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RAQAMLI JAMIYATDA FAN VA TA’LIMNING INTEGRATSIYALALASHUVI: MATEMATIKA, IQTISOD, PEDAGOGIKA VA PSIXOLOGIYANING YANGI YONDASHUVLARI

mavzusidagi Respublika ilmiy-texnik anjuman materiallari to‘plami

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Raqamli jamiyatda fan va ta’limning integratsiyalalashuvi: matematika, iqtisod, pedagogika va psixologiyaning yangi yondashuvlari. Respublika ilmiy-texnik anjuman materiallari to‘plami – Jizzax: O‘zMU Jizzax filiali Amaliy matematika kafedrasi, 2026-yil 20-21-aprel 505-bet.

Respublika miqyosidagi ilmiy-texnik anjuman materiallarida zamonaviy kompyuter ilmlari va muhandislik texnologiyalari sohasidagi innovatsion tadqiqotlar aks etgan.

Globallashuv sharoitida davlatimizni yanada barqaror va jadal sur’atlar bilan rivojlantirish bo‘yicha amalga oshirilayotgan islohotlar samarasini yaxshilash sohasidagi ilmiy-tadqiqot ishlariga alohida e’tibor qaratilgan. Zero iqtisodiyotning, ijtimoiy sohalarni qamrab olgan modernizatsiya jarayonlari, hayotning barcha sohalarini liberallashtirishni talab qilmoqda.

Ushbu ilmiy ma’ruza tezislari to‘plamida mamlakatimiz va xorijlik turli yo‘nalishlarda faoliyat olib borayotgan mutaxassislar, olimlar, professor-o‘qituvchilar, ilmiy tadqiqot institutlari va markazlarining ilmiy xodimlari, tadqiqotchilari, magistr va talabalarning ilmiy-tadqiqot ishlari natijalari mujassamlashgan.

Mazkur to‘plamga kiritilgan ma’ruza tezislarining mazmuni, undagi statistik ma’lumotlar va me’yoriy hujjatlarning to‘g‘riligi hamda tanqidiy fikr-mulohazalar, keltirilgan takliflarga mualliflarning o‘zlari mas’uldirlar.

tuproqning fizik-kimyoviy ko‘rsatkichlarida yuz beradigan o‘zgarishlar tuproq mikrob biomassasini o‘zgartirish salohiyatiga ega.

Mikroorganizmlar odatda biochar yuzasi va uning g‘ovaklarida joylashishga moyil bo‘ladi. Biocharning tuproqqa qo‘shilishi bir vaqtning o‘zida pH ko‘rsatkichini, hajmiy zichlikni hamda tuproq muhitining suv, oziqa moddalari va havoni o‘tkazish qobiliyatini oshiradi, bu esa mikroorganizmlar o‘sishini yanada qo‘llab-quvvatlaydi. Shuni ta’kidlash joizki, biocharning ishqoriy xususiyati tuproq pH qiymatini sezilarli darajada oshirishi mumkin, bu esa o‘z navbatida tuproq mikroorganizmlarining metabolik faolligi hamda umumiy hamjamiyat tuzilishiga ijobiy ta’sir ko‘rsatadi [5].

Xulosa

Biochar tuproq mikroorganizmlarining faolligi va sonini oshirish orqali tuproq unumdorligini yaxshilaydi. Uning g‘ovak tuzilishi va ishqoriy xossalari mikroorganizmlar uchun qulay muhit yaratadi, oziqa moddalari aylanishini jadallashtiradi. Shuningdek, biochar og‘ir metallarni adsorbsiya qilish, tuproq sifatini tiklash hamda uglerodni uzoq muddat saqlash orqali ekologik barqarorlikni ta’minlashda samarali vosita hisoblanadi

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IKKI O‘LCHOVLI BOG‘LIQ BO‘LMAGAN MASALANING TEKIS DEFORMATSIYA HOLIDA KO‘CHISHLARGA NISBATAN YECHILISHI

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Odatda, termoelastiklik nazariyasida temperatura ta’sirida jismlarda hosil bo‘ladigan ko‘chish va kuchlanishlarni aniqlash muhim ahamiyatga ega. Ushbu ishda ikki o‘lchovli bog‘liq bo‘lmagan termoelastiklik masalasi tekis deformatsiya holida ko‘chishlarga nisbatan qaraladi. Masalaning boshqaruvchi tenglamalari muvozanat tenglamalari va Guk qonuni asosida hosil qilinib, ular FreeFEM dasturida variatsion usul, C++ dasturida esa chekli ayirmalar usuli yordamida sonli yechiladi.

Tekis deformatsiya holi elastiklik nazariyasining muhim masalalaridan biri hisoblanadi. Bunday holatda jismning barcha nuqtalaridagi ko‘chishlar faqat x va y koordinatalariga bog‘liq bo‘ladi. Ikki o‘lchovli masalada ko‘chishlar quyidagicha aniqlanadi.

$$u = u(x,y), \quad \vartheta = \vartheta(x,y) \tag{1}$$

Bu yerda u va ϑ mos ravishda x,y yo‘nalishlardagi ko‘chish komponentalaridir. Kichik deformatsiyalar nazariyasiga asosan deformatsiya komponentalari quyidagicha bo‘ladi[5].

$$\varepsilon_{11} = \frac{\partial u}{\partial x}, \ \varepsilon_{22} = \frac{\partial \vartheta}{\partial y}, \ \varepsilon_{12} = \frac{1}{2}\left(\frac{\partial u}{\partial y} + \frac{\partial \vartheta}{\partial x}\right) \tag{2}$$

Hajmiy kuchlar mavjud bo‘lmagan holda muvozanat tenglamasi quyidagi ko‘rinishni oladi

$$\frac{\partial \sigma_{11}}{\partial x} + \frac{\partial \sigma_{12}}{\partial y} = 0, \ \frac{\partial \sigma_{21}}{\partial x} + \frac{\partial \sigma_{22}}{\partial y} = 0 \tag{3}$$

Tekis deformatsiya holida kuchlanish komponentalari (Guk qonuni) quyidagicha yoziladi.

$$\begin{aligned} &\sigma_{11} = \lambda(\varepsilon_{11} + \varepsilon_{22}) + 2\mu\varepsilon_{11} - (3\lambda + 2\mu)\alpha(T - T_0), \\ &\sigma_{22} = \lambda(\varepsilon_{11} + \varepsilon_{22}) + 2\mu\varepsilon_{22} - (3\lambda + 2\mu)\alpha(T - T_0), \ \sigma_{33} = \lambda(\varepsilon_{11} + \varepsilon_{22}) \end{aligned} \tag{4}$$

(4) tenglamalarni ko‘chish orqali ifodalab, (3) muvozanat tenglamalariga keltirib qo‘yamiz. Natijada quyidagi tenglamalar hosil bo‘ladi.[1-3].

$$(\lambda + 2\mu)\frac{\partial^2 u}{\partial x^2} + \mu\frac{\partial^2 u}{\partial y^2} + (\lambda + \mu)\frac{\partial^2 \vartheta}{\partial x \partial y} - (3\lambda + 2\mu)\alpha\frac{\partial T}{\partial x} = 0 \tag{5}$$

$$(\lambda + 2\mu)\frac{\partial^2 \vartheta}{\partial y^2} + \mu\frac{\partial^2 \vartheta}{\partial x^2} + (\lambda + \mu)\frac{\partial^2 u}{\partial x \partial y} - (3\lambda + 2\mu)\alpha\frac{\partial T}{\partial y} = 0 \tag{6}$$

(5) va (6) tenglamalar tekis deformatsiya holatidagi Guk qonunini ko‘chishlar orqali ifodasi hisoblanadi. Chegaraviy shartlari

$$u(x,t)\big|_{x=\Gamma_1} = \varsigma, \ u(x,t)\big|_{x=\Gamma_2} = \xi, \ (x,y) \in \Omega$$

Endi bu masalani FreeFEM dasturi orqali yechamiz. FreeFEM foydalanuvchiga matematik modelni o‘zining variatsion (zaif) shaklida yozish imkonini beradi. Bu esa murakkab tenglamalarni dasturga oson va aniq kiritishni ta’minlaydi.

Demak, yuqoridagi tenglamalarimizning funksionalini topib olamiz. FreeFEM dasturi Chekli elementlar usuli (FEM) ga asoslangani uchun u differensial tenglamaning o‘zini emas, balki funksionali (ya’ni variatsion formasi) bilan bog‘liq bo‘lgan integral ko‘rinishini tushunadi. Buning uchun (5) tenglamani $\phi(x,y)$ ga, (6) tenglamani $\varphi(x,y)$ ga ko‘paytiramiz va Ω soha bo‘yicha integrallaymiz. Bu yerda $\phi(x,y)$ va $\varphi(x,y)$ virtual ko‘chish funksiyalari. U holda (5) va (6) formulalarning umumiy integral ko‘rinishi quyidagicha bo‘ladi[4]

$$\int_\Omega \left[(\lambda + 2\mu)u_{xx}\phi + \mu u_{yy}\phi + (\lambda + \mu)\vartheta_{xy}\phi\right]d\Omega = \int_\Omega (3\lambda + 2\mu)\alpha T_x \phi d\Omega \tag{7}$$

$$\int_\Omega \left[(\lambda + 2\mu)\vartheta_{yy}\varphi + \mu\vartheta_{xx}\varphi + (\lambda + \mu)u_{xy}\varphi\right]d\Omega = \int_\Omega (3\lambda + 2\mu)\alpha T_y \varphi d\Omega \tag{8}$$

Berilgan ifodalarni hadma had integrallab chiqamiz. (7) tenglamani integrallasak

$$\int_\Omega (\lambda+2\mu)u_{xx}\phi d\Omega = -\int_\Omega (\lambda+2\mu)u_x\phi_x d\Omega + \int_{\partial\Omega}(\lambda+2\mu)u_x\phi n_x dS,$$
$$\int_\Omega \mu u_{yy}\phi d\Omega = -\int_\Omega \mu u_y\phi_y d\Omega + \int_{\partial\Omega}\mu u_y\phi n_y dS, \qquad (9)$$
$$\int_\Omega (\lambda+\mu)\vartheta_{xy}\phi d\Omega = -\int_\Omega (\lambda+\mu)\vartheta_y\phi_x d\Omega + \int_{\partial\Omega}(\lambda+\mu)\vartheta_y\phi n_x dS$$

Natijada

$$\int_\Omega\left[(\lambda+2\mu)u_x\phi_x + \mu u_y\phi_y + (\lambda+\mu)\vartheta_y\phi_x\right]d\Omega - \int_\Omega (3\lambda+2\mu)\alpha T_x\phi d\Omega =$$
$$= \int_{\partial\Omega}\left[(\lambda+2\mu)u_x n_x + \mu u_y n_y + (\lambda+\mu)\vartheta_y n_x\right]\phi dS \qquad (10)$$

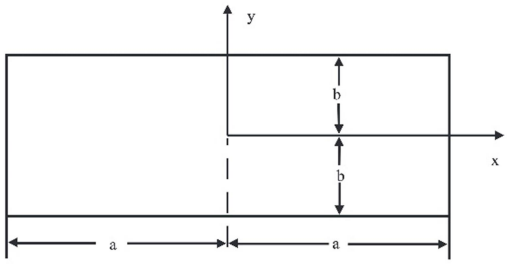
(8) tenglamani hadma-had integrallasak

$$\int_\Omega (\lambda+2\mu)\vartheta_{yy}\varphi d\Omega = -\int_\Omega (\lambda+2\mu)\vartheta_y\varphi_y d\Omega + \int_{\partial\Omega}(\lambda+2\mu)\vartheta_y\varphi n_y dS,$$
$$\int_\Omega \mu\vartheta_{xx}\varphi d\Omega = -\int_\Omega \mu\vartheta_x\varphi_x d\Omega + \int_{\partial\Omega}\mu\vartheta_x\varphi n_x dS, \qquad (11)$$
$$\int_\Omega (\lambda+\mu)u_{xy}\varphi d\Omega = -\int_\Omega (\lambda+\mu)u_x\varphi_y d\Omega + \int_{\partial\Omega}(\lambda+\mu)u_x\varphi n_y dS$$

Natijada quyidagicha ifoda hosil bo‘ladi

$$\int_\Omega\left[(\lambda+2\mu)\vartheta_y\varphi_y + \mu\vartheta_x\varphi_x + (\lambda+\mu)u_x\varphi_y\right]d\Omega - \int_\Omega (3\lambda+2\mu)\alpha T_y\varphi d\Omega =$$
$$= \int_{\partial\Omega}\left[(\lambda+2\mu)\vartheta_y n_y + \mu\vartheta_x n_x + (\lambda+\mu)u_x n_y\right]\varphi dS \qquad (12)$$

Variatsion formuladan hosil bo‘lgan tenglamalarni qo‘shib yozvolamiz.
Biz masalani quyidagi to‘g‘ri to‘rtburchakli plastnikada qaraymiz.



1-rasm

Bu yerda $\lambda = 1.5,\ \mu = 0.75,\ \alpha = 0.125,\ T_0 = 20,\ a = 0.5,\ b = 0.5.$

1.1 Jadval $u(x,y)$ qiymatlari (FreeFEM)

Y \ X	-0.5	-0.4	-0.3	-0.2	-0.1	0
-0.5	0	0	0	0	0	0
-0.4	0	-0.099	-0.127	-0.109	-0.061	0
-0.3	0	-0.142	-0.194	-0.173	-0.1	0
-0.2	0	-0.166	-0.232	-0.21	-0.122	0

-0.1	0	-0.179	-0.253	-0.23	-0.134	0
0	0	-0.184	-0.259	-0.236	-0.138	0

1.2 Jadval $\sigma_{11}(x,y)$ qiymatlari (FreeFEM)

X / Y	-0.5	-0.4	-0.3	-0.2	-0.1	0
-0.5	-2.155	-2.425	-2.893	-3.189	-3.322	-3.296
-0.4	-4.53	-4.293	-4.319	-4.425	-4.483	-4.45
-0.3	-5.756	-5.75	-5.756	-5.823	-5.861	-5.843
-0.2	-6.559	-6.776	-6.917	-7.027	-7.095	-7.103
-0.1	-7.023	-7.387	-7.693	-7.817	-7.929	-7.966
0	-7.155	-7.571	-7.894	-8.075	-8.215	-8.277

Endi tenglamani chekli ayirmalar usulida yechamiz. Buning uchun (5) va (6) tenglamalarni chekli ayirmalar bilan almashtirib olamiz.

$$\begin{cases} (\lambda+2\mu)\dfrac{u_{i+1,j}+2u_{i,j}+u_{i-1,j}}{h_1^2}+\mu\dfrac{u_{i,j+1}+2u_{i,j}+u_{i,j-1}}{h_2^2}+(\lambda+\mu)\dfrac{\vartheta_{i+1,j+1}-\vartheta_{i-1,j+1}-\vartheta_{i+1,j-1}+\vartheta_{i+1,j+1}}{4h_1h_2}=f_1 \\ (\lambda+2\mu)\dfrac{\vartheta_{i,j+1}+2\vartheta_{i,j}+\vartheta_{i,j-1}}{h_2^2}+\mu\dfrac{\vartheta_{i+1,j}+2\vartheta_{i,j}+\vartheta_{i-1,j}}{h_1^2}+(\lambda+\mu)\dfrac{u_{i+1,j+1}-u_{i-1,j+1}-u_{i+1,j-1}+u_{i+1,j+1}}{4h_1h_2}=f_2 \end{cases} \quad (13)$$

Bu yerda $f_1=(3\lambda+2\mu)\alpha\dfrac{\partial T}{\partial x}$, $f_2=(3\lambda+2\mu)\alpha\dfrac{\partial T}{\partial y}$

(13) tenglamalar sistemasini $u_{i,j}$ va $\vartheta_{i,j}$ ga nisbatan yechib olsak quyidagicha bo‘ladi.

$$\begin{cases} u_{i,j}=\dfrac{\left[(\lambda+2\mu)\dfrac{u_{i+1,j}+u_{i-1,j}}{h_1^2}+\mu\dfrac{u_{i,j+1}+u_{i,j-1}}{h_2^2}+(\lambda+\mu)\dfrac{\vartheta_{i+1,j+1}-\vartheta_{i-1,j+1}-\vartheta_{i+1,j-1}+\vartheta_{i+1,j+1}}{4h_1h_2}-f_1\right]}{\left(\dfrac{2(\lambda+2\mu)}{h_1^2}+\dfrac{2\mu}{h_2^2}\right)} \\ \vartheta_{i,j}=\left[\dfrac{(\lambda+2\mu)\dfrac{\vartheta_{i,j+1}+\vartheta_{i,j-1}}{h_2^2}+\mu\dfrac{\vartheta_{i+1,j}+\vartheta_{i-1,j}}{h_1^2}+(\lambda+\mu)\dfrac{u_{i+1,j+1}-u_{i-1,j+1}-u_{i+1,j-1}+u_{i+1,j+1}}{4h_1h_2}-f_2}{\left(\dfrac{2(\lambda+2\mu)}{h_2^2}+\dfrac{2\mu}{h_1^2}\right)}\right] \end{cases} \quad (14)$$

1.3 Jadval $u(x,y)$ qiymatlari (C++)

X / Y	-0.5	-0.4	-0.3	-0.2	-0.1	0
-0.5	0	0	0	0	0	0
-0.4	0	-0.0972	-0.1253	-0.1079	-0.0613	0
-0.3	0	-0.1414	-0.1937	-0.1723	-0.0994	0
-0.2	0	-0.1670	-0.2337	-0.2109	-0.1226	0
-0.1	0	-0.1815	-0.2557	-0.2321	-0.1354	0
0	0	-0.1863	-0.2628	-0.2389	-0.1395	0

1.4 Jadval $\sigma_{11}(x,y)$ qiymatlari (C++)

x / y	-0.5	-0.4	-0.3	-0.2	-0.1	0
-0.5	7.5000	-0.7293	-1.0602	-1.2528	-1.3614	-1.397
-0.4	4.5415	-4.2509	-4.3375	-4.5430	-4.7075	-4.768
-0.3	2.3797	-5.7104	-5.8784	-6.0466	-6.1799	-6.230
-0.2	0.4945	-6.7756	-7.0832	-7.3183	-7.4757	-7.5317
-0.1	-1.2228	-7.4346	-7.8511	-8.1551	-8.3464	-8.4123
0	-2.7943	-7.6585	-8.1150	-8.4461	-8.6517	-8.7220

Mazkur ishda tekis deformatsiya holidagi ikki o‘lchovli bog‘liq bo‘lmagan termoelastiklik masalasi ko‘chishlarga nisbatan sonli yechildi. FreeFEM va C++ yordamida olingan natijalar o‘zaro yaqin bo‘lib, tanlangan matematik model va hisoblash algoritmlarining to‘g‘riligini tasdiqlaydi. Olingan yondashuv termoelastiklik masalalarini sonli yechishda samarali bo‘lib, keyingi tadqiqotlarda yanada murakkab masalalarni o‘rganishda qo‘llanishi mumkin.

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SIPERMETRIN PESTITSIDINING BIOREMEDIATSIYASIDA MIKRORGANIZMLARNING AHAMIYATI

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Annotatsiya. Ushbu tezisda sipermetrinning ekologik xususiyatlari, *Pseudomonas sp., Catellibacterium sp., Bacillus sp* kabi bir qancha mikroorganizmlar tomonidan biodegradatsiya jarayonlari hamda zamonaviy biotexnologik yondashuvlar 10 ga yaqin adabiyotlar tahlili asosida ko‘rib chiqilgan.

Kalit so‘zlar. sipermetrin, bioremediatsiya, biodegradatsiya, bioakkumulyatsiya, pestitsidlar, piretroidlar

Qishloq xo‘jaligi maydonlarida sun’iy piretroidlar zararkunandalarni yo‘q qilish va ekin hosildorligini oshirish uchun keng qo‘llaniladi. Bu insektitsidlar uylarda chivinlar, tarakanlar, termitlar, burgalar va boshqa zararkunandalarni nazorat qilish uchun shuningdek paxta va boshqa dala ekinlari zararkunandalariga qarshi ham keng qo‘llaniladi. Biomagnifikatsiya orqali keng