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Articles are published in Uzbek, Russian, and English, ensuring a wide-reaching audience and fostering cross-cultural academic exchange. As a beacon of academic excellence, the "Journal of Transport" continues to serve as a vital conduit for knowledge dissemination, collaboration, and innovation in the transport sector and related fields.

A novel technological solution for protecting railways from sand drifts

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Abstract: This article presents a study on a novel technological solution for railway protection from sand drifts. The research focuses on identifying the optimal working composition and application rate of a binding solution to stabilize mobile sands with a 20% moisture content. The investigation details the process of achieving a stable state by fixing the sands with a locally produced polyacrylamide solution.

Keywords: Polyacrylamide solution, mobile sands, sand drifts, protective layer

Temir yo'llarni qum bosishlaridan himoya qilishda yangi texnologik yechim

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Annotatsiya: Maqolada bog'lovchi eritmaning maqbul ishchi tarkibi va maqbul tarkibining sarflanish chegarasi aniqlanib yo'llarni qumli bosishlaridan himoya qilishning yangi texnologik echimi, ya'ni harakatlanuvchi 20% li nam holatdagi qumlarni mahalliy poliakrilamid eritmasi bilan mahkamlab turg'un holatga keltirish bo'yicha tadqiqotlar taqdim etilgan.

Kalit so'zlar: Poliakrilamid eritmasi, harakatlanuvchi qumlar, qumli bosishlar, himoya qatlami

1. Kirish

Qumli cho'llarning o'ziga xos sharoitida muhandislik inshootlarini qurish va ulardan foydalanish qumning shamol ta'sirida yer yuzasidan tepaga ko'tarilishi va ko'chirilishi tufayli murakkablashadi. Shamol faolligi natijasida shamol-qum oqimi hosil bo'ladi. Uning salbiy ta'siri shundan iboratki, ma'lum sharoitlarda shamol-qum oqimining tezligi ma'lum chegaradan pastga tushganda, shamol olib kelgan qum oqimidan tushib, temir yo'lni bosib qoladi (1-rasm) yoki qumdan yasalgan inshootni (yer polotnosini) bir qismini shamol uchirib ketadi. Qum bosishi natijasida yo'lning holatida normadan yuqori o'zgarishlar va uning texnik-iqtisodiy ko'rsatkichlarining yomonlashishi kuzatiladi. Bu balast prizmasining dinamik xususiyatlarining o'zgarishi, relslar va strelkali o'tkazgichlarning tezlashtirilgan emirilishi, yer polotnosi qumlari uchirib ketishiga va natijada harakatlanuvchi tarkibning yo'l izidan chiqib ketishi bilan ifodalanadi.



1-rasm. Uchquduq – Buzaubay peregonidagi temir yo'lning qum tez-tez bosib turadigan uchastkalari PK 273 + 50 ÷ PK 273 + 90

Qumlarning ko'chish jarayoni alohida xavf tug'diradi. Bunda nafaqat yakka ob'ektlarni qum bosishi, balki yo'llar tarmog'i, Gidromeliorativ tizim ob'ektlari, sug'oriladigan dalalarni qum bosishini bartaraf qilishga ketadigan doimiy sarf-xarajatlar xo'jalik faoliyatiga zarar yetkazadi [1].

Muhandislik ob'ektlarini qurish va ulardan foydalanish normal sharoitlarini ta'minlash uchun qum bosishlardan muhofaza qilish deb nomlangan maxsus ishlar olib boriladi [1-3]. Har yili yo'l masofalari tomonidan temir yo'llarning qum bosgan uchastkalarini tozalash ishlari bajarilib, ularning hajmi o'rtacha olganda yiliga 200 km yo'l uzunligiga to'g'ri keladi [4, 5].

Harakatlanuvchi qumlarni mustahkamlash uslublari ichida fizik-kimyoviy uslub va barcha unga oid, bog'lovchi vositalardan foydalanishni ko'zda tutgan usullar ekologik jihatdan eng toza uslub bo'lgan biologik uslubga yordamchi texnologik yechim sifatida qo'llab, uning samaradorligini oshirish maqsadida taqdim etilgan.

Ammo, hozirgi davrda qumlarni mahkamlashning ko'p sonli fizik-kimyoviy usullari mavjud. Ular faqat yilning quruq faslida qo'llaniladi, bu esa usuldan foydalanish doirasini cheklab qo'yadi, ishchi va material-texnik resurslardan nooqilona foydalanishga olib keladi.

2. Tadqiqot metodologiyasi

Poliakrilamid, ya'ni poliakrolamidli yelim KPI-001 (umumiy formulasi $(-CH_2CHCONH_2-)$) ekologik jihatdan xavfsiz quyuq maxsulot bo'lib, suvda eritish yo'li bilan foydalanish mumkin va uning qum zarralarini biriktirib bog'lash xususiyatini namoyon bo'lishi uning eritmadagi miqdoriga bog'liq [6].

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Poliakrilamid yirik miqdorda ishlab chiqaruvchi korxonalar AQSh, Evropa, Yaponiya, Xitoy, Rossiya federasiyasida yuqori kulamda ishlab chiqariladi.

O'zbekistonda Tsh23592457-01:2015. Poliakilamid standarti talablari bo'yicha xususiy korxonalarda mahalliy materiallardan maxsus texnologiya asosida ishlab chiqarilishi yo'lga qo'yilgan.

Tadqiq etishning o'zaro bir-biriga bog'liq nazariy va evristik uslublari majmui qo'llanilgan: tahlil va sintez, eritmani qumga similish chuqurligi hamda fizik mexanik ko'rsatqichlarini o'lchash, analogiya va fizik modellashirish, tadqiqot natijalariga ishlov berishda aniqlashtirish (konkretlashtirish), axborot texnologiyalari (Macrosoft Exel) muxitida Trend dasturi, induksiya va deduktsiya, formallashtirish, va aksiomatik uslublar qo'llanilgan.

Undan tashqari tadqiqotlarda kimyoviy meliorantlar - bog'lovchi materiallardan foydalanish imkoniyatlarini aniqlash uchun tezkor uslubdan foydalangan, bu esa tadqiqot vaqtini sezilarli darajada qisqartirishga va qimmat tajribalarni qo'llamaslikga imkon berdi.

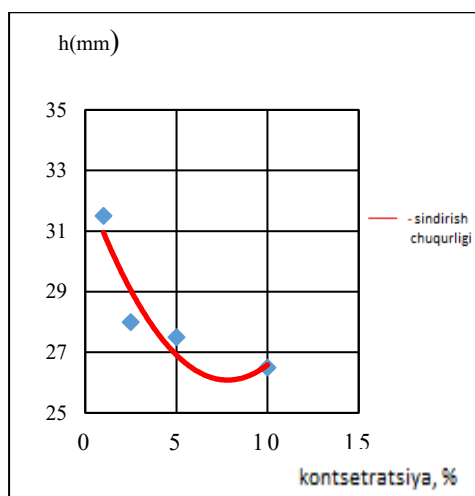
Tezkor uslub talablari bo'yicha bog'lovchi yordamida hosil qilingan himoya qatqalog'i eng maqbul strukturasi $P_m \geq (2,5 \div 2,7) \times 10^3 Pa$, singish chuqurligi $h \geq 5 mm$ shartiga mos bo'lishi kerak. Qiyligi nishabligi ortishi hamda yaxlit qatlam hosil qilinishi bilan plastik mustahkamlikning eng kichik qiymati $5 \times 10^3 Pa$ bo'lishi mumkin. Himoya qatqalog'i bir vaqtning o'zida ikki shart, ya'ni ham plastik mustahkamlikka, ham qatqaloq qalinligiga qo'yiladigan zaruriy va yetarli darajadagi shartlar bajarilsa, chidamli bo'ladi. Tadqiqotlar natijasida ushbu ikki shartning bir vaqtda bajarilishi muhim o'rin egallaydi [1, 5, 7].

Umuman olganda, texnologik yechimni amalda texnologik qo'llanilishini asoslash uchun quyidagi masalalarni yechish zarur:

- bog'lovchining nam qumlarga shimilishini o'rganish;
- himoya qobig'ini ekspluatatsiya turg'unligi shartlariga mosligini tekshirish.

3. Natija va muhokamalar

Quruq qumlarga singdiriladigan poliakrilamidning ishchi tarkibi turli xil to'yinganlik (quyuq-suyuqlik)larda (1%; 2,5%; 5%; va 10%) [3] da tekshirilgan (2-rasm).

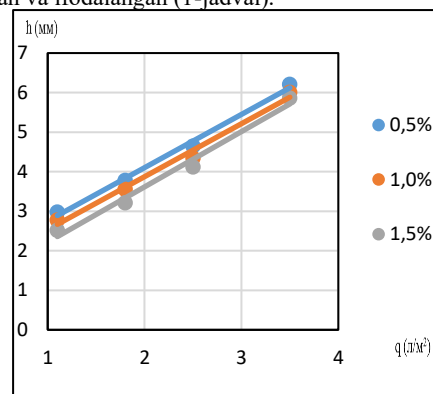


2-rasm. Poliakrilamidli bog'lovchi qum yuzasiga shimilish qalinligining ishchi tarkibiga bog'liqligi

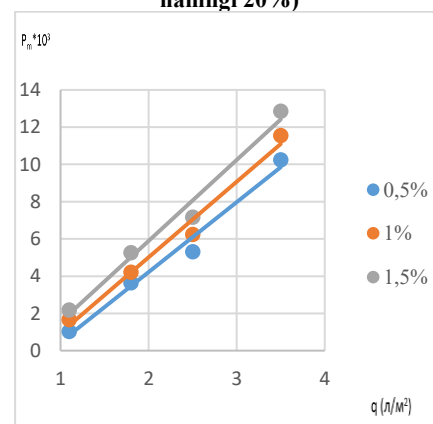
Hozirgi kunda resurslardan tejamkor va samarali foydalanish yo'llari qidirilmoqda. Shuning uchun yangi uslubda nam holatdagi yoki oldin namlab sung aralashmani qo'mga singdirish natijasida ancha tejamkor va samarali natijalarni kulga kiritish mumkin.

Eksperimentlar nam holatdagi qumlarda o'tkazildi. Singdirish natijasida olingan himoya qatlami namunalari shamolli-qumli oqim ta'siriga chidamlilikning yig'ma mezonlariga mosligi kamida besh marotaba o'lchab, o'rta qiymati aniqlandi.

Olingan eksperimentlar natijalari Microsoft Exel dasturida chiziqli grafik ko'rinishda sharhlanishi (interpretasiya) orqali plastik mustahkamlik va himoya qatlami qalinligini aralashmaning solishtirma sarfiga bog'liqligi (3-, 4-rasm) yuqori darajali aniqlik bilan topilgan va ifodalangan (1-jadval).



3-rasm. Poliakrilamid elimining ishchi tarkibini nam qumlarga singirishda himoya qatlamining qalinligi bog'lovchi tarkibning sarflanishiga bog'liqligi (qumni namligi 20%)



4-rasm. Himoya qatlamining plastik mustahkamligini bog'lovchi moddaning ishchi tarkibi va yuza birligiga bo'lgan sarfiga bog'liqligi (qumni namligi 20%)

Muhokama. Fizik-kimyoviy uslubi bilan turg'un holatga keltirishda qumlarni dastlab nam xolatga keltirib, keyin mahalliy ishlab chiqarishning yo'lovchi moddalarini bog'lovchi sifatida sepib-shimdirish va bunda g'ovaklar namlanish oqibatida ma'lum darajada egallanganligi uchun shimilish jarayoni sekinlanishi va g'ovaklarni bog'lovchi modda bilan bir tekisda to'ldirilishi hamda bog'lovchi moddaning ish tarkibida va yuza birligiga sarfi kamaishini taxmin qilish mumkin. Bunday texnologik echim resurslarni tejatishiga olib keladi.



1-jadval

Himoya qatlamining qalinligi va plastik mustahkamligini poliakrilamid eritmasining ishchi tarkib miqdoriga bog'liqligi (qumni namligi 20%)

Poliakrilamid eritmasining ishchi tarkib miqdori, %	Himoya qatlam qalinligining ifodasi	Himoya qatlam plastik mustahkamligining ifodasi
0,5	$h = 1,35q + 2,35$ $R^2 = 0,963$	$P = 3,76q - 3,29$ $R^2 = 0,94$
1,0	$h = 1,34q + 2,33$ $R^2 = 0,949$	$P = 4,06q - 3,10$ $R^2 = 0,97$
1,5	$h = 1,31q + 2,30$ $R^2 = 0,921$	$P = 4,35q - 2,80$ $R^2 = 0,96$

Tajribalardan ko'rinib turibdiki olingan natijalar taxlili asnosida iqtisodiy tejamkor va shu bilan birgalikda yuqoridagi qonuniyatlarga mos keladigan himoya qatlamini olish uchun aralashma tarkibidagi poliakrilamid miqdorini kamaytirishga erishildi. Ammo iqtisodiy ko'rsatkichlar bo'yicha bu bilan cheklanib qolinmaydi. Yangi usulda ko'chki qumlarga ishlov berilgan xolda bundanda samarali natijalarni olish mumkinligi tajribalarda yaqqol nomoyyon bo'ldi.

Himoya qatlamining texnologik parametrlarini aniqlash uchun (2-jadval) bog'lovchini singdirish jarayoni o'rganiladi.

2-jadval

Himoya qatlamining qurilish–texnologik tavsiflari

Eritma tarkibi, %	h (mm), P_m (Па $\times 10^3$), q (l/m ²)		
Poliakrilamid – 1,5 suv – qolgani.	h	P_m	q
	5-6	5,0-8,0	2,1 ÷ 2,5

4. Xulosa

Maxalliy mahsulot - poliakrilamid suv eritmasini 20 % li nam holatdagi qumlar yuzasiga sepilganda uning shimilishi va himoya qobig'i hosil bo'lishi taminlanadi va shu bilan ko'chuvchi qum turg'un xolatga keltiruvchi yangi texnologik echim taklif etildi.

Poliakrilamidli bog'lovchining maqbul ishchi tarkibi: poliakrilamid – 0,5-1,5 %; suv – qolgani.

Chidamlilik talablariga javob beruvchi himoya qatlamini olishda maqbul tarkibining sarflanish chegarasi $q = 2,1 - 2,5$ l/m².

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