fracture models, having previously disturbed by the crack hydro-fracturing is less, than at the previously pristine models.Dueto the collisions of the upper and lower parts of the models, as well as the upper parts of the rebounds from the bottom ones, there is the energy redistribution of the falling weight load up, andas the consequence, the degree increase fragmentation of the upper parts, compared with the pre – intact models;

7. When the shock fracture models, having previously disturbed by the crack, which has already been formed, using the viscous fluid, the energy of the falling weight load is lost at the collisions of their upper and lower parts, the upper parts bounces from the lower ones, as less massive to more massive, and also it is distinguished in the layer of the viscous fluid. Due to the energy losses triple drop weight load, when the total number of the debris and fragments at the shock fracture models, previously broken crack, having formed, using the viscous fluid is less, than at that, which has been formed by means of the liquid. Dueto the degree decrease of the upper and the lower parts collision, the degree reducing of the bounces of the upper parts from the bottom ones, as well as the disappearance of the energy part in the layer of the viscous fluid, there is the energy redistribution of the falling weight load up, but with the decrease in the degree of the fragmentation of the upper parts of these models, in comparison with those, that are pre-broken by the crack, having formed with the liquid;

8. The fluid-fracturing application in the technology of the stocks opening of the ornamental rock will be allowed to be reduced of the artificial fracturing of its indigenous reserves, due to the energy redistribution in the direction of the impact fracture, which is subjected to be removed the layer of the alluvial and out-weathered mining rocks. For all this, the degree of its pre-crushing will be increased, that will be created the quite good conditions for the subsequent production the secondary production from it, in the form of the building crushed stone.

Thus, the scientific significance of these studies is to be applied the fundamental laws of the mining rocks failure in the solving of the urgent challenges of the mining production and industry. The scientific obtained results, in this direction, can be presented, in the form of the necessary recommendations for the production of the mining activities at the enterprises for the marble extraction, in the form of the special blocks in the open method and way.

Thus, some challenges are remained, the significance of which are quite substantially, which can be solved using the mining rocks fluid – fracturing:

1. The justification of the need for the prior hardening of the fractured massif of the ornamental rock by the polyester resins (e.g. they are used to be filled the cracks) from the holes, that later they will be used for the monolith separation. So, this separation can be performed by the dynamic or the static wedges, as well as using the fluid – fracturing or without it;

2. The justification of the destruction need of the strongly fractured (e.g. «springy») of the oversized ornamental rock through the drilled holes in them blind, having filled by the viscous fluid. So, this destruction can be done by the blow of the hydro – pneumatic hammer peak, and the destructible oversized one itself – can be clamped by piling on it other oversizes.

The work is submitted to the International Scientific Conference "Priority directions of development of science, technologies and equipment", Italy (Rome-Florence), April 12-19, 2014, came to the editorial office on 18.02.2014

DISTRIBUTION OF RESOURCES IN HIERARCHICAL MULTIELEMENT SYSTEMS WITH PARALLEL STRUCTURE

[1,2]Umbetov U., [1,2]Imanova Zh., [1,2]Myrzakhmetova S., [1,2]Dusenbaeva T.

[1]Taraz State University by K. Dulaty, Taraz, Kazakhstan;
[2]Kzylorda State University by Korkyt Ata, Kzylorda, Kazakhstan

The Majority of modern chemical manufactures are complicated technological complexes, each stage of processing of raw material on which is carried out by the several same technological operations forming systems with parallel structure. Here there is a problem of modeling and optimization of systems with parallel structure. This problem includes three basic aspects: the decision of distribution problems of the limited resources between parallel operations or elements on top level of management's system, a finding of local-optimum decisions for its separate elements at the bottom level and by mutual coordination decisions of these problems among themselves. From here follows, that to one of questions defining a complex who are considered on the management information system the enterprises, problems of division distribution of the limited resources between separate subsystems. Here the concept resources is used in the most general sense and can accept various forms, such as financial, material, information, etc.

Introduction

By virtue of parallelism and uniformity of technological operations the basic matrix of system of restrictions of a problem of resources distribution appears close to singular and leads to instability of the decision. In works [1, 2] for the of problems decision of resources distribution between parallel objects the method of expansion of admissible values set is offered. For the decision of resources distribution problems, forming parallel casual streams, generalization of the given method [3] is offered. In work [4] method of expansion is generalized for of accommodation problems of discrete objects which parameters are set by casual image. The given approach consists that the decision of an initial of optimization task is defined by the directed transition to its optimum decision from the point corresponding the decision of more simple problem with expanded area of admissible decisions. Computing procedure at use of this approach becomes not only tolerant to degeneracy matrixes of restrictions matrixes task, but because of specificity of model of systems with parallel structure provides a finding of exact problem decision.

1. The elementary of resources distribution's problem in hierarchical systems.

Mathematically the resources distribution tasks in hierarchical multielement systems with parallel structure can be formulated as follows. The parallel structure of multielement system (figure 1) where each element carries out some identical kinds of activity is considered. The interrelation between these *i*-s subsystems happens through the general entrance parameter X = (x1, x2..., xn) which is the some resource, and through target parameters

Y = (y1, y2..., yп).

Here x_i – an entrance variable, a resource which is allocated for processing to *i* -th subsystem ($i = 1, ..., n$); y_i – a product which can be races-считан on the basis of model of interrelation y_i c x_i; u_i – some operating influence which is used for realization of economic processes in a subsystem; $y_i = f(x_i, u_i)$ – mathematical model of *i* - th element.

$$\sum_{i=1}^{n} x_i \le A,$$

where *n* – the general number of subsystems, $A = (a_1, a_2, ..., a_m)$ – a vector of the limited resources (a total resource) which is required to be distributed(allocated) between separate subsystems.

The total of a target product can be presented in the form of the sum

$$Y = \sum_{i=1}^{n} y_i .$$

There are various terms for definition of criterion of optimization: function of benefit, criterion of quality, function of the purpose, function of satisfaction and others. We shall use all these terms, including their unequivocal. The general problem of distribution of resources can be formulated as follows. It is required to find such vector X* = (x1 *, x2 *..., xn *), satisfying to conditions

$$\sum_{i=1}^{n} x_i \le A \qquad (1)$$

at which function of the purpose reaches(achieves) the maximal value, that is.

$$\sum_{i=1}^{n} y_i \to \max \qquad (2)$$

Operating influence u_i ($i = 1, …, n$) enables the central body to influence a subsystem, considering its activity. A condition (1) generally are not strict inequality, however more often in considered problems strict equality as if the inequality there can be a undesirable rest of some resource is set is carried out.

The task in view concerns to a class of problems nonlinear about cramming static optimization as assumes, that X and Y or do not depend on time, or are considered on some interval of time [0, T] where it is possible to consider(count) these variables constant. For organizational-economic systems as the purposes various economic categories, such at least expenses or a maximum of the income of realization of production and (or) services can act. In chemical-technological systems criterion functions can be as well quantity parameters of a let out product. We shall consider the limited resource as scalar size that is one certain kind of a resource, for example, the finance, raw material, etc. In case of when it is necessary to distribute some kinds of resources, требу-NO to solve more complex vector problem. The elementary case of scalar problems arises, when functions yi=f (xi), i = l..., n, are linear functions. For a case when resource X is scalar size, this problem has the elementary decision which can be described by simple algorithm:

1. There is a subsystem in which the output is maximal at giving values X.

2. The following subsystem for which it is maximal you-courses from the remained subsystems gets out.

3. The following subsystem by the same rules gets out, etc. the Choice is carried out until there will be the most bad subsystem in sense of the chosen criterion.

This problem can be written down in terms of linear programming as follows. It is required to find non-negative values of variables x_1, x_2..., x_n , xn which optimize criterion functions yi = fi (x). Thus restrictions on used resources (1) should be carried out. Let fi (xi) = aixi bi, i = 1..., n, and the general criterion of optimization is additive-separable function. Then the problem consists in definition of a maximum of global linear criterion function

$$F\left(X^0\right)=\max\left(\sum_{i=1}^{n}a_i x_i+\sum_{i=1}^{n}b_i\right) \quad (2)$$

at performance of restrictions on resources

$$\sum_{i=1}^{n}x_i - X^0 = 0 \quad (3)$$

and technological restrictions

$$x_{i\min} \le x_i \le x_{i\max}$$

or

$$x_{i\min} - x_i \le 0,\quad x_i - x_{i\max} \le 0 .$$

the given problem can be solved by methods linear programming. However in Minsker's book more simple algorithm considering features of a problem is offered. For this purpose we shall appropriate to subsystems but-measure in ascending order factors $a_1 \le a_2 \le a_3 ... \le a_n$ and we shall distribute resources as follows:

$$x_1 = x_{1\min},\ x_2 = x_{2\min},\ \dots,\ x_{i-1} = x_{(i-1)\min} \quad (4)$$

$$x_i = X^0 - \sum_{j=1}^{i-1}x_{j\min} - \sum_{j=i+1}^{n}x_{j\max},\ x_{i+1} = x_{(i+1)\max},\ \dots,\ x_n = x_{n\max} .$$

Thus performance of a condition (2) is obvious. It is possible to show, that the given distribution is optimum. Let k> i and l <i. We shall transfer a part of a resource x from k-th subsystem to l-th subsystem. It will lead to change of global criterion function F (x) = (al – ak) x. As al <ak value of criterion will decrease, i.e. distribution (8) is optimum. The algorithm of optimum distribution of resources can be presented as follows:

1. As much as possible to distribute resources between subsystems, that is to put xj = xjmax and to check up a condition 1.

2. To reduce quantity of resources for the first subsystem until will be satisfied a condition (1). Then or the condition x1min x01 x1max is satisfied or the condition x1min – x01 0 is broken. We accept x01 = x1min then the condition (1) is not executed yet.

3. To reduce quantity of resources for the second subsystem on rule, described in item2, etc. the Block diagram of the given algorithm is resulted in figure 2. More challenges of mathematical modeling when mathematical models are nonlinear functions. If even one of functions yi = f (xi), i =1..., n, describing object, is nonlinear then we have a problem of nonlinear programming. For the decision problems can be used as analytical methods, such both a method of uncertain multipliers Lagrange, and various numerical methods.

2. Distribution of resources between parallel systems.

In the event that parallel systems are same, the basic matrix of system of restrictions of a problem of distribution of resources appears close to вырожденной, that leads to greater(big) computing difficulties and instability of the received decision. In works [1-3] it is offered to use the approach which assumes, that the decision of a problem(task) of distribution of resources receive by the directed transition to its(her) optimum decision from the point corresponding the decision of more simple problem with expanded area of admissible decisions.

$$F = CX \to \max , \quad (5)$$

$$AX \le S , \quad (6)$$

$$EX = X_0 , \quad (7)$$

$$X_{\min} \le X \le X_{\max} . \quad (8)$$

For her will be this task:

$$F_{\partial} = CX \to \max , \quad (9)$$

$$EX = X_0 , \quad (10)$$

$$X_{\min} \le X \le X_{\max} . \quad (11)$$

The general scheme of the decision of a linear problem of distribution of resources includes following steps:

1. The decision of the expanded problem (9) - (11).

2. Check of the received decision on an admissibility on restriction (6) initial problems. If the decision is admissible, it is optimum.

3. A choice of a direction and a step of descent.

4. Transition to the new decision. The new decision received as a result of descent, will be, obviously, optimum if descent in the chosen direction leads to the least change of value of criterion function in comparison with other directions. The algorithm of the decision of a linear problem of distribution of resources can be found in [10]

3. Modeling of system of the analysis of a problem of resource distribution.

By optimization of various chemical-technological processes up to-is free often there is a problem of revealing of conditions or parameters, at which stable work of system, and also the parameters constraining the further improvement of process and an establishment of areas of more favorable values of these parameters [1, 4, 6] is provided. With reference to problems of distribution of resources, us can interested in a question on in what limits it is possible to change factors ci before the optimum decision will cease to be those; or on-how many it is possible to change the factors describing size of resource before the decision will cease to be admissible, or, at last, as change of restriction factors influences the optimum decision. We shall consider two cases:

1.possible change of a vector of the right restrictions (6) – resources S on some size

$$AX \leq S + \Delta S \; ; \tag{12}$$

2. possible changing parameters of functions

$$F = (C + \Delta)X \rightarrow \max \, . \tag{13}$$

General scheme of computer system of the analysis of a problem of distribution of resources is presented in figure 3 [6]. The device of computer modeling will allow to carry out the analysis of parameters, using consecutive diagnostics of parameters of system. Identification of stochastic model of change of resources is one of essential tasks of imitating system. Casual character of change of some parameters, for example, volumes of a resource, is the reason of necessity of identification of laws of distribution of the random variables describing change of volumes of a resource. Thus it is necessary to use known methods and algorithms of identification. Then it is made имитирование under the received laws of distribution of actual changes of parameters by means of corresponding algorithms of modeling of casual laws [6]. Thus, applying offered and other methods, it is possible to simulate most often meeting continuous of distribution. Normal, or гауссово distribution is one of the most important and often used continuous distributions. Uniform distribution on frequency of application concedes to only normal law. Exponent ional distribution describes a lot of real processes where «time of occurrence" is examined. Many non-negative masks describing any casual phenomena, it is possible to describe by means of scale-distribution. As its parameters define scale and the form of the law of distribution at change of their values density the scale-distribution can accept the most various forms and, hence, does this law by one of the most universal and valuable in the applied attitude [6]

The conclusion

Computer system of the task analysis of distribution of resources can be or is used as independent, or included in structure of the information system's management by the chemical - technological processes assuming presence of parallel objects with the purpose of optimization of technological processes, proceeding in parallel units.

The majority of modern chemical productions are the difficult technological complexes, each stage of processing of raw materials on which several technological operations of formation of systems with parallel structure are carried out. There is a problem of modeling and optimization of systems with parallel structure. This problem includes three main aspects: solution of the problem of distribution of limited resources between parallel operations or elements at the top level of a control system, in stay local optimum decisions for its separate elements at the bottom level and on mutual solutions of coordination of these of a problem among themselves. From this it follows that one of questions of definition of a complex which are considered in a control system of information of the enterprise, problems of division of distribution of limited resources between separate subsystems. Here the concept of resources is used in the broadest sense and can take various forms, such, as financial, material, information, etc.

References

1. Shukayev D. N., Tazhibayeva A.K. Modeling and optimization of processes of distribution of resources in systems with parallel structure. // Reports of the II international scientific and technical conference "Modelling and Research of Difficult Systems". P.1. Modeling of systems by the set criteria of quality. M, 1998. – Page 144-150.

2. Shukayev D.N. Optimization of resource allocation processes in parallei structure systems. // Presentation of International scientific and technical conference FEIIC. – Almaty, 1999. – P.185-192.

3. Ermakov A.S. Shukayev A.D. Kim E.R. Distribution of parallel streams with the general resource. // Messenger of KAZNTU. – 2002 . – No. 3. – Page 18-22.

4. Shukayev D. N., Kim E.R. Temirbekov R. Metod of expansion in problems of placement of discrete objects. // Messenger of KAZATK. – 2006 . – No. 3. – Page 108-112.

5. Balakirev V. S., Volodin V. M., Tsirlin A.M. optimum control of processes of chemical technology. – M.: Chemistry, 1978. – 382 pages.

6. Shukayev D. N. Analysis and modeling of information processes. – Alma-Ata: Evero, 2005.

The work is submitted to the International Scientific Conference "Priority directions of development of science, technologies and equipment", Italy (Rome-Florence), on April 12-19, 2014, came to the editorial office on 14.03.2014

SIMULATION OF HYDROGEN-AIR PEMFC

Vasilenko V.A., Koltsova E.M., Meshcheryakova T.V., Bogdanovskaya V.A.

D. Mendeleev University of Chemical Technology of Russia, Moscow, Russia, e-mail: kolts@muctr.ru

Nowadays it is increasingly important to search new energy systems based on the use of pure and inexhaustible energy sources. Attractiveness of hydrogen as a universal energy is caused by its environmental cleanliness, flexibility and efficiency of energy conversion processes with its participation.

The aim of this work is to simulate the low operating temperature hydrogen-air polymer electrolyte membrane fuel cell (PEMFC) for generation of electricity using as a fuel gas containing impurities of methane and carbon oxide. At creating a PEMFC the main attention is focusing on the development of catalysts with enhanced tolerance to methane and carbon oxide in the fuel.

PEMFC is a complex system, its characteristics are determined by parameters of each component. Developed mathematical model of the PEMFC is based on the basic equations of hydrodynamics, conservation equations of mass, energy and current. The model takes into account the influence of the catalyst layer active area, the platinum content of the catalyst in the active layer, its overall characteristics on the current and the power produced by the FC.

Mathematical model includes the following equation: potential equation, local surface over-potential equations at anode and cathode, the boundary conditions for the potential and equations calculating current density at anode and cathode.

The model treats the following processes: transport of water and reagents in bipolar plate channels, gas diffusion and active layers, membrane; protons transfer in membrane and active layer of the catalyst; electron flow in the active, gas diffusion layers and electrodes collectors. These areas are described separately in the model and are connected with each by boundary conditions.

The main equations of processes in bipolar graphite plates channels at anode and cathode sides are the laws of components mass conservation and the Navier-Stokes equations for the calculation of gas flow movement. The laws of components mass conservation in the diffusion layers are similar to the previous one, with accounting of layers porosity. The laws of components mass conservation in catalyst layers are similar to laws in the diffusion layers, with the addition of reactions. The law of water mass conservation is in the zone of membrane.

The mathematical model has been tested by comparison with a series of experiments for two types of cathode catalysts: commercial catalyst 40 wt.% Pt/C (E-TEK) -0.4 mgPt/cm^2 and synthesized catalyst.

In the result of simulation the dependences of components concentrations and gas concentration distribution along MEA thickness, the current-voltage characteristics are obtained. Aging of electrochemical active surface due to Pt catalyst poisoning has been simulated.

This study is supported by state contract with Russian Foundation for Basic Research (RFBR) № 14-07-00960.

The work is submitted to the International Scientific Conference «MODERN HIGH TECHNOLOGIES», April 25 - May 2, 2014, Israel (Tel Aviv), came to the editorial office on 18.03.2014