Modeling and Technology of Management with Processors of Separation Oil and Liquid on the Oil-Trades

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***Abstract*— The method of synthesis and approach of the group analysis of the differential equations and the counting analysis cultivate the good possibilities and allows to research numerous not linear appearances and the management influence on the productivity and oil recovery of layer.**

***Keywords*— oil recovery; group analysis; infinitesimal; operator; invariant; decision; viscosity; pervious; pressure; porosity**

I. INTRODUCTION

The development of methods of mathematical modeling for production oil field, increasing of hydrodynamic models of layer, so creating of system automation project for working allowed the next step in the direction of determining and increasing of calculate optimal dynamic of extracting oil. For the production of oilfield there are the objective conditions of the creating different dynamic for extracting oil which consisting in being reserves of layer energy for intensification extracting oil in the first period of the production and so for the technical extent of resources artificial influence on the oil layers and racing from the layer. The main factors, which determining the dynamic and the levels of changing oil and liquid can be divorced on geological, which characterize the collector qualities of layers and filling their fluids and the technology conditions of the production oilfields.

In this case the first group of factors in traditional flood are unregular: pervisity, porosity, viscosity of oil, configuration,mass expences and porosity of deposit. The first group is concerning to the manager paramete of the production oilfields:heometry and porosity of tuile wells, the system of placing of extract and supercharge wells, inflexions of pressure and ets. Different dynamic of extraction oil and corresponding tempo of the selection set in motion to different technico-economics indexes of the production. The dynamic of extracting oil is the not linear on the stages of the intensive drilling of deposits and increasing of extraction oil, stabilization of extraction oil with influences on the layer, degradation of extraction oil, emaciation of reserves oil and energy resourses of layer.

II. PROBLEM STATEMENT

Submit for concideration the mathematical model of two-phases in the pit zone:

$$div a(x)\nabla p - c(x)\frac{\partial p}{\partial t} + \xi - \eta f = 0,$$

$$a(x) = k_i(\rho)/\mu_i,\ x = (x_1, x_2), x \in \Omega, \qquad (1)$$

$$c(x) = h(x)(m_0\beta_l + \beta_p),\ p_{t=0} = p^0,$$

$$\vec{k} = (k_1, k_2),\ \vec{f} = (f_1, f_2),\ f_i = k_i/(\mu_i a),$$

μ_i is viscosity, k_i is relative pervious, i=1 apply to oil, i=2 to liquid, η is intensive of selection ,P is pressure, m is porosity, x_1, x_2 is co-ordinates of plane, t is time, J is oil recovery, V0 is primary volume of oil in the layer, $\xi(x,t)$ is intensive of rolling up oil.

$$\int_\Omega (\xi - \eta)dx = 0\ ,\ \eta \geq 0\ , \qquad (2)$$

$$J = \int \frac{1}{V_0}\int_0^T\int_\Omega \eta f_1 d\vec{x}\,dt, \qquad (3)$$

T is time of production.

Problem consist in definition of manager influences $\xi(x,t)$, $\eta(x,t)$,which allow to get maximum oil-give

$$\int_0^T\int_\Omega \eta dxdt = Q_0,$$

where Q_0 is definite value

Assign the definite classes of decisions, finding which simpler than finding the general decision, we use theory *Ly* for it.

Construction the infinitesimal operator for the mission in the following form:

$$x=\omega^1(x_1,x_2,t,p)\frac{\partial}{\partial x_1}+\omega^2(x_1,x_2,t,p)\frac{\partial}{\partial x_2}+$$
$$\omega^3(x_1,x_2,t,p)\frac{\partial}{\partial t}+\omega^4(x_1,x_2,t,p)\frac{\partial}{\partial p}+v_1\frac{\partial}{\partial p_{x_1}}+v_2\frac{\partial}{\partial p_{x_2}}+ \quad (4)$$
$$v_3\frac{\partial}{\partial p_t}+v_{11}\frac{\partial}{\partial p_{x_1x_1}}+v_{12}\frac{\partial}{\partial p_{x_1x_2}}+v_{22}\frac{\partial}{\partial p_{x_2x_2}}+v_{13}\frac{\partial}{\partial p_{x_1t}}+$$
$$v_{23}\frac{\partial}{\partial p_{x_2t}}+v_{33}\frac{\partial}{\partial p_{tt}}$$

In result of the action of the operator we get the next differential equation:

$$v_{11}=D_{x_1}(v_1)-p_{tx_{11}}D_{x_1}(\omega^3)-P_{x_1x_1}D_{x_1}(\omega^1)- P_{x_2x_1}D_{x_1}(\omega^2) \quad (5)$$

where v_{11} и v_{22} express in full differential D with formulas:

$$v_{22}=D_{x_2}(v_2)-p_{tx_2}D_{x_2}(\omega^3)-P_{x_2x_1}D_{x_2}(\omega^1)- P_{x_2x_2}D_{x_2}(\omega^2)$$

In order to define a view function

$$\omega^1(x_1,x_2,t,p),\omega^2(x_1,x_2,t,p),\omega^3,\omega^4(x_1,x_2,t,p),$$

it is necessary with reckoning expressions for

$$v_{11},v_{22},v_1,v_2,v_3$$

to split the definite equation ,which is differential concerning of unknown co-ordinates

$$\omega^1,\omega^2,\omega^3,\omega^4.$$

It is necessary to mark if do not use with the infinitesimal create of invariant differential equation and the formula substitute into the equation, in this case receiving system will be not linear, if the first equation is not linear, and, mission of finding group will seem very complex and unwieldy. The definition equations always not linear it means the application of the infinitesimal creates of invariant actually makes not linear the mission of finding group of the transformation with permissible system of the differential equations.

Splitting the equation (5) concerning "free" co-ordinate P and its derivatives, we get:

$$\left.\begin{array}{l} a\omega_p^4-2a\omega_{x_1}^1+a_{x_1}\omega^1=0,\omega_p^1=0,\omega_p^3=0,\omega_{x_2}^3=0\\ a\omega_p^4-2a\omega_{x_2}^2+a_{x_2}\omega^2=0,\omega_p^2=0,\omega_{x_1}^3=0,\omega_{pp}^4=0\end{array}\right\}$$

$$\left.\begin{array}{l} c\omega_p^4+c\omega_t^3-\omega^1c_{x_1}-\omega^2c_{x_2}=0\\ -c\omega_t^4+a\omega_{x_1x_1}^4+a\omega_{x_2x_2}^4+a_{x_1}\omega_{x_1}^4+a_{x_2}\omega_{x_2}^4-\omega^3Q+\end{array}\right\}$$

$$\xi_{x_1}+\eta_{x_1}f+\xi_{x_2}+\xi_{x_2}f=0 \quad (6)$$

$$c\omega_t^1+2a\omega_{x_1p}^4-a\omega_{x_1x_1}^1-a\omega_{x_2x_2}^1+a_{x_1x_1}\omega^1-a_{x_1}\omega_{x_1}^1- a_{x_2}\omega_{x_2}^1+a_{x_1}\omega_p^4=0$$

$$c\omega_t^2+2a\omega_{x_2p}^4-a\omega_{x_2x_2}^2-a\omega_{x_1x_1}^2+a_{x_2x_2}\omega^2-a_{x_1}\omega_{x_1}^2- a_{x_2}\omega_{x_2}^2+a_{x_2}\omega_p^4=0$$

It is possible to decide the mission of the group classification concerning element $\eta=\eta(x)$. Proposition about the arbitrary $\eta=\eta(x)$ and its derivative is made in receiving definition equations, that assists to additional splitting system (6) and give us the definition equations of nucleus of main groups.

$$\left.\begin{array}{l} \xi\omega_{px_1}^4+\xi\omega_{x_1x_1}^1+c\omega_t^1-\xi\omega_{x_2x_2}^1-\xi_{x_2}\omega_{x_2}^1=0\\ \eta\omega_{px_2}^4+\eta\omega_{x_2x_2}^2+c\omega_t^2-\eta\omega_{x_1x_1}^2-\eta_{x_2}\omega_{x_1}^2=0\end{array}\right\}$$

After transformations we get the following treatments:

$$\omega_p^4=\omega_t^3;\omega_{x_1x_1}^1=0;\omega_{x_2x_2}^2=0$$

The following equations appear in view of definite receiving system, which keep only $\eta(x)$. These equations are classifications:

$$\omega^2=\left(\frac{\eta}{\eta_{x_2}}\right)(2\omega_{x_2}^2-\omega_t^3);\omega^1=\left(\frac{\eta}{\eta_{x_1}}\right)(2\omega_{x_1}^1-\omega_t^3) \quad (7)$$

We get some expanse of vector fields of tangent to groups for each decision of classification equations. We see the addition base of the main expanse till the base of expanse $L(\eta)$.

The main group is generated with transformations, which belong to 5 groups:

$$X_1=x_1\frac{\partial}{\partial x_1}+x_2\frac{\partial}{\partial x_2}+t\frac{\partial}{\partial t},X_2=\frac{\partial}{\partial x_1},X_3=\frac{\partial}{\partial x_2},$$
$$X_4=\frac{\partial}{\partial t},X_5=\frac{\partial}{\partial t}$$

It is possible to get the invariant decision for each of them. It is interesting the chance of submitting the operators X_2 and X_3. For X_2 corresponds the invariant decision $p = p(x_1, x_2, t)$, putting up in (1) we get:

$$\frac{\partial}{\partial x_2}\left[\eta(x_2)\frac{\partial p}{\partial x_2}\right] - c\frac{\partial p}{\partial t} = Q(t)$$

The receiving equation represents the single-measure equation of heat-conducting with variable coefficient and source, so the applying of theory *Ly* gave us the splitting of the first equation in directions x_1 and x_2 .

When we use operator X_3, we get:

$$\frac{\partial}{\partial x_1}\left[\eta(x_1)\frac{\partial p}{\partial x_1}\right] - c\frac{\partial p}{\partial t} = Q(t)$$

We can begin the classification. The main base is found, the group of equivalent of equation is looked for in the class of equations, joining with condition, so as arbitrary η depended on from x_2 (or from x_1).

When we difference the first equation in (7) on x_2, but the second on x_1, we get the following classification equation:

$$\left(\frac{\eta}{\eta_{x_2}}\right)_{x_2 x_2} = 0, \quad \left(\frac{\eta}{\eta_{x_1}}\right)_{x_1 x_1} = 0$$

The decisions are written in this form:

$$\frac{\eta}{\eta_{x_2}} = \frac{x_2}{r_1} + r_2 \; ; \; \frac{\eta}{\eta_{x_1}} = \frac{x_1}{r_1^{/}} + r_2^{/} \, ,$$

where $r_1, r_2, r_1^{/}, r_2^{/}$ are const.

The linear combination of invariant decisions of the main base of the group transformations are the invariant decision too. Then the general decision of the classification system is noted in following view:

$$\eta(x) = c_1 x_1^{\alpha} + c_2 x_2^{\beta}, \; \alpha = \frac{1}{r_1}, \beta = \frac{1}{r_1^{/}} .$$

In that case we see the extending of the main group on vectors:

$$(\alpha x_1, \beta x_2, 0, 2p).$$

III. Conclusion

The cultivate method of synthesis and approach of the group analysis of the differential equations and the counting analysis reveals the good possibilities and allows to research numerous not linear appearances, and the management influence, which influence on the productivity and oil recovery of layer.

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