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**TOSHKENT DAVLAT  
TRANSPORT UNIVERSITETI**

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# TASHKENT STATE TRANSPORT UNIVERSITY

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## Study of mechanical properties of modified sulfur polymer composite

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**Abstract:** In this article, the effect of modified dispersed and fibrous fillers on the mechanical and operational properties of sulfur-based concrete is studied, and the optimal time and method of modification are determined. The obtained results were compared with M450 heavy concrete, which is currently used in the production of reinforced concrete sleepers for railway transport.

**Keywords:** Sulfur concrete, modification, glass fiber, dispersed filler.

## Modifikatsiyalangan oltingugurt polimer kompozitning mexanik xossalarini tadqiqotlash

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**Annotatsiya:** Ushbu maqolada oltingugurt asosli betonning mexanik va ekplutatsion xossalarini ta'minlashda modifikatsiyalangan dispers va tolali to'ldiruvchilarning ta'siri o'rganilgan, hamda modifikatsiyalashning optimal vaqti va usuli aniqlangan. Olingan natijalar bugungi kunda temir yo'l transporti temir-beton shpalalarini ishlab chiqarishda qo'llanilib kelinayotgan M450 markali og'ir beton bilan solishtirilgan.

**Keywords:** Oltingugurt beton, modifikatsiyalash, shisha tola, dispers to'ldiruvchi.

### 1. Kirish

Xozirgi kunda, chet elda va mamlakatimizda xar xil sharoitda va soxalarda ishlovchi kompozit materiallarni yangi tarkiblarini va ularni mexanik xossalarini oshirish uchun kimyoviy, fizik va mexanik modifikatsiyalash usullari bo'yicha tadqiqotlar olib borilmoqda. Bunda termoplast materiallarning molekulyar tuzilishi va qatlamlararo strukturaning shakllanishi o'ziga xos xususiyatlariga mos ravishda modifikatsiyalash usullari tarkibiy komponentlarga, olish texnologiyasiga va shu kabi boshqa omillarga bog'likligini tadqiqotlash bilan energiya tejankor, ekologik toza, mustaxkam, ekspluatatsion sharoitlarni inobatga olgan xolda mustaxkam yangi materiallar yaratish va ularni amalda qo'llash uchun real ekspluatatsion sharoitda sinash orqali uni chidamliligini, dinamik yuklanishlarni materialning mexanik mustahkamligi va ishonchligiga ta'sirini aniqlash dolzarb muammo bo'lib kelmoqda.

Qariyb o'n asrdan beri insonlar tomonidan foydalanib kelinayotgan beton – shag'al, qum, maydalangan toshlar, Portland sement, suv kabi materiallar aralashmasi hisoblanadi. Beton ishlab chiqarish sanoati yillar o'tgan sayin rivojlanib bormoqda.

Bugungi kunda betonning bir qancha modifikaqiyalan turlari yaratilgan bo'lib, polimer-beton, sement-beton, temir-beton, qo'rg'oshin-beton va oltingugurt-beton shular jumlasidandir. Yuqorida keltirilgan turlardan oltingugurt-beton boshqa beton turlaridan o'zining agressiv muhitlardagi ekspluatatsion, mexanik va fizik xossalari bilan ajralib turadi.

Oltingugurt beton – zamonaviy kompozitsion material bo'lib, u inert agregatlar va konstruktiv mustahkamlash funksiyalarini bajaradigan to'ldiruvchi moddalarni o'z ichiga oladi. Oltingugurt asosida tayyorlangan kompozitlar, shu jumladan oltingugurt beton ham termoplast material hisoblanadi. Oltingugurtning bunday xossalari vareaksiyon xossalarini inobatga olib undan polimerlanish jarayonida

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struktura shakllanishida to'ldiruvchi va bog'lovchi orasidagi fizik kimyoviy jarayonlarni tadqiqotlash asosida bu materialdan yuqori mustahkamlikka ega bo'lgan konstruksiyalar, issiqlik izolyatsiya xususiyatli materiallar va yuqori agressiv muhitlarga bardoshli materiallar olish mumkin.

Oltinugurt elementining funksional imkoniyatlarining yuqoriligiga qaramay hozirgi kunda materiallar olish imkoniyatlari olimlar tomonidan to'liq o'rganilib chiqilmagan. Yevropa olimlari olib borgan ilmiy izlanishlar natijasiga ko'ra oddiy oltinugurt betonga nisbatan modifikatsiyalangan oltinugurt beton xossalari bir qator afzalliklarga ega. Bunga ko'ra oltinugurt polimer beton modifikatori portland sementga qaraganda ishqalanishga qarshilik, bosim, egilish kabi xususiyatlari yuqori. Oddiy betonga nisbatan charchoqqa chidamli bo'lib, takroriy yuklarga bardoshli hisoblanadi. Oltinugurt polimer beton modifikatori qariyb 50 yildan beri qishloq xo'jaligi va oziq ovqatni qayta ishlash zavodlarida, qoplamlar sifatida, quvur liniyalarini ushlab turuvchi vosita sifatida, sanoatda keng ko'lamda foydalanib kelinmoqda [1].

O'zbek olimlari tomonidan olib borilgan tadqiqotlarda neft gaz korxonalarida ikkilamchi xom ashyo sifatida hosil bo'ladigan oltinugurdan oltinugurt beton ishlab chiqarishda bog'lovchi sifatida foydalanilgan hamda portlandsement asosli beton bilan solishtirilgan. Natijada olingan yangi tarkibli oltinugurt betonning o'rtacha zichligi portlandsement asosli betonning zichligidan 4-5% ga, hamda siqilishdagi mustahkamligi 2-2,5 martaga, egilishdagi mustahkamligi esa 1,5-2 barobarga yuqorroq ekanligi aniqlangan. Oltinugurt tutgan beton portlandsement bog'lovchisi asosidagi betonlardan kam bo'lmagan arzon va yuqori samarali betonlar va mahsulotlarni olish imkonini bergan [2].

Ushbu ilmiy izlanishlarda modifikatsiyalangan oltinugurtdan asos sifatida foydalanish materialning mexanik xossalari yaxshilanganligi keltirib o'tilgan. Ammo modifikatsiyalashning turi va madifikatsiyalash parametrlarining material xossalari va struktura hosil bo'lish jarayonlariga ta'siri o'rganilmagan.

Adabiyot manbalarini ko'rib chiqish shuni ko'rsatadiki, gazni qayta ishlash chiqindilari (oltinugurt) asosida mexanik xossalari yaxshilangan materiallar turli sohalarda keng qo'llaniladi. Bunday materiallarga talablarning ortib borishi, ayniqsa, ularning ishlashi, turli xil agressiv muhitlarga qarshilik, shuningdek, suv o'tkazmasligi bilan bog'liq soxalarda istiqbolli bo'lib qolmoqda. Bunday materiallar gazni qayta ishlash va gaz-kimyo korxonalarida gazni tozalash davrida ko'plab miqdorda ajralib chiqayotgan oltinugurt asosida olinishi mumkin bo'lgan oltinugurtli organomineral polimer kompozit materialdan foydalanish bir nechta muhim muammolarni hal qilishi mumkin [3]:

- mamlakat qurilish bozorini yuqori mustahkamlikka ega bo'lgan mahsulotlar bilan ta'minlash;
- ekspluatatsion ishonchlilikni oshirib, buyumning dizaynini ta'minlovchi materiallar tannaxini kamaytirish;
- mexanik yuklanishlarga va agressiv kimyoviy muhitlarga bardoshlilikni oshirish hisobiga konstruksiyalarning tannaxini kamaytirish;
- texnik oltinugurti utilizatsiya qilish hisobiga atrof-muhitga zararli ta'sirlarini kamaytirish.

Organomineral kompozit polimer materiallardan konstruksiyalarini ishlab chiqarish an'anaviy keramik kompozit materiallardan konstruksiyalar ishlab chiqarish bilan solishtirganda CO<sub>2</sub> emissiyasini 40% ga kamaytirishga olib keladi. Bu katta miqdorda karbonat anhidrid gazi

ajraladigan, mineral oxaktoshlarni sementga aylantirishda sarf bo'ladigan energiyani, boshqa maqsadlarga yo'naltirish imkonini beradi. Bundan tashqari organomineral kompozit materiallarni olish uchun 140 °C harorat yetarli bo'ladi. Sement ishlab chiqarishda esa 1400 °C harorat talab etiladi.

## 2. Tadqiqot metodikasi

Tadqiqotlar natijasida olingan modifikatsiyalangan to'ldiruvchilar bilan boyitilgan oltinugurt beton namunalarning mexanik va ekspluatatsion xossalari bugungi kunda qo'llanilib kelinayotgan M450 markali og'ir beton turlari bilan solishtirildi.

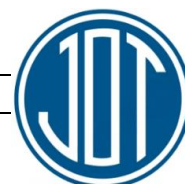
Namunalar tayyorlashda foydalanilgan dispers to'ldiruvchilarning sirt yuzalari faolligini oshirish uchun vibroplanetar faollashtirgichdan foydalanildi (1-rasm). Vibroplanetar faollashtirgichning mavjud analoglaridan farqi shundaki, ushbu faollashtirgichda to'ldiruvchi zarrachalariga bir vaqtning o'zida turli yo'nalishlarda koriolis kuchini ta'sir ettirib sirt yuzalarini yaxshiroq faollashtirish imkoniyati mavjud. To'ldiruvchi sifatida material tarkibiga kiritilgan faol dispers zarrachalar mexanik faollashtirish jarayonida ikkilamchi Van-der Vaals va vodorod bog'larini hosil qilib, geterosistemadagi strukturaviy bog'lanishlarni yaxshilaydi.

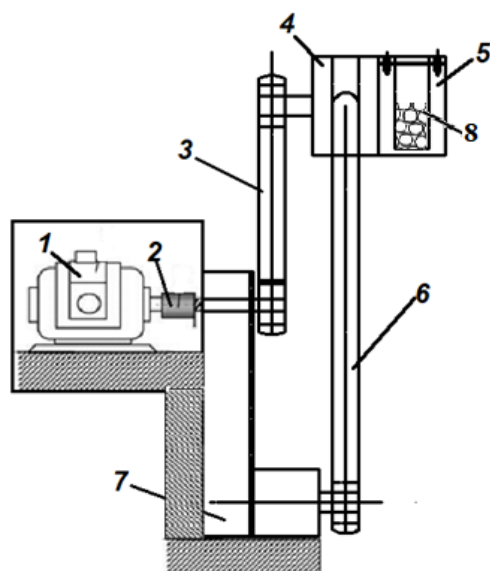
Mexanik faollashtirilgan to'ldiruvchilar va qum-shag'al aralashmasini oltinugurt bilan birganikda 140 – 160 °C haroratda qizdirib aralashtirish uchun "IN-test" MLA-20 markali aralashtirish qurilmasidan foydalanildi. MLA-20 laboratoriya aralashtirgichining texnik ko'rsatgichlari 1-jadvalda keltirilgan.

1-jadval

MLA-20 laboratoriya aralashtirgichining texnik ko'rsatgichlari

№	Nomlanishi	Miqdori
1	Aralashtirish kamerasi sig'imi	10 l
2	Haroratni nazorat qilish aniqligi	± 3 °C
3	Aralashtirish vaqti	1 - 9999 sekund
4	Aralashtirgich tezligi	48 ayl/min.
5	Harorat	10°C ÷ 400°C
6	Nasby namlik	< 80%





1 – rasm. Vibroplanetar mexanik faollashtirgich sxemasi

1 – elektrodvigatel; 2 – bog‘lovchi mufta;  
3- aylantiruvchi richag; 4- tosh; 5 – mexanik faollashtirgich; 6 – yo‘naltiruvchi richag; 7 – korpus;  
8 – maydalovchi jism.

MLA-20 aralashtirgichda 160 °C haroratda 15 daqiqa davomida aralashirilgan oquvchan holatdagi aralashma,

o‘lchamlari 100×100×100 mm bo‘lgan qoliplrga qo‘yilib, 24 soat davomida havoda quritildi. Olingan namunalarning mexanik yuklanishlarga bardoshlilik xossalari pressda (2 - rasm) aniqlandi.



2 - rasm. E160PN181 Markali gidravlik pressing umumiy ko‘rinishi

### 3. Natijalar va muhokamalar

Tadqiqodlar uchun mayda va yirik qumning mos ravishda 1:3 nisbatdagi aralashmasi, O‘z DSt 127.1-93 bo‘yicha granulalangan texnik oltingugurt hamda tarkibida 60,68% [4] kremnizem saqllovchi “Olmaliq kon

metallurgiya kombinati”da mis ishlab chiqarish jarayonida hosil bo‘ladigan chiqindidan modifikator sifatida foydalanildi (3-rasm).



a



b



c

3-rasm. Namunalar tayyorlash uchun xom ashyo materiallari:

a) qum-shag‘al; b) oltingugurt; c) kremnizem

Qum-shag‘al aralashmasi 170 °C haroratda 15 daqiqa davomida qizdirilib aralashma tarkibidagi namliklar yo‘qotildi, so‘ng modifikatsiyalovchi kremnizem qo‘shilib hajm bo‘ylab bir xilda taqsimlangunga qadar aralashtirildi. Haroratni 150°C gacha tushirib, aralashmaga oltingugurt qo‘shildi va suyaq faza hosil bo‘lgunga qadar aralashtirildi. Aralashma to‘liq oquvchan

holatga o‘tgandan so‘ng standart qoliplarga quyib namunalar olindi. Shu tartibda material tarkibini tashkil etuvchi komponentlarning miqdorini o‘zgartirib bir qancha namunalar tayyordab olindi. 2-jadvalda olingan namunalar tarkibidagi tashkil etuvchi komponentlarning miqdoriy yo‘rsatkichlari keltirilgan.



4-rasm. Kub shaklidagi namunalarni siqilishga sinash

2 - jadval.

Oltिंगugurt beton namunalarni laboratoriya sharoitida fizik-mexanik sinovlari natijalari

Namuna raqami	Shixta tarkibi, mas. %				Zichlik, g/sm <sup>3</sup>	Suv shimishi, mas. %	Yuklanish, MPa
	Oltिंगugurt	Qum	Shag'al	Kremnezim			
№1	30	60	10	2	0,792	0,0006	22,006
№2	50	10	35	5	0,493	0,0004	18,953
№3	30	15	50	5	0,634	0,0006	32,679
№4	30	20	45	5	0,704	0,0006	43,087
M450 markali beton (GOST 26633-2012)					2,5	< 0,038	44,95

Tadqiqotlar shuni ko'rsatdiki organomineral oltिंगugurt polimeri kompozit material olish jarayonida to'ldiruvchilarni sirt yuzalaridagi namlikni yo'qotish maqsadida ularni 150-170 °C gacha qizdirib unga vibro planetar aktivatorida faollashtirilgan oltिंगugurt kukuni qo'shilganda, dastlab oltिंगugurt suyuq holatga o'tadi. Komponentlarni aralashtirish jarayonida harorat 170°C dan oshgandan oltिंगugurtning polimerizatsiya jarayoni yuz berib, aralashma quyulish holati kuzatildi. 2-jadvalda keltirilgan 1 va 2 namunalarni kompozitsiyada polimerlanish jarayoni boshlanishidan oldin suyuq holatda quyilgan namunalardir. 3 va 4 namunalarni esa 180 °C haroratgacha qizdirilib kompozitsiya quyulish holatga o'tgandan so'ng qoliplarga quyib olingan.

Kompozitsiya tarkibiga to'ldiruvchi sifatida 5% miqdorda kremnezimning qo'shilishi, to'ldiruvchi zarrachalarining o'ziga xos sirt maydoni tufayli tarkibni yuqori darajadagi to'ldirishga, bundan tashqari modifikatsiyalangan kompozitsiyalarining reologik xususiyatlarini yaxshilashga, yuqori elektr izolyatsiyasiga (kam ifloslik tufayli) va modifikatsiyalangan kompozitsiyalarni yuqori mexanik xususiyatlarga erishish imkonini beradi [5-8].

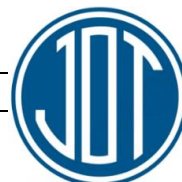
Materialning suv singish xususiyati uning tarkibidagi bog'lovchining miqdoriga bog'liq bo'lib, unga teskari proporsional ravmda o'zgarishini ko'rishimiz mumkin.

#### 4. Xulosa

Olingan natijalar va eksperimental tadqiqotlarning chuqur ilmiy tahlili asosida xulosa qilish mumkinki, tarkibida 30% miqdorda oltिंगugurt bog'lovchi, 20% qum, 45% sheben va 5% miqdorda kremnezim bo'lgan kompozitsion materialning siquvchi kuchlanishga mustahkamligi M450 markali sement mustahkamligiga yaqin. Demak oltिंगugurt asosli kompozit material olishda harorat muhim ahamiyatga ega bo'lib, aralashmada polimerizatsiya boshlangandan keyin olingan materiallar nisbatan mustahkamligi yuqori bo'ladi

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