BIR O'LCHAMLI SUSPENZIYANI FILTRLASH MASALASINI SONLI YECHISH

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Annotatsiya: Suspenziyani filtrlash masalasi murakkab texnologik jarayon hisoblanadi. Juda ko'p faktrlar bu jarayonga bo'ysunadi. Bu masalada filtrlashda cho'kma hosil bo'lishini qaraymiz, cho'kma qatlami o'sib boruvchi deb hisoblaymiz, uning siqilishi konsolidatsiya teoremasiga bo'ysunadi. Bunday jarayonni hisoblash uchun sonli usullardan foydalanish mumkin.Ushbu maqolada suspenziyani filtrlash masalasini sonli yechish usuli haqida so'z boradi.

Kalit so'zlar: Tekis filtrlash, Siqiluvchi cho'kma tenglamasi, filtrlash matematik modeli, aralashmani filtrlashda real fizik shartlar, qo'zg'aluvchan chegara.

NUMERICAL SOLUTION OF THE ONE-DIMENSIONAL SUSPENSION FILTERING PROBLEM

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Annotation: The problem of suspension filtration is a complex technological process. Many factors are subject to this process. In this problem, we consider the formation of sediment during filtration, we assume that the sediment layer is growing, its compaction is subject to the consolidation theorem. Numerical methods can be used to calculate such a process. This article discusses the method of numerical solution of the suspension filtration problem.

Keywords: Flat filtration, Compressible sediment equation, mathematical model of filtration, realistic physical conditions in the filtration of a mixture, movable boundary.

Jarayonni quyidagicha qabul qilamiz. Tekis filtrlash elementini qaraymiz. Filtrlash qatlami boshlang'ich momentda qandaydir z_0 qalinlikka ega deb olamiz. Vaqt o'tishi davomida bosim farqi o'zgarmas. Cho'kma-suspensiya ko'chish chegarasi $h(t)$ o'sishi bilan cho'kma qatlami ortib boradi. Bu qaralayotgan bir o'lchamli masalada z cho'kma qatlami suspenziya oqimiga qarshi oshib boradi.

Siqiluvchi cho'kma tenglamasi analogik issiqlik o'tkazuvchanlik va diffuziya tenglamasiga o'xshash bo'ladi. Cho'kma-suspenziya chegarasi qo'zg'aluvchan. Bu Stefan masalasini hisoblashda quyidagi faktorlarni olamiz. p – bosim; p_0, p_1, p_2 – mos ravishda boshlang'ich, cho'kma qatlamiga kiruvchi va filtrlash qatlamidan chiquvchi bosimlar; μ – suyuqlik qovushqoqligi; r – cho'kmaning solishtirma qarshiligi; u – cho'kmaning tashqi ta'sir koeffisinti; G – Cho'kmaning siqilish modeli; b – konsolidatsiya koeffitsiyenti, tashqi bosim ostida cho'kmaning siqilishi amalga oshiriladi, $b = \dfrac{G}{\mu \cdot r}$.

U holda filtrlash matematik modelini gidrodinamik bosimga nisbatan quyidagi ko'rinishda yozishimiz mumkin:

$$\frac{\partial p}{\partial t} = b \cdot \frac{\partial^2 p}{\partial z^2}, \quad 0 \le t \le T, \quad 0 \le z \le h(t), \tag{2.31}$$

$$p[h(t), t] = p_1, \quad 0 \le t \le T, \tag{2.32}$$

$$p[0, t] = p_2, \quad 0 \le t \le T, \tag{2.33}$$

$$p[z, 0] = p_0, \quad 0 \le z \le z_0, \tag{2.34}$$

$$\left.\frac{\partial p}{\partial z}\right|_{z=h(t)} = l \cdot \frac{dh}{dt}, \quad 0 \le t \le T, \tag{2.35}$$

Bu erga $h(0) = z_0$, $l = \frac{r \cdot \mu}{u}$, $p_0 = p_2 + \frac{z \cdot (p_1 - p_2)}{z_0}$, $0 \le z \le z_0$; b, l, p_1 va p_2 o'zgarmas kattaliklar.

Umumiy holda, Aralashmani filtrlashda real fizik shartlart cho'kmaning tuzilish strukturasi, filtrlash siqilishi bosim ta'sir farqidagi bir jinslimas muhit holati va boshqa konsolidasiya kuchlardan bog'liq bo'ladi. Shunday qilib, konsolidasiya koeffiyenti o'zgaruvchang bo'ladi va osadka qalinligidagi bosimning tarqalishidan bog'liq bo'ladi. Shuning uchun aralashmani filtrlashda hosil bo'ladigan cho'kmaning analiz qilish uchun konsolidasiya koeffisiyentini o'zgaruvchi qilib olamiz.

Tekis filtrlanuvchi elementni qaraylik. Filtrlash jarayonida aralashmaning yo'nalashga teskari ravishda filtr qatlami qandaydir z_0 bo'lsin. Vaqt o'tishi davomida filtr qatlami bosimning ta'sir farqidan qat'iy nazar o'zgarmas bo'lsin. Aralashma filtrga tushgandan so'ng uzluksiz $h(t)$ cho'kma qatlami chiziqli bo'lmagan holda o'sib boradi, ya'ni cho'kma – aralashma chegarasi ko'chib boradi. U hoda bu soxalarni ikkita soxashga ajratish mumkin: $\Omega_1(0, z_0)$ - filtrlanuvchi qatlam sohasi va $\Omega_2(z_0, h(t))$ - cho'kma sohasi, bu yerda albatta $z = h(t)$ - qo'zg'aluvchan chegara. Bu shartlarda jarayon xuddi Stefan masalasiga mos keladi.

Noma'lum qo'zg'aluvchi chegara h(t) chiziqlimas masalaga keladi. (2.31) – (2.35) masalani sonli yechish uchun $Q = \{0 \le t \le T,\ 0 \le z \le h(t)\}$ sohaga to'r kiritamiz:

$$z_i = i \cdot f_i, \quad i = \overline{1, M_0 + N}, \tag{2.36}$$

$$t_j = j \cdot \tau, \quad j = \overline{1, N}, \tag{2.37}$$

Bu erga f_i – koordinata o'zgaruvchi qadami z bo'yicha; M_0 – tugunlar soni, boshlang'ich z_0 filtrlash qatlamigacha bo'lgan; N – $[0,\mathrm{T}]$ kesmadagi vaqt qatlami tugunlar soni; τ – vaqt qadami. Koordinata qadami $f_1 = ... = f_{M_0} = h,\ h = \frac{z_0}{M_0}$, $f_{M_0+j} = h_j,\ j = \overline{1,N},\ h_j$ – kattalik cho'kma-suspensiya qo'zg'alish chegarasidagi $\lfloor t_{j-1}, t_j \rfloor,\ j = \overline{1,N}$ intervalidagi qadam.

(2.31) – (2.35) masalaga mos quyidagi sxemani kiritamiz:

$$\frac{p_i^j - p_i^{j-1}}{\tau} = \frac{2 \cdot b}{f_{i+1} + f_i} \cdot \left(\frac{p_{i+1}^j - p_i^j}{f_{i+1}} - \frac{p_i^j - p_{i-1}^j}{f_i} \right),\quad i = \overline{1, M_0 + j - 1},\quad j = \overline{1,N}, \tag{2.38}$$

$$p_0^j = p_2,\quad j = \overline{0,N}, \tag{2.39}$$

$$p_{M_0+j}^j = p_1,\quad j = \overline{0,N}, \tag{2.40}$$

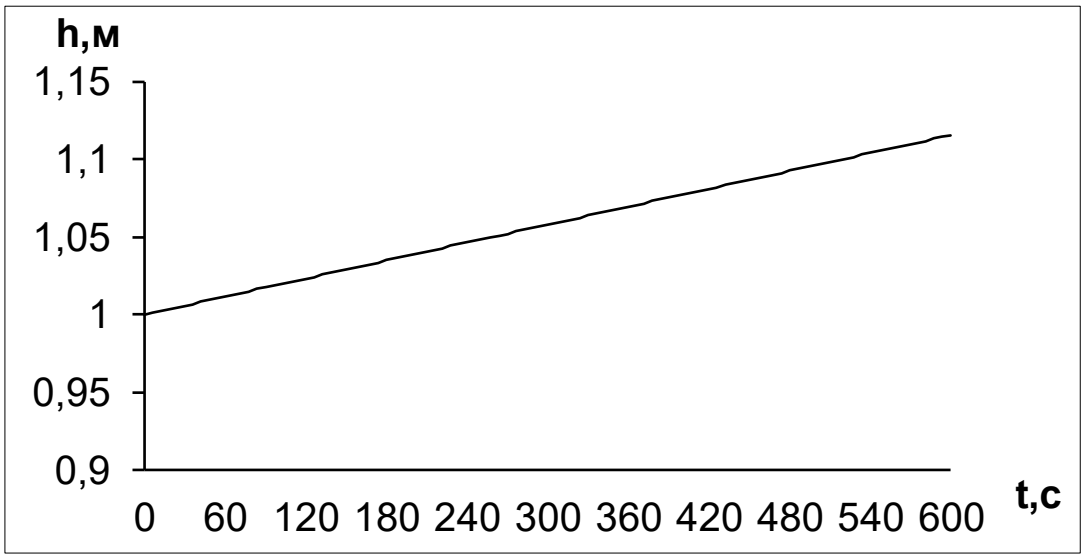
$$p_i^0 = p_0,\quad i = \overline{1, M_0 - 1}, \tag{2.41}$$

$$\frac{p_{M_0+j}^j - p_{M_0+j-1}^j}{f_{M_0+j}} = l \cdot \frac{f_{M_0+j}}{\tau},\quad j = \overline{1,N}, \tag{2.42}$$

Bu erda $p_i^j = p(z_i, t_j),\ i = \overline{1, M_0 + j - 1},\ j = \overline{1,N}$;

$$p_0 = p_2 + \frac{z_i \cdot (p_1 - p_2)}{z_0},\ i = \overline{0, M_0}.$$

(2.38) – (2.42) sonli echish uchun quyidagi parametrlarni qabul qilamiz: p_1=436 MPa; p_2=100 MPa; l=19,642·10^{10} Pa· s· m^{-2}; b=5,31·10^{-7} m^{-2}·s^{-1}; T=600 s, z_0=1 m. quyidagi rasmda filtrlash hosil bo'ladigan cho'kma qatlamining osjib borishi tasvirlangan.



ADABIYOTLAR

1. Нигматулин Р.И. Динамика многофазных сред. Т. II. М., Наука, 1987.- 389с.

2.Abdusaidov S.U ” ISSIQLIK O’TKAZUVCHANLIK TENGLAMALARINI SONLI YECHISH”. "Экономика и социум" №7(134) 2025 https://www.iupr.ru/_files/ugd/b06fdc_8ad11bc174984b479be03af4f254bbfe.pdf?index=true