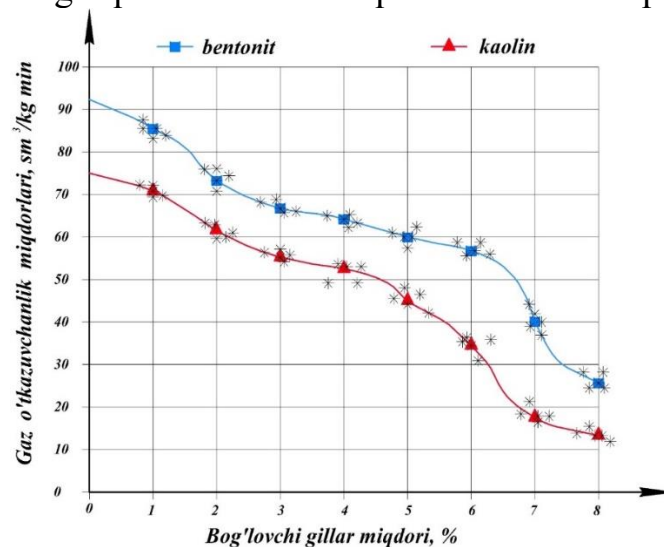


## QUM – GILLI QOLIP ARALASHMASINING GAZ O‘TKAZUVCHANLIK QOBILIYATIGA BOG‘LOVCHI GILLAR TA‘SIRINI MATEMATIK MODELLASHTIRISH

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**Gaz o‘tkazuvchanlik qobiliyati sinov tahlillari.** Qolip aralashmasida mavjud havo, quyish paytida hosil bo‘ladigan gazlar qolipga suyuq metallni quyish davrida osonlik bilan chiqib ketishi kerak. Aks holda ular quyib olinayotgan quyma mahsulotning mexanik xossalarini pasaytiradi. Shu bilan birga, quymakorlik xossalarini ham, ya’ni suyuq metallning oquvchanligini ham pasayishiga olib keladi.

Qum – gilli qolip aralashmasining gaz o‘tkazuvchanlik qobiliyatining qiymatlari 1-rasmda ko‘rsatilgan. Yuqori gaz o‘tkazuvchanlik bentonit gili bilan bog‘langan qolip aralashmasida aniqlandi, ya’ni 4, 5, 6, 7 va 8 % bog‘lovchi gil qo‘shimchalar uchun 64, 60, 57, 40 va 27  $\text{sm}^3/\text{kg min}$ . Xuddi shu 4, 5, 6, 7 va 8 % kaolin gili bog‘lovchisi qo‘llanilgan qolip aralashmasida gaz o‘tkazuvchanlik miqdorlari 53, 45, 34, 28 va 13  $\text{sm}^3/\text{kg min}$  ekanligi aniqlandi. Yana bir muhim jihat shundaki qum – gilli qolip aralashmasining gaz o‘tkazuvchanlik qobiliyati tarkibdagi bog‘lovchi gil qo‘shimchalar miqdori ortishi bilan pasayadi.



1 – rasm. Kaolin hamda bentonit bog‘lovchi gillarining turli miqdorlarida qum-gilli qolip aralashmasining gaz o‘tkazuvchanlik miqdorlari.

O‘tkazilgan tadqiqot natijalari asosida bentonit bog‘lovchi gillarida kaolin bog‘lovchi gillariga nisbatan qolip aralashmasining siqilishdagi biriktiruvchi kuch kam ekanligi, biroq gaz o‘tkazuvchanlik qobiliyati esa yuqori ekanligi aniqlandi. Biz quyib olayotgan val detallari qoliplarida yuqori aniqlikdagi geometrik o‘lchamlar yoki yupqa devorli qismlar bo‘lmagani sababli bentonit bog‘lovchi gillardan foydalanilgan qolip aralashmasining siqilishdagi biriktiruvchi kuchi yetarli, tahlil qilingan nuqsonlarda gazli g‘ovakliklar kuzatilganligi sababli biz



uchun kerak bo'lgan qolip aralashmasining gaz o'tkazuvchanlik qobiliyati yuqori bo'lishi zarur.

Tajribalar ikki turdagi bog'lovchi gillardan foydalangan holda o'tkazilganligi sababli har bir bog'lovchi gil uchun qolip aralashmasining gaz o'tkazuvchanlik miqdorlarining matematik ifodasini tuzamiz.

Dastlab, qum-gilli qolip aralashmasi tarkibidagi kaolin gilining turli miqdorlarida qolip aralashmasining gaz o'tkazuvchanlik qobiliyatiga bog'liqligining matematik modelini tuzamiz. Buning uchun kaolin bog'lovchi gilli miqdorini erkli o'zgaruvchi sifatida qabul qilsak, qum-gilli qolip aralashmasining gaz o'tkazuvchanligini aks ettiruvchi funksiyani hosil qilish masalasini ko'rib chiqamiz. Bu holda, Lagranjning interpolatsion ko'phadini tuzib chiqamiz, ya'ni masala algebraik tenglamalar sistemasiga keltirilib, noma'lum koeffitsiyentlarni aniqlash bilan gaz o'tkazuvchanlik funksiyasini ko'phad shaklida ifodalash mumkin bo'ladi.

$y$  – gaz o'tkazuvchanlik miqdori,  $\text{sm}^3/\text{kg min}$ ;

$x$  – kaolin bog'lovchi gil miqdori, % hisobida;

$$y = f(x); \quad (4.1)$$

$$\begin{cases} 4^5 x_1 + 4^4 x_2 + \dots + 4x = 53 \\ 5^5 x_1 + 5^4 x_2 + \dots + 5x = 45 \\ 6^5 x_1 + 6^4 x_2 + \dots + 6x = 34; \\ 7^5 x_1 + 7^4 x_2 + \dots + 7x = 28 \\ 8^5 x_1 + 8^4 x_2 + \dots + 8x = 13 \end{cases} \quad (4.2)$$

$$x_1 = -0.03$$

$$x_3 = -1.64$$

$$x_5 = 49.83$$

$$x_2 = 0.48$$

$$x_4 = -8.3$$

(4.2) tenglamalar sistemasini matritsa shakliga keltirib olamiz va uni murakkab chiziqli tenglamalar sistemasini yechishning Kramer usulidan foydalangan holda noma'lumlarni topamiz. Dastlab tenglamalar sistemasi yordamida tuzilgan matritsaning determinanti  $\Delta$  topiladi.

$$\Delta = \begin{vmatrix} 1024 & 256 & 64 & 16 & 4 \\ 15625 & 3125 & 625 & 25 & 5 \\ 7776 & 1296 & 216 & 36 & 6 \\ 16807 & 2401 & 343 & 49 & 7 \\ 32768 & 4096 & 512 & 64 & 8 \end{vmatrix} = -4191344640 \quad (4.3)$$

yuqoridagi matritsalarini yechib, noma'lumlarning quyidagi qiymatlarini topamiz,

$$x_1 = \frac{\Delta_1}{\Delta} = \frac{125412000}{-4191344640} = -\frac{37325}{1247424};$$

$$x_2 = \frac{\Delta_2}{\Delta} = \frac{-2021974080}{-4191344640} = \frac{300889}{623712};$$

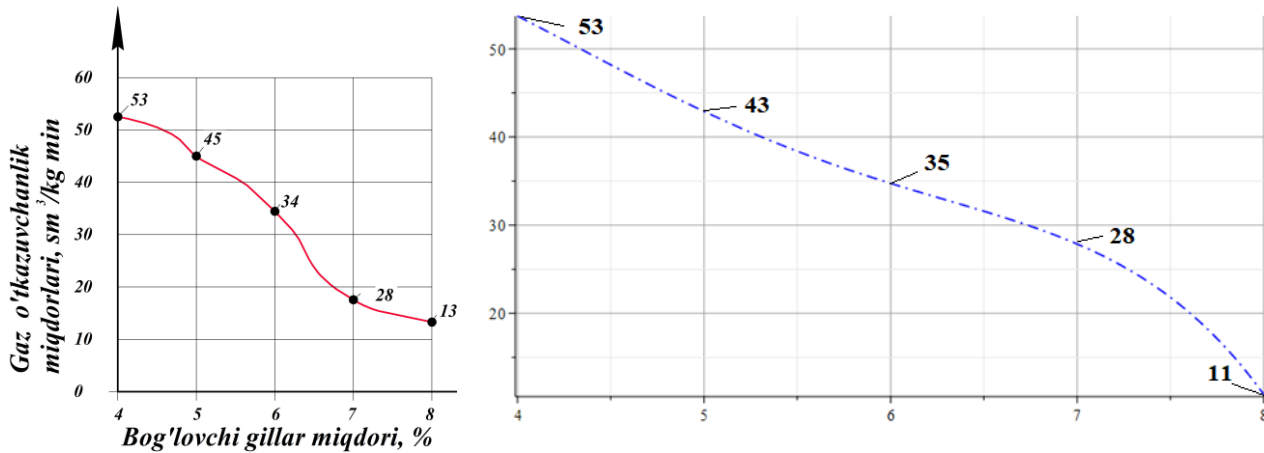
$$x_3 = \frac{\Delta_3}{\Delta} = \frac{6949350240}{-4191344640} = -\frac{2068259}{1247424};$$

$$x_4 = \frac{\Delta_4}{\Delta} = \frac{34854469440}{-4191344640} = -\frac{5186677}{673712};$$

$$x_5 = \frac{\Delta_5}{\Delta} = \frac{-208841928960}{-4191344640} = \frac{7769417}{155928};$$

Yuqoridagi tenglamalar sistemani yechib, noma'lumlar aniqlangandan so'ng, qum-gilli qolip aralashmasi tarkibining kaolin bog'lovchi gilining miqdorlariga bog'liq holda gaz o'tkazuvchanligini ifodalovchi funksiya quyidagicha bo'ladi:

$$y = -0.03x^5 + 0.48x^4 - 1.64x^3 - 8.3x^2 + 49.83x; \quad (4.4)$$



**2-rasm. Tadqiqot natijalari asosida olingan matematik modelning haqiqiy natijalarga mosligi.**

Keyingi navbatda, qum-gilli qolip aralashmasi tarkibidagi bentonit bog'lovchi gilining turli miqdorlarida qolip aralashmasining gaz o'tkazuvchanligiga bog'liqligining matematik modelini tuzamiz. Buning uchun bentonit bog'lovchi gili miqdorini erkli o'zgaruvchi sifatida qabul qilsak, qum-gilli qolip aralashmasining gaz o'tkazuvchanligini aks ettiruvchi funksiyani hosil qilish masalasini ko'rib chiqamiz. Bu holda, Lagranjning interpolatsion ko'phadini tuzib chiqamiz, ya'ni masala algebraik tenglamalar sistemasiga keltirilib, noma'lum koeffitsiyentlarni aniqlash bilan gaz o'tkazuvchanlik funksiyasini ko'phad shaklida ifodalash mumkin bo'ladi.

$y$  – gaz o'tkazuvchanlik miqdori, sm<sup>3</sup>/kg min;

$x$  – bentonit bog'lovchi gil miqdori, % hisobida;

$$y = f(x); \quad (4.5)$$

$$\begin{cases} 4^5 x_1 + 4^4 x_2 + \dots + 4x = 64 \\ 5^5 x_1 + 5^4 x_2 + \dots + 5x = 60 \\ 6^5 x_1 + 6^4 x_2 + \dots + 6x = 57; \\ 7^5 x_1 + 7^4 x_2 + \dots + 7x = 40 \\ 8^5 x_1 + 8^4 x_2 + \dots + 8x = 27 \end{cases} \quad (4.6)$$

$$x_1 = 0.022$$

$$x_3 = 1.04$$

$$x_5 = 17.25$$

$$x_2 = -0.32$$

$$x_4 = -0.9$$

(4.6) tenglamalar sistemasini matritsa shakliga keltirib olamiz va uni murakkab chiziqli tenglamalar sistemasini yechishning Kramer usulidan foydalangan holda noma'lumlarni topamiz. Dastlab tenglamalar sistemasini yordamida tuzilgan matritsaning determinanti  $\Delta$  topiladi.

$$\Delta = \begin{vmatrix} 1024 & 256 & 64 & 16 & 4 \\ 15625 & 3125 & 625 & 25 & 5 \\ 7776 & 1296 & 216 & 36 & 6 \\ 16807 & 2401 & 343 & 49 & 7 \\ 32768 & 4096 & 512 & 64 & 8 \end{vmatrix} = -4191344640 \quad (4.7)$$

yuroridagi matritsalarini yechib, noma'lumlarning quyidagi qiymatlarini topamiz,

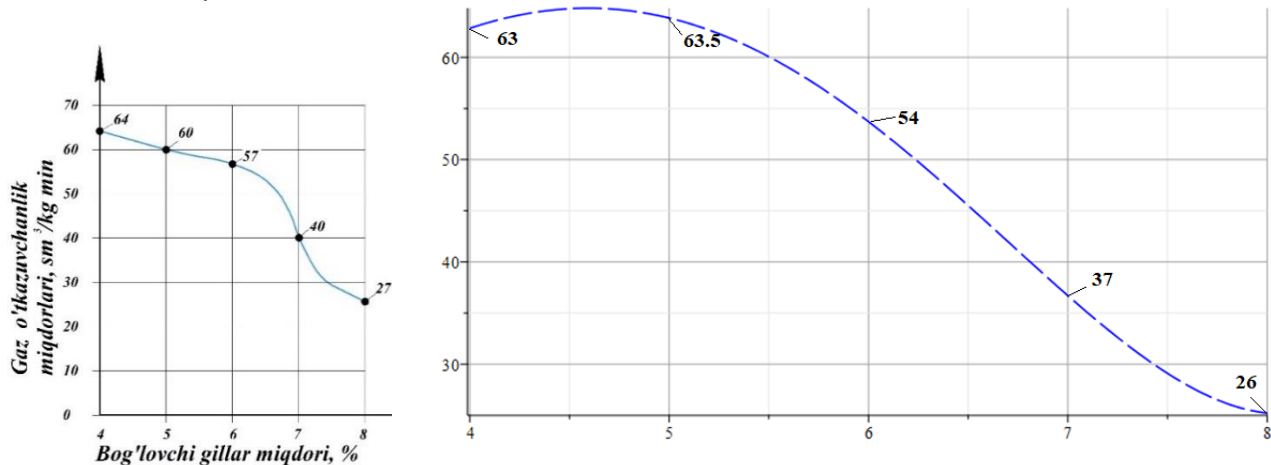
$$x_1 = \frac{\Delta_1}{\Delta} = \frac{-92579040}{-4191344640} = \frac{64291}{2910656}; \quad x_2 = \frac{\Delta_2}{\Delta} = \frac{1369552320}{-4191344640} = -\frac{475539}{1455328};$$

$$x_3 = \frac{\Delta_3}{\Delta} = \frac{-4481022240}{-4191344640} = \frac{3111821}{2910656}; \quad x_4 = \frac{\Delta_4}{\Delta} = \frac{2487216960}{-4191344640} = -\frac{863617}{1455328};$$

$$x_5 = \frac{\Delta_5}{\Delta} = \frac{-69265140480}{-4191344640} = \frac{6012599}{363832};$$

Yuqoridagi tenglamalar sistemani yechib, noma'lumlar aniqlangandan so'ng, qum-gilli qolip aralashmasi tarkibining bentonit bog'lovchi gilining miqdorlariga bog'liq holda gaz o'tkazuvchanligini ifodalovchi funksiya quyidagicha bo'ladi:

$$y = 0.022x^5 - 0.32x^4 + 1.04x^3 - 0.9x^2 + 17.52x; \quad (4.8)$$



3-rasm. Tadqiqot natijalari asosida olingan matematik modelning haqiqiy natijalarga mosligi.

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