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ANALALYTICAL SOLUTION OF CRITICAL PROBLEM FOR SLAB HOMOGENEOUS REACTOR WITH INTERNAL REFLECTOR

A.V. Kuzmin

Tomsk Polytechnic University
E-mail: kuzminav@tpu.ru

Analytical estimation of central reflector influence by the example of slab reactor in one-group and diffusion-growing approximations has been carried out. On the side of external reflector an effective border is introduced which simplifies the mathematical statement of critical problem. Approbation of the solution is performed for one of the states of the researched IRT-T reactor.

Introduction

Estimation of critical parameters or critical concentration (mass) of fuel is a main problem of the nuclear reactor theory. In conventional presentation consideration of critical problem has been confined by reactors of the classical geometry (a sphere, an unrestricted cylinder and a plate) without neutron reflector and with it observing the central symmetry. Moreover, its was historically determined that external arrangement of reflector met the existing at that time requirements of nuclear reactors.

The influence of external reflector has been considered only in one-group approximation for the extreme cases of its diffusion characteristics: for vacuum and black body). Such an approach permitted the significant simplification of mathematical problem statement (the diffusion equation was excluded). The results of solving the critical problem in one-group approximation found practical application in calculation of particular types of reactors (e.g. heavy-water reactor) and in the theory of central absorber.

More than half-century experience of nuclear reactor operation has revealed the appropriateness of application of central or external reflectors. For example, in high-temperature reactor with helium heat-transfer medium GT-MGR the reflector is a construction made of graphite blocks of different form [1]. It includes not only conventional upper, lower and lateral reflectors, but also central one.

The reactor core GT-MGR consists of prismatic graphite blocks and, hence, it possesses less thermal resistance in comparison with the core of spherical heat emitting elements. The presence of central graphite reflector increases storage capacity of the reactor and, hence, decreases the heating rate of the core at impairment of heat-transfer medium. Simultaneously, such circular composition provides better equalization of energy distribution over core and, hence, less specific power of energy-release and fuel temperature.

In the reactor IRT-T involved the application of not only external reflector, but also internal one is explained by the necessity of increase in average density of neutron flux [2, 3]. For the same purpose the choice of beryllium as a reflector material is used.

Distribution of slow neutron flux density in general case is performed by numerical methods in multigroup approximation and in multidimensional statement. The purpose of the work is to obtain analytical estimation of influencing central reflector by the example of IRT-T reactor and taking into account the taken assumptions is rather of methodical nature.

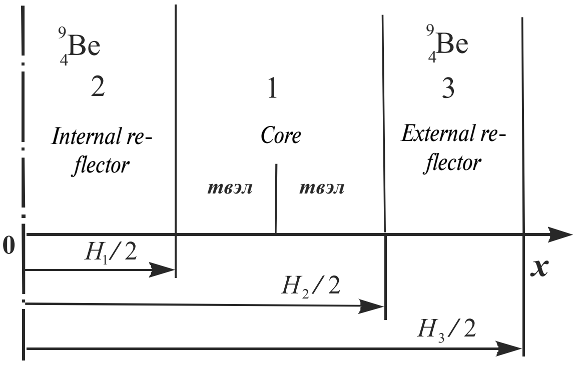

Fig. 1. *Scheme of IRT-T reactor element location*

In the scheme core of the IRT-T reactor presents a rectangle with the sides of 6×8 square section cells. In the periphery reflector beryllium blocks are arranged in one row, in the centre there is a beryllium neutron trap (internal reflector) including 4 cells, the rest of cells occupy heat emitting fuel assembly, washed by light-water heat-transfer medium. On the whole the element arrangements along the long side of the rectangle with respect to the symmetry axis have the view presented in fig. 1, where $H_i/2$ are the boundaries of corresponding zones.

The problem on the reactor with internal and external reflectors will be solved in one-group and diffusion-growing approximation, considering the core a homogeneous zone and in the form of unrestricted plate for simplicity.

One-group approximation

The trend is to describe the distribution of neutron flux Φ_i in the core, in the internal and external reflectors in one-group approximation with the following wave equations:

$$\Delta\Phi_1 + \chi_1^2\Phi_1 = 0, \quad (1)$$

$$\Delta\Phi_2 - \chi_2^2\Phi_2 = 0, \quad (2)$$

$$\Delta\Phi_3 - \chi_3^2\Phi_3 = 0, \quad (3)$$

where χ_1, χ_2, χ_3 are material parameters of the core medium, internal and external reflector.

Let us use the following boundary conditions to solve the equations (1–3):

$$x=0 \qquad \nabla\Phi_2(0)=0, \tag{4}$$

$$x=H_1/2 \qquad \Phi_2(H_1/2)=\Phi_1(H_1/2), \tag{5}$$

$$x=H_1/2 \qquad D_2\nabla\Phi_2(H_1/2)=D_1\nabla\Phi_1(H_1/2), \tag{6}$$

$$x=H_2/2 \qquad \Phi_1(H_2/2)=\Phi_3(H_2/2), \tag{7}$$

$$x=H_2/2 \qquad D_1\nabla\Phi_1(H_2/2)=D_3\nabla\Phi_3(H_1/2), \tag{8}$$

$$x=H_3/2 \qquad \Phi_3(H_3/2)=0, \tag{9}$$

where D_i is the diffusion coefficients.

Application of external reflector of thickness T decreases neutron leakage and effects a saving in the core equal to efficient additive [4]

$$\delta_{эф}=\frac{1}{\chi_1}\mathrm{arctg}\left[\frac{D_1\chi_1}{D_3\chi_3}\mathrm{th}(\chi_3 T)\right].$$

Simplify the problem (1–9), for this purpose introduce the effective boundary condition

$$x=H_2/2+\delta_{эф}=H_{эф}/2 \quad \Phi_1(H_{эф}/2)=0. \tag{10}$$

Thus, the problem on critical state is determined by the equation system (1, 2, 4–6) and (10).

Solution of the wave equations (1) and (2) are known and has the view:

$$\Phi_1(x)=C_1\sin(\chi_1 x)+C_2\cos(\chi_1 x),$$
$$\Phi_2(x)=C_3\mathrm{sh}(\chi_2 x)+C_4\mathrm{ch}(\chi_2 x).$$

Meeting the boundary conditions by these solutions, we obtain the system of algebraic equations. After decreasing the order of the system up to two and then having got rid of the constants, we obtain the critical equation for the reactor in the form of unrestricted plate with central reflector:

$$D_2\chi_2\mathrm{th}(\chi_2 H_1/2)=-D_1\chi_1\mathrm{ctg}(\chi_1(H_{эф}/2-H_1/2)). \tag{11}$$

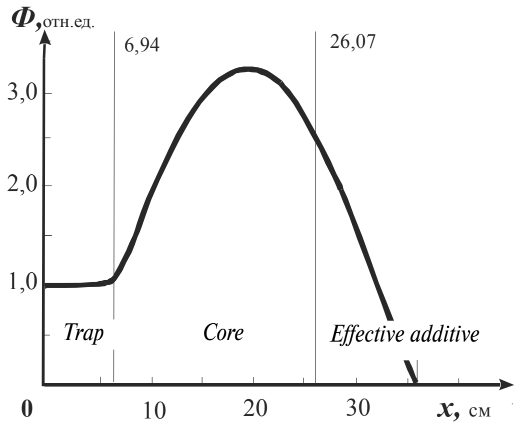

Fig. 2. Neutron flux distribution over the core and the central reflector

At the specified thickness of the internal reflector and known material characteristics one can find the critical value of the core dimension from this equation.

The initial system of algebraic equations allows us to find out the expressions of spatial distribution of neutron flux density just with the accuracy of some constant C_i. To find the laws of neutron distribution in the core and the reflector in the explicit form let us set up the condition:

$$x=0 \quad \Phi_2(0)=\Phi^*=f(N_p) \tag{12}$$

as a result we obtain the distribution laws [6]:

$$\Phi_1(x)=\Phi^*\mathrm{ch}(\chi_2 H_1/2)\frac{\sin(\chi_1(H_3/2-x))}{\sin(\chi_1(H_3/2-H_1/2))}, \tag{13}$$

$$\Phi_2(x)=\Phi^*\mathrm{ch}(\chi_2 x). \tag{14}$$

If we take that $\Phi^*=1$, then the solutions (13, 14) have the view presented in fig. 2.

Two-group approximation

The more high diffusion-growing approximation includes slowing down fast and spreading slow neutrons. Let us use the effective boundary condition too.

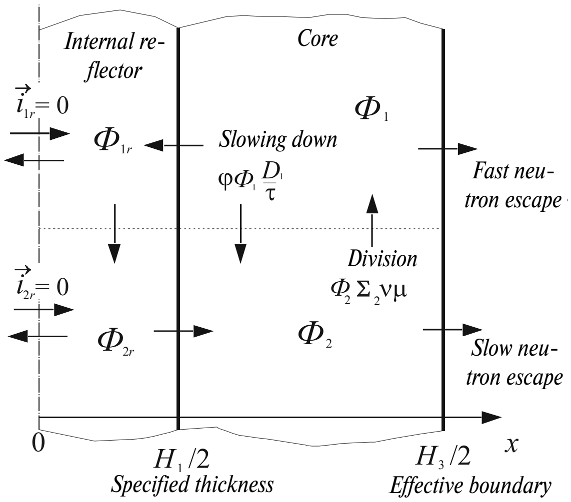

Fig. 3. The scheme of two-group processes

According to the scene of two-group processes (fig. 3) the critical problem in the axil-symmetrical Cartesian statement includes the following equations of neutron balance for:

- core $H_1/2\le x\le H_3/2$:

$$D_1\Delta\Phi_1-\Sigma_R\Phi_1+k_\infty\Sigma_{a,T}\Phi_2/\varphi=0, \tag{15}$$

$$D_2\Delta\Phi_2-\Sigma_{a,T}\Phi_2+\varphi\Sigma_R\Phi_1=0; \tag{16}$$

- internal reflector $0\le x\le H_1/2$:

$$D_{1r}\Delta\Phi_{1r}-\Sigma_{R\,r}\Phi_{1r}=0, \tag{17}$$

$$D_{2r}\Delta\Phi_{2r}-\Sigma_{a\,Tr}\Phi_{2r}+\Sigma_{R\,r}\Phi_{1r}=0. \tag{18}$$

The boundary conditions are presented in the form:

$$x=0 \qquad \Delta\Phi_{1r}=0, \quad \Delta\Phi_{2r}=0, \tag{19}$$

$$x=H_1/2 \qquad \Phi_{1r}(H_1/2)=\Phi_1(H_1/2),$$
$$D_{1r}\nabla\Phi_{1r}(H_1/2)=D_1\nabla\Phi_1(H_1/2), \tag{20}$$

$$x=H_1/2 \qquad \Phi_{2r}(H_1/2)=\Phi_2(H_1/2),$$
$$D_{2r}\nabla\Phi_{2r}(H_1/2)=D_2\nabla\Phi_2(H_1/2), \tag{21}$$

$$x = H_3/2 \quad \Phi_1(H_3/2) = 0, \quad \Phi_2(H_3/2) = 0, \qquad (22)$$

where $\Sigma_{a,T}$, Σ_R are the macroscopic sections of absorbing slow and withdrawal of fast neutrons, sm^{-1}; k_∞, φ are the coefficients of infinite media propagation and probability of avoiding resonant capture.

The laws of neutron flux distribution in the core and the reflector

As the equations (15) and (16) are symmetrical with respect to the flux, it gives grounds to suggest the flux is estimated by the wave equations with one and the same wave number [4, 5]:

$$\Delta\Phi_1 + \alpha^2\Phi_1 = 0, \quad \Delta\Phi_2 + \alpha^2\Phi_2 = 0, \qquad (23)$$

from which express the Laplacians in the form

$$\Delta\Phi_1 = -\alpha^2\Phi_1, \quad \Delta\Phi_2 = -\alpha^2\Phi_2$$

and substitute them into (15) and (16). As a result we obtain:

$$(\alpha^2 D_1 + \Sigma_R)\Phi_1 = k_\infty \Sigma_{a,T}\Phi_2/\varphi,$$

$$(\alpha^2 D_2 + \Sigma_{a,T})\Phi_2 = \varphi\Sigma_R\Phi_1.$$

After division of one equation by the other and introduction of length square of slow neutron diffusion $L^2=D_2/\Sigma_{a,T}$ and their age $\tau=D_1/\Sigma_R$, after simple transformations we obtain:

$$k_\infty = (1+\alpha^2L^2)\cdot(1+\alpha^2\tau).$$

This quadratic equation with respect to α^2 has two roots: $\alpha_1^2=\mu^2$ and $\alpha_2^2=-\nu^2$, where μ^2 and $-\nu^2$ are numerical constants, similar to the material parameters [3]:

$$\left.\begin{aligned} \alpha_1^2 &= -\frac{1}{2}\left(\frac{1}{\tau}+\frac{1}{L^2}\right)+\sqrt{\frac{1}{4}\left(\frac{1}{\tau}+\frac{1}{L^2}\right)^2+\frac{k_\infty-1}{\tau\cdot L^2}},\\ -\alpha_2^2 &= \frac{1}{2}\left(\frac{1}{\tau}+\frac{1}{L^2}\right)+\sqrt{\frac{1}{4}\left(\frac{1}{\tau}+\frac{1}{L^2}\right)^2+\frac{k_\infty-1}{\tau\cdot L^2}}=\\ &= \alpha_1^2+\frac{1}{\tau}+\frac{1}{L^2}. \end{aligned}\right\} \qquad (24)$$

Thus, the equation (23) for fast neutrons disintegrates into the equations:

$$\Delta\Phi_1 + \mu^2\Phi_1 = 0, \quad \Delta\Phi_1 - \nu^2\Phi_1 = 0$$

and its solution is a linear combination of the solutions of the last equations:

$$\Phi_1(x) = A_1\sin(\mu x) + A_2\cos(\mu x) + $$
$$+ A_3\mathrm{sh}(\nu x) + A_4\mathrm{ch}(\nu x). \qquad (25)$$

Similarly we obtain the general view of the solution for slow neutrons:

$$\Phi_2(x) = B_1\sin(\mu x) + B_2\cos(\mu x) + $$
$$+ B_3\mathrm{sh}(\nu x) + B_4\mathrm{ch}(\nu x), \qquad (26)$$

where $B_i=S_iA_i$, but S_i are the corresponding coupling coefficients.

In the diffusion equation for fast neutrons in reflector (17) the generation term of fast neutrons is absent as the environment is not multiplying, therefore the equation system (17, 18) ceases to be symmetric and disintegrates into two solved in sequence equations. This homogeneous equation for fast neutrons we write down in the form:

$$\Delta\Phi_{1r} - \beta_{1r}^2\Phi_{1r} = 0,$$

where $\beta_{1r}^2=\Sigma_{Rr}/D_{Rr}$. The general solution of this equation is known, it can be written down in the form:

$$\Phi_{1r}(x) = F_1\cdot\mathrm{sh}(\beta_{1r}x) + F_2\cdot\mathrm{ch}(\beta_{1r}x).$$

As the symmetry condition is to be met (19), it follows that $F_1=0$, and the solution has the form:

$$\Phi_{1r}(x) = F_2\cdot\mathrm{ch}(\beta_{1r}x) \equiv F\cdot\mathrm{ch}(\beta_{1r}x). \qquad (27)$$

Slow neutron flux in reflector is determined by the equation (18). First, find out the solution of homogeneous part of this equation:

$$D_{2r}\Delta\Phi_{2r}^{o} - \Sigma_{a,Tr}\Phi_{2r}^{o} = 0$$

or by introduction of the parameter $\beta_{2r}^2=\Sigma_{a,Tr}/D_{2r}=1/L_2^2$

$$\Delta\Phi_{2r}^{o} - \beta_{2r}^2\Phi_{2r}^{o} = 0.$$

Similarly, due to the condition (19), its solution is determined by the dependence:

$$\Phi_{2r}^{o}(x) = G_2\cdot\mathrm{ch}(\beta_{2r}x) \equiv G\cdot\mathrm{ch}(\beta_{2r}x),$$

but the solution of non-homogeneous equation (18) can be written down in the form:

$$\Phi_{2r}(x) = G\cdot\mathrm{ch}(\beta_{2r}x) + S_rF\cdot\mathrm{ch}(\beta_{1r}x). \qquad (28)$$

For the sake of convenience rewrite the general solutions of the equations (15–18) in the form:

$$\left.\begin{aligned} \Phi_1(x) &= A_1X_1 + A_2X_2 + A_3Y_1 + A_4Y_2,\\ \Phi_2(x) &= S_1A_1X_1 + S_2A_2X_2 + S_3A_3Y_1 + S_4A_4Y_2,\\ \Phi_{1r}(x) &= FX_{1r},\\ \Phi_{2r}(x) &= GX_{2r} + S_rFX_{1r}, \end{aligned}\right\} \qquad (29)$$

where A_i, F, G are the constants defined from boundary conditions; the functions $X_1=\sin(\mu x)$, $X_2=\cos(\mu x)$, $Y_1=\mathrm{sh}(\nu x)$, $Y_2=\mathrm{ch}(\nu x)$, $X_{1r}=\mathrm{ch}(\beta_{1r}x)$, $X_{2r}=\mathrm{ch}(\beta_{2r}x)$; S_1, S_2, S_3, S_4, S_r are coupling coefficients.

Search for coupling coefficients

The procedure of coupling coefficients determination is described in [4, 5] in details, let us show it by the example of determining the value S_r. Substitute the heterogeneous part of the solutions $\Phi_{1r}(x)=FX_{1r}$ and $\Phi_{2r}(x)=S_rFX_{1r}$ in the equations (18):

$$D_{2r}S_rF\Delta X_{1r} - \Sigma_{a,Tr}S_rFX_{1r} + \Sigma_{R,r}FX_{1r} = 0.$$

Taking into consideration $\Delta X_{1r}=X_{1r}/\tau$ we obtain

$$D_{2r}S_rFX_{1r}/\tau - \Sigma_{a,Tr}S_rFX_{1\cdots r} + \Sigma_{R\,r}FX_{1r} = 0,$$

hence

$$S_r = \frac{\Sigma_{R,r}}{\Sigma_{a,Tr} - D_{2r}/\tau_r} = \frac{\Sigma_{R,r}\tau_r}{\Sigma_{a,Tr}(\tau_r - L_r^2)}. \qquad (30)$$

Similarly the other coupling coefficients are determined:

$$S_1 = S_2 = \frac{\varphi \Sigma_R}{\Sigma_{a,T} + \alpha_1^2 D_2} = \frac{\varphi \Sigma_R}{\Sigma_{a,T}(1+\alpha_1^2 L^2)}, \qquad (31)$$

$$S_3 = S_4 = \frac{\varphi \Sigma_R}{\Sigma_{a,T}(1-\alpha_2^2 L^2)}. \qquad (32)$$

The expressions (30–32) for the coupling coefficients remain the same [4, 5], which is explained by the identity of the original equations.

Criticality condition

To determine constants in general solution of the equations (29) meet their boundary conditions (20–22):

$$\left.\begin{aligned}
&A_1[X_1] + A_2[X_2] + A_3[Y_1] + A_4[Y_2] = F[X_{1r}],\\
&S_1A_1[X_1] + S_1A_2[X_2] + S_3A_3[Y_1] + S_3A_4[Y_2] =\\
&= S_r F[X_{1r}] + G[X_{2r}],\\
&D_1A_1[\nabla X_1] + D_1A_2[\nabla X_2] + D_1A_3[\nabla Y_1] +\\
&+D_1A_4[\nabla Y_2] = D_{1r}F[\nabla X_{1r}],\\
&S_1D_2A_1[\nabla X_1] + S_1D_2A_2[\nabla X_2] + S_3D_2A_3[\nabla Y_1] +\\
&+S_3D_2A_4[\nabla Y_2] = D_{2r}S_rF[\nabla X_{1r}] + D_{2r}G[\nabla X_{2r}],\\
&A_1(X_1) + A_2(X_2) + A_3(Y_1) + A_4(Y_2) = 0,\\
&S_1A_1(X_1) + S_1A_2(X_2) + S_3A_3(Y_1) + S_3A_4(Y_2) = 0.
\end{aligned}\right\} \qquad (33)$$

It is recalled that we have already used the boundary conditions (19), it permitted us to obtain the improved solutions (27) and (28).

Square brackets are used here to identify the functions and their derivatives at the boundary of the core and reflector, round ones are at the effective core boundary.

The system (33) has a nontrivial solution only in the case if its determinant is equal to zero:

$$\Delta =$$

$$= \begin{vmatrix}
[X_1] & [X_2] & [Y_1] & [Y_2] & [X_{1r}] & 0\\
S_1[X_1] & S_1[X_2] & S_3[Y_1] & S_3[Y_2] & -S_r[X_{1r}] & -[X_{2r}]\\
D_1[\nabla X_1] & D_1[\nabla X_2] & D_1[\nabla Y_1] & D_1[\nabla Y_2] & -D_{1r}[\nabla X_{1r}] & 0\\
S_1D_2[\nabla X_1] & S_1D_2[\nabla X_2] & S_3D_2[\nabla Y_1] & S_3D_2[\nabla Y_2] & -D_{2r}S_r[\nabla X_{1r}] & -D_{2r}[\nabla X_{2r}]\\
(X_1) & (X_2) & (Y_1) & (Y_2) & 0 & 0\\
S_1(X_1) & S_1(X_2) & S_3(Y_1) & S_3(Y_2) & 0 & 0
\end{vmatrix} = \qquad (34)$$

$$= 0.$$

The system determinant (34) at specified thickness of the internal reflector and known material characteristics (the criticality condition) allows us to find the effective value of the core critical size. The reflector economy is determined by the known formula [4] and makes possible to find quaesita of critical size.

Determination of constants in the equations of neutron flux distribution

To calculate the flux distribution in the core and the reflector it is necessary to know critical size of the core and constants A_1, A_2, A_3, A_4, G and F, the equation (29). As the number of unknowns increases the number of initial equations, the distribution laws can be found only in the implicit form with the accuracy up to a definite constant. To state the laws of neutron distribution over the core and the internal reflector in the explicit form let us use the additional condition:

$$x = 0 \quad \Phi_{1r}(0) = \Phi_{1r}^{\min},$$

whence it follows that

$$\Phi_{1r}^{\min} = F \cdot \mathrm{ch}(\beta_{1r} \cdot 0) = F.$$

The other constants take the form:

$$A_1 = \frac{\Phi_{1r}^{\min}[X_{1r}] - A_2[X_2] - A_3[Y_1] - A_4[Y_2]}{[X_1]},$$

$$A_2 = \frac{-\Phi_{1r}^{\min}\begin{pmatrix}\alpha[X_{1r}] - \\ -\rho[\nabla X_{1r}]\end{pmatrix} - A_3\begin{pmatrix}[\nabla Y_1] - \\ -\alpha[Y_1]\end{pmatrix} - A_4[\nabla Y_2](-\alpha[Y_2])}{[\nabla X_2] - \alpha[X_2]},$$

$$A_3 = \frac{-\Phi_{1r}^{\min}\delta_1 - A_4\delta_3}{\delta_2}, \quad A_4 = \frac{-\Phi_{1r}^{\min}(\delta_2\xi_1 - \delta_1\xi_2)}{(\delta_2\xi_3 - \delta_3\xi_2)},$$

where

$$\begin{gathered}
\delta_1 = \beta[X_{1r}]\cdot([\nabla X_2] - \alpha[X_2]) - (\alpha[X_{1r}] -\\
-\rho[\nabla X_{1r}])\cdot((X_2) - \beta[X_2]),\\
\delta_2 = ((Y_1) - \beta[Y_1])\cdot([\nabla X_2] - \alpha[X_2]) -\\
-([\nabla Y_1] - \alpha[Y_1])\cdot((X_2) - \beta[X_2]),\\
\delta_3 = ((Y_2) - \beta[Y_2])\cdot([\nabla X_2] - \alpha[X_2]) -\\
-([\nabla Y_2] - \alpha[Y_2])\cdot((X_2) - \beta[X_2]),\\
\xi_1 = S_1\beta[X_{1r}]\cdot([\nabla X_2] - \alpha[X_2]) -\\
-(\alpha[X_{1r}] - \rho[\nabla X_{1r}])\cdot(S_1(X_2) - S_1\beta[X_2]),\\
\xi_2 = (S_3(Y_1) - S_1\beta[Y_1])\cdot([\nabla X_2] - \alpha[X_2]) -\\
-([\nabla Y_1] - \alpha[Y_1])\cdot(S_1(X_2) - S_1\beta[X_2]),\\
\xi_3 = (S_3(Y_2) - S_1\beta[Y_2])\cdot([\nabla X_2] - \alpha[X_2]) -\\
-([\nabla Y_2] - \alpha[Y_2])\cdot(S_1(X_2) - S_1\beta[X_2]),\\
\rho = D_{1r}/D_1, \quad \alpha = [\nabla X_1]/[X_1], \quad \beta = (X_1)/[X_1].
\end{gathered}$$

Discussion

The solution check is carried out by the example of IRT-T reactor, the core of which is constructed of eight-tube heat-emitting assemblings. At the end of the procedure at the power 12 MW the reactor has the following core characteristics: τ=45,831 sm^2, D_1=1,632 sm, D_2=0,292 sm, Σ_{aT}=0,10352 sm^{-1}, φ=0,973, k_∞=1,3463 and the reflector: τ_r=92,037 sm^2, D_{1r}=0,538 sm, D_{2r}=0,373 sm, Σ_{aTr}=0,00873 sm^{-1}, L^2_r=42,745 sm^2. Plotting the graph of neutron flux distribution it is convenient to accept and then in our case the coefficients are equal to: A_1=0,472388, A_2=2,528782, A_3=85,387631, A_4=–85,387631, F=1, G=–0,57191. To determine the average flux of slow neutrons over the core one needs to find effective additive of the reflector. The results of solution in MathCAD medium are presented in fig. 4.

It is conventional to estimate reflector efficiency not only by the core economy, but also by the change of relation of the slow neutron flux to its maximum value. For reactor without reflectors it is known [4, 5] and equals to 0,637. If we apply the external beryllium reflector, the relation amounts 0,939.

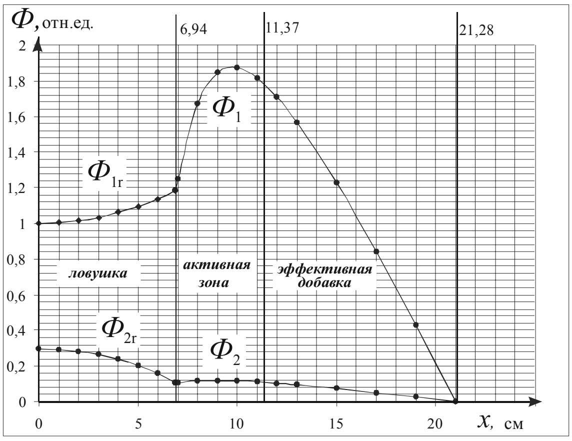

Fig. 4. *Distribution of neutron flux*

In the case of using central reflector (fig. 2) the value of this relation in one-group approximation is equal to 0,82 according to the data [6]. This result is not unexpected one and can be explained, first of all, by the fact that one-group model does not include the slow neutron storage in the reflector due to slowing down fast neutrons.

Solutions in two-group approximation (fig. 4) show visually the role of central reflector. The efficiency of neutron trap permits us to increase the relation of slow neutron average flux to its maximum value up to 0,966.

It should be noted that at transition to the effective boundary the neutron field distribution near the «core-external reflector» boundary is deformed. A more detailed consideration requires increase in system order and significant complication of computations.

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REGULARISING ALGORITHM OF PARAMETER IDENTIFICATION OF ELECTRIC CHARGE EQUIVALENT CIRCUIT. P. I.

Yu.E. Voskoboinikov*, Yu.N. Isayev, V.A. Litasov*, V.A. Kolchanova, H.O. Kuleshova

Tomsk Polytechnic University
*Novosibirsk State Architecture-Building University
E-mail: voscob@mail.ru, isaev_yusup@mail.ru

A new algorithm of parameter identification of equivalent circuit for electrical charge replacement is suggested. The approach is based on the solution of integral equation of the I type with respect to the function of indicial admittance, by which then determination of replacement circuit parameters is carried out. Application of smoothing splines and original regulating algorithm including kernel setting error of integration equation permits to obtain a stable algorithm of parameter identification. The investigation of algorithm shows high calculating efficiency and sufficient accuracy of parameter identification.

1. Introduction

One of the most interesting from the physical point of view and practically important trends in different fields of engineering is barrier discharge. In particular, barrier discharge is used in water purification, plasma technology, etching, etc. However, a strong spatial irregularity and short durability of physical processes taking place in barrier discharge make it difficult to study this phenomenon.

In characteristic description of electric discharge (barrier discharge, in particular) their description as objects of electric circuit is widely used [1]. The bases of such approaches are the replacement of electrophysical phenomena by the phenomena taking place in electric circuit consisting of definite electric elements (resistance, capacity, and inductance). Such electric circuit will be called an equivalent circuit of electric discharge replacement.

Investigating the discharge physics voltage $U(t)$ and current $I(t)$ in circuit with discharge gap are available for measuring. Therefore, there appears the problem of determination of electric discharge replacement circuit parameters with registered function values $U(t)$, $I(t)$. In fact, we have the problem of identification of replacement equivalent circuit.