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RESEARCH, INNOVATION, RESULTS



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TRANSPORT UNIVERSITETI**

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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.

The role of special road vehicles in the spreading of anti-icing technological materials (salt-sand mixture)

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Abstract:

This scientific article analyzes the functional and technological capabilities of special road maintenance vehicles that play a crucial role in eliminating ice formation and slipperiness on road surfaces during the winter season. The targeted and optimal application of anti-icing materials—particularly the sand-salt mixture—onto road surfaces is essential not only for ensuring the safe movement of vehicles but also for preventing road traffic accidents. The article examines how the efficiency of this technological process can be enhanced through the technical characteristics of modern specialized vehicles, material spreading mechanisms, automated control systems, and precise dosing methods. In particular, the integration of GPS-based real-time control systems allows the vehicles to distribute the required amount of material accurately across various road sections, thereby optimizing resource consumption while supporting economic and environmental sustainability. Additionally, the paper reviews practical experiences from different regions, including recommendations on the appropriate ratio and spreading density of sand-salt mixtures based on temperature and humidity conditions. Based on the research findings, proposals are developed to improve winter road maintenance services by enhancing the role of specialized equipment, modernizing technological systems, and implementing real-time monitoring solutions. This article offers scientifically grounded and practical recommendations aimed at improving safety and operational efficiency in the road maintenance sector during winter conditions.

Keywords:

vehicle, snow and ice, slippery, road, steep, hill, salt-sand (mixture), unit, node, braking system, spreading and movement mode, liquid, traffic safety

Muzlashga qarshi texnologik materiallar (tuz-qum aralashmasi) bilan yo‘llarni qoplashda maxsus transport vositalarining ahamiyati

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Annotatsiya:

Ushbu ilmiy maqolada qishki mavsumda yo‘l qatnov qismlarida yuzaga keladigan muzlamalar va sirpanchilikni bartaraf etishda muhim rol o‘ynovchi maxsus yo‘l mashinalarining funksional va texnologik imkoniyatlari tahlil qilinadi. Muzlamaga qarshi materiallar, xususan, tuz-qum aralashmasining yo‘l qoplamasiga maqsadli va me‘yoriy darajada sepilishi – nafaqat transport vositalarining xavfsiz harakatlanishini ta‘minlash, balki yo‘l-transport hodisalarining oldini olishda ham katta ahamiyat kasb etadi. Maqolada ushbu texnologik jarayonning samaradorligini oshirishda zamonaviy maxsus yo‘l mashinalarining texnik xususiyatlari, material sepish mexanizmlari, avtomatlashtirilgan boshqaruv tizimlari va dozalashtirish usullari muhim omil sifatida ko‘rib chiqiladi. Jumladan, GPS tizimlari asosida real vaqt rejimida boshqariluvchi mashinalar yordamida yo‘lning har bir qismiga zarur miqdorda texnologik materiallar sepilishi, bu esa material sarfini optimallashtirib, iqtisodiy va ekologik barqarorlikni ta‘minlash imkonini beradi. Shuningdek, maqolada turli hududlardagi amaliy tajribalar, harorat va namlik sharoitlariga qarab tuz-qum aralashmasining nisbati va sepilish zichligi haqidagi tavsiyalar ham tahlil qilinadi. Tadqiqot natijalari asosida qish mavsumida yo‘l xizmatlarini tashkil etishda maxsus texnika vositalarining rolini kuchaytirish, ularni modernizatsiya qilish va monitoring tizimlarini joriy etish bo‘yicha takliflar ishlab chiqilgan. Ushbu maqola yo‘l xo‘jaligi tizimida xavfsizlik va samaradorlikni oshirishga qaratilgan ilmiy-amaliy yechimlarni o‘z ichiga oladi.

Kalit so‘zlar:

avtomobil, qor-muz, sirpanchiq, yo‘l, tik, tepa, tuz-qum, agregat, uzal, tormoz tizimi, sepish va harakat rejimi, suyuqlik, harakat xavfsizligi

1. Kirish

O‘zbekiston Respublikasi Prezidentining 2017 yil 14-fevraldagi “Yo‘l xo‘jaligini boshqarish tizimini yanada

takomillashtirish chora-tadbirlari to‘g‘risida” gi farmoyishda yo‘l xo‘jaligi tizimini boshqarishning samaradorligini oshirish, boshqaruv organlarini optimallashtirish, shuningdek, yo‘l xo‘jaligiga oid qonun hujjatlarini takomillashtirish vazifalari qo‘yilgan[1].

^a <https://orcid.org/0009-0001-6098-5775>



Avtomobil yo'llarida harakatlanish vaqtida haydovchi avtomobilni boshqarishda qatnov qismidagi muzlama katta qiyinchilik va yo'llarda harakat rejiminingg o'zina buzilishi og'ir oqibatlarni olib kelishini doimo yodda tutishi kerak. Avtomobil yo'llarining joylashish relefiga qarab haydovchi avtomobilni xavfsiz boshqarishda alohida boshqarish rejimini talab qiladi. Ayniqsa, tog'li hududlardagi avtomobil yo'llar uzunlamasiga cho'zilgan baland va pastliklar, o'zgaruvchan yo'nalishlarda yo'lining kichik radiusli va ko'rinishi juda cheklangan keskin egriligi, shuningdek, qor, muz, tosh yoki loy bilan qoplangan yo'l qoplamali tor qatnov qismi bilan ajralib turadi. Qoida tariqasida, tog' yo'llarining bir tomonida tik qoyaliklar, boshqa tomonda jarliklar mavjud. Kunu-tun davomida qor yog'ishi, tuman tushishi, tog'larda yo'llarning muzlashi va havo haroratining keskin o'zgarishi yog'ingarchilik bilan birga sodir bo'ladi, shuningdek tog' yon bag'ridan tuproq va toshlar ko'chishi mumkin.

2. Tadqiqot metodologiyasi

Balandlikning oshishi bilan atmosfera bosimi pasayadi, harorat va havo zichligi pasayadi va shu munosabat bilan dvigatel kuchi keskin pasayadi, yonilg'i sarfi oshadi, suvning qaynash harorati pasayadi, pnevmatik tormoz tizimining ishlashi ishonchiligi kamroq bo'ladi, yondirish tizimining ishlashi yomonlashadi, elektr sim izolyatsiyasining elektr o'tkazgich qarshiligi pasayadi, vakuum korrektoring ishi buziladi, kondensatör va yondirish tizimi tezroq buziladi va akkumlyatordan elektrolitning bug'lanishi kuchayadi. Baland tog' sharoitlari haydovchiga sezilarli ta'sir qiladi.

Tog'larda kislorod kamligi bosh og'rig'iga sabab bo'ladi. Ko'zni qamashtiradigan quyosh nuri uzoq vaqt davomida ta'sir qiladi, ayniqsa dovonlarda qor bo'lsa ko'pincha ko'zning shilliq pardasiga ta'sir qilib ko'zni qamashtiradi, ko'rish qobiliyatini pasaytiradi. Bundan ko'rinib turibdiki, tog'larda ishlash va harakatlanish tartibi oddiy sharoitlarga qaraganda ancha murakabdir[2].

Tog' yon bag'ridan o'tgan avtomobil yo'llardan harakatlanib o'tishdan oldin, siz mashinaning texnik holatini, xizmat ko'rsatish uskunalarining mavjudligini diqqat bilan tekshirib ko'rishingiz kerak: domkrat, ballon kaliti, arqon(tros), shina zanjirlari va boshqalar. Tormozning ishlash qobiliyatiga, rul va boshqarish tizimiga, dvigatelning aniq va to'g'ri ishlashiga, nazorat datchiklarining to'g'ri ishlashiga e'tibor berish kerak. Tekshiruv paytida shinalardan havo chiqishi, yonilg'i va moylovchi mahsulotlarining oqishi, suv, tormoz suyuqligi bor yoki yo'qligini aniqlash kerak. Faqatgina barcha mexanizmlar va agregatlarning to'liq ishlashiga ishonch xosil qilgandan so'ng yo'lga chiqishingiz mumkin[3].

Tezlik yo'lining holatiga qarab tanlanadi. Tumanda, yo'lining ko'rinish masofasiga qarab yaqinni yorituvchi faralari yoqilgan holda xavfsiz harakatlanish tezligi tanlanadi(5-40 km/soat). Tik va ko'rinishi cheklangan joylarda xuddi shu tezlikda haydash tavsiya etiladi. Yo'lining tik tepalik va nishabliklarida avtotransport vositasining uzatmalar qutisidan ajratilgan holda haydash qat'iy taqiqlanadi. Dovonning yuqori qismiga yaqinlashganda, tovushli, yorug'lik signallari berish tavsiya etiladi[4].



1-rasm. Qish mavsumida avtomobil yo'l qatnov qismlarida qor-muzlama bilan qoplanishi

Qish mavsumida avtomobil yo'l qatnov qismlarida qor-muzlama bilan qoplanib qoladi. Bunday hollarda avtomobilning g'ildiragi bilan qatnov qism orasidagi ilashish koeffitsenti kamayadi va sirpanish oshadi, haydovchining transport vositasini boshqarishini yanada qiyinlashtiradi hamda yo'llarda tirbandliklar hosil bo'ladi[5,8].



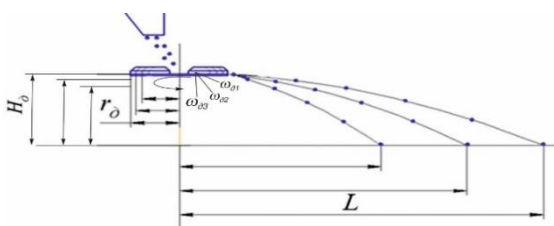
2-rasm. Qish mavsumida avtomobil yo'l qatnov qismlarida qor-muzlama tozalash jarayoni

Qish mavsumida bunday tirbandliklarning oldini olish uchun yo'l tashkilot ishchilari tomonidan sirpanchiqqa qarshi tuz-qum aralashmalar sepib ilashish koeffitsentini oshirish choralari ko'riladi. Tuz-qum aralashmani sepish jarayonida harakatdagi yo'lda harakat xavfsizligini ta'minlash katta ahamiyatga ega. Tuz-qum aralashmani Maxsus yo'l mashinalari(MYM)da sepish jarayonida shu yo'nalish bo'ylab harakatlanayotgan boshqa transport vositalari oraliq masofani kamida 20 metr saqlab harakatlanishi tavsiya etiladi. Chunki tuz-qum aralashma MYMdan to'g'ridan to'g'ri otilib chiqib avtomobil va harakat ishtirokchilariga shikast yetkazishi mumkin[6,7].

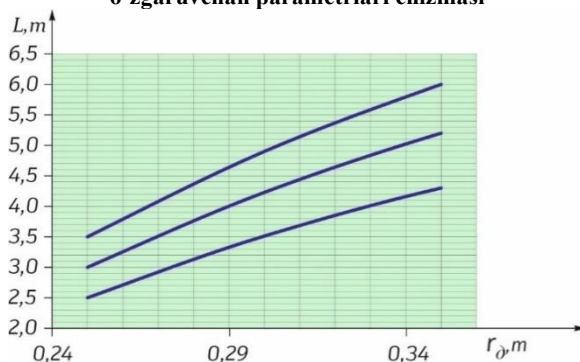
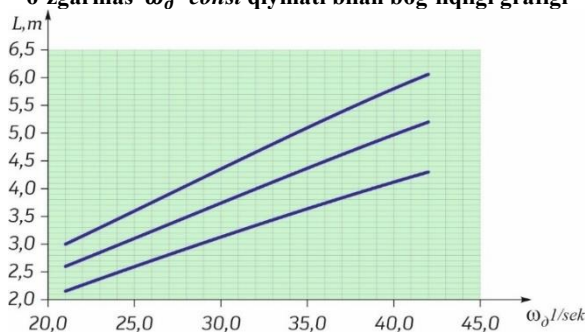
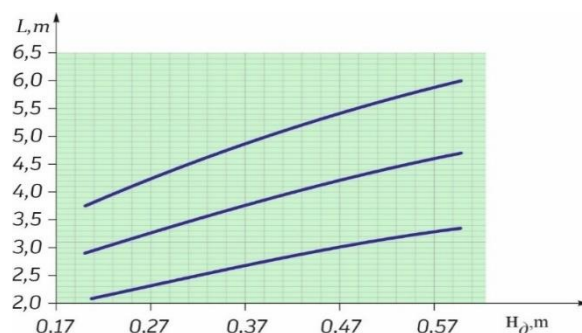


3-rasm. Maxsus yo'l mashinasi

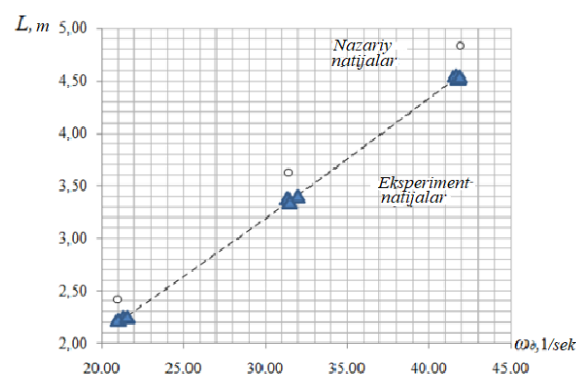
Yoyib sepish disk parametrlarini tanlash uchun biz qiymatlarni o'zgarib kiritamiz va ularning sepish kengligiga ta'sirini ko'rib chiqamiz.



4-rasm. Yoyib sepish disk va zarrachaning o'zgaruvchan parametrlari chizmasi

5-rasm. M zarrachaning L uchish masofasi disk r_d radiusi va disk H_d balandligi burchak tezligining o'zgarmas $\omega_d = \text{const}$ qiymati bilan bog'liqligi grafigi6-rasm. Disk balandlik qiymati o'zgarmas bolganda $H_d = \text{const}$, diskning burchak tezligi ω_d va disk radiusi r_d bo'yicha M zarrachaning L uchish masofaning bog'liqligining grafik ko'rinishi7-rasm. Disk radiusi qiymati $r_d = \text{const}$ o'zgarmas, diskning H_d balandligi va diskning burchak tezligi ω_d bo'yicha M zarrasining L uchish masofasining bog'liqligi grafigi

Nazariy va eksperimental usulni o'tkazishda yoyish diskni ω_d tezligining texnologik materialning sepish S_{sk} kengligiga bog'liqligi grafigi.



8-rasm. – nazariy natijalar; – eksperimental natijalar; ----- – tajribaning o'rtacha qiymati

MYMning agregatidan to'g'ridan to'g'ri tuz-qum aralashmaning otilib chiqib avtomobil va harakat ishtirokchilariga shikast yetkazishning oldini olish uchun MYMning agregat tuzilishiga o'zgartirish kiritish va texnologik materiallarni maqsadli lozim darajadagi miqdorda sepilishini hamda qatnov qismi bilan shinalar orasidagi ilashish koeffitsientini ta'minlash, avtomobil yo'llarida harakat xavfsizligining ta'minlanishi ortiqcha sarf-xarajatning oldini olinishi hamda shu hududdagi kuch-vositalarining ish unumdorligini oshiradi.

3. Xulosa

MYMning yoyib sepish diskidan to'g'ridan to'g'ri tuz-qum aralashmaning otilib chiqishini oldini olib, uni qatnov qismiga ma'lum bir burchakda yo'naltirish, bu-oraliq yaqin masofada bo'lgan harakat ishtirokchilariga ya'ni transport vositalari, piyoda-yo'lovchilarga ma'lum darajada shikast yetkazilishining oldi olinadi.

- Tuz-qum aralashmani maxsus yo'l mashinalari(MYM)da sepish jarayonida shu yo'nalish bo'ylab harakatlanayotgan boshqa transport vositalari oraliq masofasi minimal darajaga bo'lishi ta'minlangan bo'lar edi;

Maxsus yo'l mashinalari texnologik materiallarni (tuz-qum aralashma) sepishda alohida o'rin tutadi.



Qishki mavsumda yo'l harakati xavfsizligini ta'minlashda muzlamaga qarshi texnologik materiallardan – xususan, tuz va qum aralashmasidan – foydalanish muhim amaliy ahamiyat kasb etadi. Ushbu tadqiqotda mazkur materiallarning samarali qo'llanilishi va ularni yo'l qoplamasiga bir tekisda, vaqtda va optimal miqdorda sepilishida maxsus yo'l mashinalarining hal qiluvchi o'rni yoritildi.

Tahlillar shuni ko'rsatdiki, zamonaviy texnologiyalar bilan jihozlangan maxsus yo'l mashinalari (masalan, tuz-qum purkagichlar, avtomatik dozatorli tarqatuvchilar) muz va qor qoplamasining samarali yo'qotilishini, harakatlanish silliqligini tiklashni va avtohalokatlar xavfini sezilarli darajada kamaytirishni ta'minlaydi. Bundan tashqari, avtomatlashtirilgan boshqaruv tizimlariga ega mashinalar materiallar sarfini optimallashtiradi, atrof-muhitga salbiy ta'sirni kamaytiradi va iqtisodiy jihatdan ham samaradorlikni oshiradi.

Tadqiqot natijalari asosida xulosa qilish mumkinki, muzlamaga qarshi kurashishda faqatgina materiallar emas, balki ularni samarali va ilmiy asoslangan tarzda taqsimlash va qo'llash mexanizmlarining mavjudligi – ya'ni maxsus yo'l mashinalarining texnik imkoniyatlari – xavfsizlik va iqtisodiylikning asosiy omillaridan biridir. Shu bois, kelgusida ushbu texnik vositalarni modernizatsiya qilish, GPS va real vaqtli monitoring tizimlarini joriy etish orqali yo'l xizmatlarining qishki faoliyatini yanada takomillashtirish muhim yo'nalish bo'lib qoladi.

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