# VISUALIZATION METHOD FOR PROCESSING OF THE NUMERICAL DATA FLOW AT THE CHEMICAL-TECHNOLOGICAL PROCESSES INVESTIGATION

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The paper presents the advantage of using of the visualization method for processing of the numerical data flow followed the processes of mathematical description and modeling at the various stages of investigation for chemical-technological processes application purposes.

On the base of the processes examples as the sulphatizing roasting of the chalcopyrite concentrate at copper and iron metals extraction and the optimization structures study of the metal protection from corrosion process it was developed the visual modeling at the stage of experiment planning. For signal – liquid substance system it was realized the method of visualization for the mathematical model of the polar liquid' pulse sounding process with adjustable depth of the reflecting layer of the investigated material.

In the case of metals extraction' process the maximum output of a product is the parameter of optimization. In the corrosion process it was implemented the optimization of regimes for obtaining the structures ensuring the maximum protection of metal from corrosion. For the signal – liquid system the total absorption (min $\rho(\lambda,l)$) or total reflection (max $\rho(\lambda,l)$) of the electromagnetic radiation arising in the substance' layer from an incident radiation it is considered as the parameters of optimization [1,2].

For the process of metal's extraction it was obtained the surfaces of response for $f_{1,2}(X_1, X_2, X_3=\text{const}1, X_4=\text{const}2)$ with highlighted by color resolution optimum areas, where $X_i$ - encoded values of natural scales of $\xi_i$ :

$\xi_1$ - temperature of the calcinations, $C^0$; $\xi_2$ - duration of the calcination, min;
$\xi_3$ – $SO_2$ in blast, %; $\xi_4$ - volume rate of the gas flow, l\min.

The coordinates of the extremes - points random chosen from optimum area on the response surface, constructed on the base of the $f_1(X_1, X_2, X_3=\text{const}1, X_4=\text{const}2)$, regression equation, describing the process of cuprum extraction, are shown in the table 1, as well as visually imaged in the field of module realization, in Excel environment.

Table 1

Coordinates of the extreme points - $P_{max}(\xi_1, \xi_2, \xi_3, \xi_4)$

| $\xi$ | $P_1$ | $P_2$ | $P_3$ | $P_4$ | $P_5$ |
|---|---|---|---|---|---|
| $\xi_1$ | 631,6 | 638,6 | 589,6 | 671,4 | 671,2 |
| $\xi_2$ | 50,5 | 49,3 | -19,5 | 41,17 | 15,5 |
| $\xi_3$ | 10 | 10 | 10 | 10 | 10 |
| $\xi$4 | 1,7 | 1,7 | 1,7 | 1,7 | 1,7 |

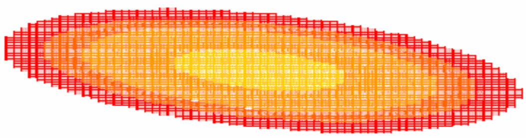

**Fig.1.** The parameters value from optimal area (red background – 98-100%), corresponding to $y_1$ = 98-100% output, where $y_1$ – amount of the extracted copper, (%) of the sulphatization roasting of chalcopyrite concentrate process.

For metal protection from corrosion process it was applied the method of visualization of the parametric dependence describing the influence of synthesized compound component's ratio and experiment's conditions on the protection degree of metal from corrosion in corrosive medium. By the use of the method of active planning of the experiment it was developed the mathematical model in the form of linear regression equation. This regression model reflects the influence of process basic factors included: alkyl phenol quantity - $X_1$, M-6 oil quantity – $X_2$, temperature of the reaction of neutralization – $X_3$, solvent quantity - $X_4$, on process parameter - protection degree against corrosion, (%) - $Y_1$. The control of the model adequacy has been spent by means of the Fisher's criterion.

On the basis of the regression function f ($x_1$, $x_2$, $x_3$, $x_4$) it was implemented the visualization of 2 factors dependence of disubstituted alkyl phenol output characteristic - $Y_{1Max}$ from structure and reaction conditions. And the choice of the fixed values of $X_3$ and $X_4$ parameters is defined by solving of the problem of optimization of the maximum output of the product Fmax = f ($x_1$, $x_2$, $x_3$, $x_4$). An extreme of the problem of optimization: the maximal protection degree of steel $Y_{1Max}$ = 98.8 % at $X_1$ = 98, $X_2$ =110, $X_3$ = 90, $X_4$ = 433 was found by use of the standard mathematical package of applied programs MathLab 6.5.

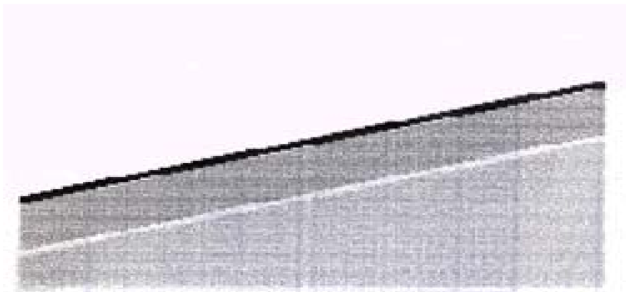

**Fig.2.** Visualization of the parameter's optimal area (highlighted by black color), corresponding to maximal output of the product - disubstituted alkyl phenol.

On the obtained topogram the area of $X_1$ and $X_2$ parameter's values at which the output product parameter achieves the optimum values is visually highlighted. This optimum area on the topogram is painted over during calculations by black color and corresponds to values from an interval of 98 %-100 %. For example, the values of $X_1$ and $X_2$ regime parameters captured in the optimum area from the topogram are shown in the table 2.

Table 2

| Coordinates of the extreme points $Y_{max}(X_1, X_2, X_3, X_4)$ | | | | |
|---|---|---|---|---|
| $X_1$ | 63 | 80 | 90 | 96 |
| $X_2$ | 140 | 125 | 116 | 110 |
| $X_3$ | 90 | 90 | 90 | 90 |
| $X_4$ | 433 | 433 | 433 | 433 |
| $Y_{1Max}$ | 99.39 | 99.03 | 98.9 | 99.14 |

For signal – liquid substance system it was realized the method of visualization for the mathematical model of the polar liquid' distance sounding process with adjustable depth of the reflecting layer of the investigated material [3]. The developed module of visualization for reflected signal' Fourier-transformation is served to conduct the qualitative analysis of investigated polar liquid with the followed recognition – identification of the liquid.

Visualization of the spatial - frequency relation represented the signal reflection from the investigated substance at pulse sounding process by colorizing the dispersion and absorption regions on the response surface of the polar liquid and localization of the discretionary parameter' coordinates of material simplifies a problem of frequency values selection for the dielectric coefficients of the investigated liquid calculation purpose.

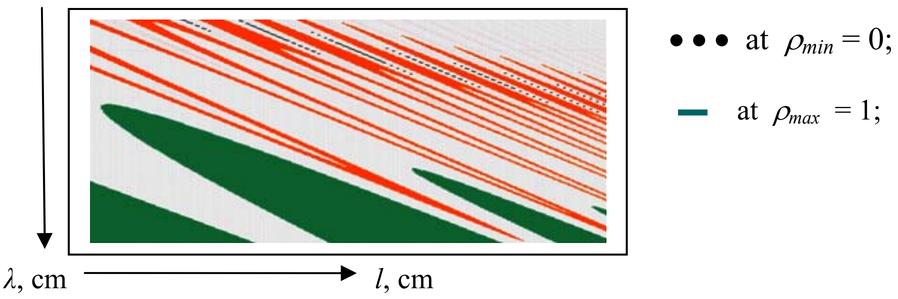


**Fig. 3.** Topological map of the ρ constant values lines near the $\lambda$ and $l$ discretionary parameters of acetone; where $\rho(\lambda, l)$ – wave reflection coefficient, $\lambda$ - wave length, $l$ – layer thickness.

**Results**

On the base of the developed regression models by using of the experimental data it was solved the problem of processes parameters optimal regions determination in accordance with the optimization criterions for every, separately selected chemical-technology process.
For "signal – substance" system by the method of visualization of spatial - frequency relation describing the signal reflection from the polar liquid at pulse sounding process it was solved the problem of visualization of the dispersion and absorption regions of investigated liquid.

**Conclusions**

Optimal areas visualization for chemical-technology processes, realized in Excel environment, has been characterized by wide choice of extreme points as well as convenient selection, pickup of the extreme point coordinates from optimal area and facilitates the experiment regimes management and automation. By fixing the hard realized experimental factors and selection of the optimal regimes in accordance with easily reproducible factors it is achieved the significant simplification during the experiment conduction.

For "signal – substance" system - physico-chemical process by the visualization method of spatial - frequency description of the signal reflection from the polar liquid it is solved the problem of liquid identification.

## References

1. *Касимов Р.М.* Инженерно-физический журнал. 1994, т.67, №5, с. 489.
2. *Касимов Р.М., Калафи М.А., Касимов Э.Р., Каджар Ч.О., Салаев Э.Ю.* // Журнал технической физики, 1999, т.66, №5, с. 167.
3. *Касимов Р.М., Шабанова Ч.М.* Распознавание полярных жидкостей методом визуализации и структурирования данных. // Тезисы II Международного Форума «АНАЛИТИКА И АНАЛИТИКИ», Воронеж, 2008, с. 245.