



IMMOBILLANGAN METIL TIMOL KO‘KI YORDAMIDA TELLUR IONLARINI ANIQLASHNING SORBSION SPEKTROSKOPIK USLUBINI ISHLAB CHIQISH

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Annotatsiya. Ushbu ishda tellur ionlarini aniqlash uchun immobillangan metil timol ko‘ki asosida sorbsion-spektroskopik usul ishlab chiqishning nazariy va amaliy jihatlari o‘rganildi. Tadqiqotning asosiy maqsadi metil timol ko‘ki reagentini sorbent yuzasiga immobillash orqali tellur ionlarini selektiv sorbsiya qilish va hosil bo‘lgan kompleksning optik xususiyatlari asosida ularni aniqlash imkoniyatlarini baholashdan iborat. Tadqiqot davomida sorbsiya jarayoniga muhit pH qiymati, reagent konsentratsiyasi, sorbsiya vaqti hamda tellur ionlari konsentratsiyasining ta’siri o‘rganildi. Optimal sharoitlarda tellur ionlarining sorbentda to‘planishi va metil timol ko‘ki bilan kompleks hosil qilishi natijasida analitik signalning o‘zgarishi qayd etildi. Olingan natijalar ishlab chiqilgan sorbsion-spektroskopik usulning tellur ionlarini aniqlashda qo‘llash imkoniyatini ko‘rsatdi. Taklif etilayotgan usulning soddaligi, kam miqdordagi reagent sarfi, ekspressligi va tahlil jarayonini soddalashtirish imkoniyati uni atrof-muhit obyektlari va turli tabiiy hamda texnologik namunalarni tahlil qilishda istiqbolli usul sifatida baholashga imkon beradi.

Kalit so‘zlar: tellur ionlari, metil timol ko‘ki, immobillangan reagent, sorbsiya, sorbsion-spektroskopik usul, spektroskopiya, kompleks hosil bo‘lishi, analitik signal, selektivlik, mikroanaliz.

KIRISH. Jamiyat jadal rivojlanib borar ekan, tabiiy resurslarni iste’mol qilish ham tezlasha boshladi. Strategik va muhim metall element bo‘lgan xrom sanoat va qishloq xo‘jaligida, birinchi navbatda, xrom qoplamasi, qotishma ishlab chiqarish, pigmentlar ishlab

chiqarish, saqlash, kataliz va ko'nchilikda keng qo'llanilishini topadi, uning ahamiyati atrof-muhit toksikologiyasi va biologiya sohasiga taalluqlidir. Kimyo sanoatini rivojlantirishda atrof-muhit ob'yektlari tarkibidagi tellur(IV) ionlarini aniqlashning "gibrid" uslublarini yaratishga alohida e'tibor qaratilmoqda [1-10]. Tellur zamonaviy elektronika, quyosh energetikasi va termoelektrik materiallar ishlab chiqarishda strategik ahamiyatga ega bo'lgan elementlardan biridir. Uning sanoat va ekologik ahamiyatining ortib borishi tufayli turli obyektlarda tellurning, ayniqsa Te(IV) shaklining, tez, sezgir va selektiv usullar bilan aniqlanishini takomillashtirish dolzarb ilmiy-amaliy vazifa hisoblanadi. Shu nuqtai nazardan, metil timol ko'ki asosidagi spektrofotometrik usullarni ishlab chiqish va optimallashtirish muhim ilmiy ahamiyat kasb etadi. Adabiyotlar tahlili shuni ko'rsatadiki, tellurning sanoat va ekologik ahamiyati ortib borayotganligi sababli uni tez, sezgir va selektiv usullar bilan aniqlash muhim ilmiy-amaliy masaladir. Instrumental usullar yuqori aniqlikka ega bo'lsa-da, spektrofotometrik usullar soddaligi va iqtisodiy samaradorligi bilan amaliy laboratoriyalarda muhim o'rin tutadi. Shu nuqtai nazardan, Te(IV) ning metil timol ko'ki bilan kompleks hosil qilishiga asoslangan usullarni rivojlantirish istiqbolli yo'nalish hisoblanadi [11-18]. Polimer tashuvchilarga organik reagentlarni immobillashning optimal sharoitlari aniqlanganligi, ularni metall ionlariga tanlab ta'sir etuvchanligini oshirish imkoniyatlari ko'p maqolalarda berilgan [19-26], lekin immobillangan reagentlarning tellur(IV) ionlarining aniqlashning va unung analitik va metrologik parametrlari yaxshilanganligi keltirilmagan. Tellur(IV) ionlarini aniqlashning sorbsion-spektrofotometrik usullarini tabiiy ob'yektlari analizida qo'llanilishi analitik kimyoning muammolarini yechishga xizmat qilishi bilan o'z ifodasini topgan. Ishlab chiqilgan usulning analitik va metrologik ko'rsatkichlari eritma hamda qattiq fazada qiyoslandi va boshqa nazorat metodlari natijalari bilan solishtirildi. Tellur(IV) ionlarini aniqlashning sorbsion-spektrofotometrik usuli o'zining tezkorligi, natijalarning yuqori aniqligi va qayta takrorlanuvchanligi, quyi aniqlash chegarasining kichikligi bilan boshqa muqobil metodlarga nisbatan yuqori raqobatbardoshligi aniqlandi.

MATERIAL VA USULLAR.

Reagent tashuvchi va immobillangan OR ning IQ spektrlari birikmalarning IQ-Fur'e-spektrometre "Bruker Invenio S-2021"da olindi. Eritmalarning pH qiymatlari qayd etishda shisha solishtirish elektrodi "Mettler-Toledo AG" va "I-130" potenciometr-ionometridan foydalanildi.

Reagentlarning o'rganilayotgan eritmalarini va kompleks birikmalarni elektron yutilish spektrlari va optik zichliklari "EMC-30PC-UV Spectrophotometer (Germaniya) UV-5100 UV VIS Spectrophotometer (Xitoy)" spektrofotometrlarda o'lchandi, kyuvetalarning qalinligi barcha xolatlarda 1,0 sm ga teng. Organik reagent va kompleks birikmalarning tarkibi SEM-EVO MA 10 (Zeiss, Germaniya) hamda JSM-7001F skanerlovchi elektron mikroskopi (Yaponiya) yordamida amalga oshirildi. Bu asbobning ishlash prinsipi shunga asoslanganki, namuna yuzasi fokuslangan elektr nuri yordamida skanerlanadi. Natijada obyekt yuzasining yuqori aniqlikdagi (bir necha nanometrgacha) fazoviy tasvirini olish mumkin. Rentgen-fluouressent spektrlari (Rigaku NEX CGEDXRF Analyzer with Polarization in set 9022190000) asbobida qayd etildi, natijalarni solishtirildi.

Reagent tashuvchi va immobillangan OR ning IQ spektrlari “Bruker” (AQSH) firmasiga tegishli “Avatar system 360 FT-IR” spektrometrida, “SPECORD UR-10” asbobida qayd etildi, eritmalarning pH qiymati shisha solishtirish elektrodi “Mettler-Toledo AG” va “1-130” potensiometr ionometrida olib borildi.

NATIJALAR VA MUNOZARALAR

Tellur(IV) ionlari bilan immobillangan reagentlar o‘zaro kompleks hosil qilganligini tekshirish maqsadida organik immobillangan tola va kompleks SEM (JSM-7001F skanerlash electron mikroskopi) yordamida analiz qilindi va natijalar solishtirildi. Bu asbobning ishlash prinsipi shuni asoslanganki, namuna yuzasi fokuslangan elektr nuri yordamida skanerlanadi. Natija obyekti yuzasining yuqori aniqlikdagi (bir necha nm gacha) fazoviy tasvirini olish mumkin.

1.Sorbentni tayyorlash: Tashuvchini tanlash (tsellyuloza, polimer membranalar, silikagel). Reagentni immobilizatsiyalash (masalan, organik bo‘yoq yoki kompleks hosil qiluvchi modda). Sorbentni quritish va konditsiyalash.

2.Ionlar sorbtsiyasi: Namuna (Te ionlari bo‘lgan eritma) sorbent orqali o‘tkaziladi. Ionlar immobilizatsiyalangan reagent bilan komplekslar hosil qilishi hisobiga sirtida kontsentratsiyalanadi.

3.Spektroskopik o‘lchov: Sorbtsiyadan keyin sorbentning yutilish yoki qaytish spektrlari o‘lchanadi. Tellur(IV) uchun turlicha yutilish chiziqlari xos bo‘lib, bu ularni bir-biridan farqlash imkonini beradi.

4.Ma’lumotlarni qayta ishlash: Tellur(IV) ionlari uchun darajalash (kalibrlash) grafiklari chiziladi. Spektral chiziqlarning intensivligi bo‘yicha dastlabki eritmadagi ionlar kontsentratsiyasi aniqlanadi.

Tolali tashuvchiga reagentlarni immobilash quyidagicha amalga oshirildi:

I. Modifikatsiyalangan tolasidan 0,2000 g dan ikkita namuna analitik tarozida tortib olindi.

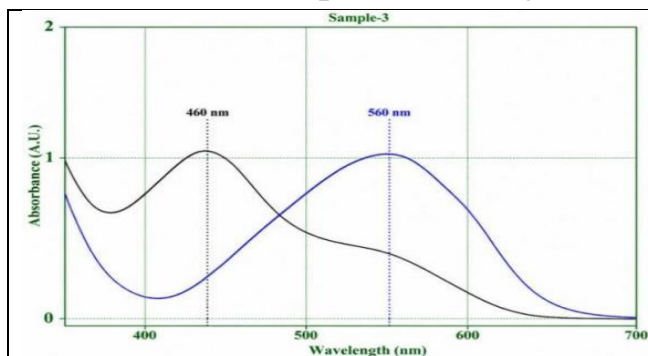
II. Oldindan tayyorlanga metil timol ko‘ki (MTK) reagentining eritmasidan 20 ml olinib, 100 ml li shisha stakanlarga alohida solindi.

III. Avvaldan tortib olingan modifikatsiyalangan tolalarida MTK reagentning immobillanish jarayoni 15-20 daqiqa davomida amalga oshirildi.

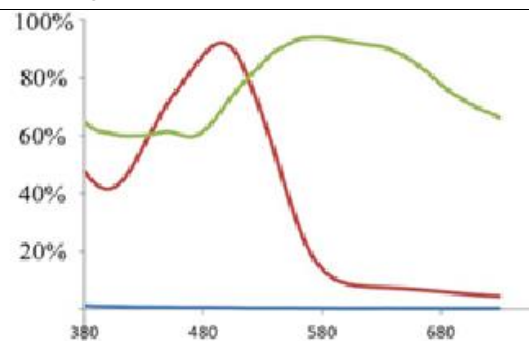
IV. Immobilash jarayonidan so‘ng tolalar distillangan suv bilan yuvilib, tolalar Petri idishida saqlandi.

Nur qaytarish va nur yutish spektrlarini tahlil qilishda adabiyotlarda keltirilgan tavsiyalarga amal qilgan holda amalga oshirildi.

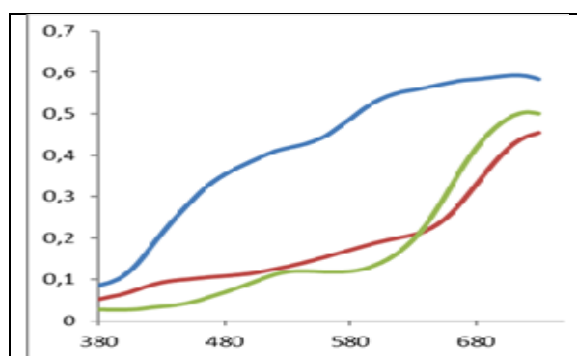
Te(IV) xloridi standart eritmasini tayyorlash uchun umumiy molekular massasini topib olamiz va valentligiga bo‘lamiz. 100 ml tuz eritmasini tayyorlashda 0,221g TeCl_4 tuzidan analitik tarozida tortib olamiz. Bunda eritma 0,1N li bo‘ladi.



1-rasm. MTK reagenti va uning telur ionlari bilan hosil qilgan kompleksining yutilish spektrlari.

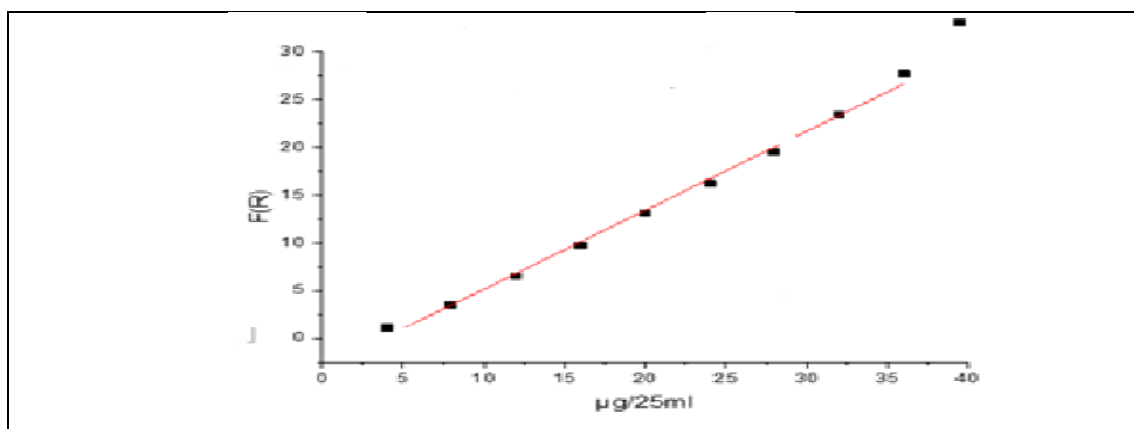


2-rasm. MTK diffuz aks etish koeffitsiyentining (Kubelka-Munk funksiyasi) to'liq uzunligiga bog'liqligi



3-rasm. 1-MTK reagent, 2-MTK+PPD, 3-MTK+selyulloza

Nur qaytarish spektrlari immobillangan reagentlarning metall ionlari bilan komplekslanishini tasdiqladi. Metil timol ko'ki uchun analitik signal 560 nm dan 620 nm ga siljib, 120 nm kontrastlik kuzatildi, bu reaksiyaning yuqori sezgirligini ko'rsatadi. Spektrlar orasidagi bunday sezilarli siljishlar Te^{4+} ionlari bilan barqaror komplekslar hosil bo'lganini ishonchli ravishda tasdiqlaydi (1-3-rasmlar).



4-rasm. Immobillangan organik reagentlarning Te^{4+} ionlari bilan hosil qilgan komplekslarining graduirovkali grafigi.

Te(IV) ionlarini aniqlash uchun ishlab chiqilgan sorbsion-spektroskopik usulning samarali ekanligini tekshirish uchun tarkibi real obyektlardagi namunalar tarkibiga yaqin bo‘lgan murakkab model aralashmalar tayyorlab olindi va individual eritma kabi sharoitda Te(IV) ionini sorbsion-spektroskopik aniqlandi.

1-jadval

Te(IV) onlarini murakkab model aralashmalarda sorbsion-spektrofotometrik aniqlash natijalari (n=5; P=0,95)

Tahlil qilinadigan aralashma tarkibi, mkg/ml	Topilgan Me miqdori, mkg ($\bar{x} \pm \Delta X$)	Sr
Te(1,0)+Zn(2,0)+Cu(10);	0,95±0,03	0,03
Te(1,0)+Fe(2,0)+Cd(4,0);	0,94±0,04	0,05
Te(1,0)+Co(2,0)+Ni(1,0);	0,97±0,02	0,02

Te(IV) ionlarini aniqlash uchun ishlab chiqilgan sorbsion-spektroskopik usulning samarali ekanligini tekshirish uchun tarkibi real obyektlardagi namunalar tarkibiga yaqin bo‘lgan murakkab model aralashmalar tayyorlab olindi va individual eritma kabi sharoitda Te(IV) ionini sorbsion-spektroskopik aniqlandi.

2-jadval

Tuproq namunasi Te (IV) ionini ishlab chiqilgan va inversion-voltamperometrik usullarida aniqlashning qiyosiy natijalarini baholash (n=11; f₁ = f₂ = 11; P=0,95)

Obyekt tahlili	Ishlab chiqilgan usul		IV usuli	
	topildi $\bar{x}$, mkg/ml	Sr	topildi $\bar{x}$, mkg/ml	Sr
Tuproq namunasi	0,51	0,11	0,53	0,16
t- mezonlari	thisob. = 2.14; tjadval=3.17		thisob < tjadval	
F- mezonlari	Fhisob. = 2.67; Fjadval = 4.46		Fhisob < Fjadval	

Olingan natijalardan shuni bilish mumkinki titan ionlarini aniqlash uchun ishlab chiqilgan sorbsion-spektroskopik usul zamonaviy spektroskopik hamda an’anaviy usullar bilan raqobatlasha oladi.

XULOSA. Te(IV) ionlarini atrof-muhit obyektlari tarkibidan sorbsion-spektrofotometrik aniqlashda immabillangan ksilenol oranj reagentlarini analitik reagent sifatida qo‘llanildi va optimal sharoitlari topildi. Optimal pH: odatda 2,0–3,5 oralig‘i (ko‘pincha asetat buferida). Aniq qiymat ishlatilgan metodikaga bog‘liq. Kompleksning stexiometriyasi: ko‘pincha 1:1 (Te:MTB). Yutilish maksimumi (λ_{max}): odatda 610–630 nm oralig‘ida, ko‘plab metodlarda 620 nm atrofida o‘lchanadi. Rangi: ko‘k-yashil tusli rangli kompleks hosil qiladi, bu spektrofotometrik aniqlash uchun qulay. Bi(III), Fe(III), Cu(II), Al(III), Zr(IV) kabi ionlar MTB bilan ham kuchli komplekslar hosil qilgani uchun Te(IV) ni aniqlashda xalaqit berishi mumkin. Bunday hollarda niqoblovchi reagentlar yoki ajratish bosqichi qo‘llanadi. Te(IV) ionlarini aniqlashda real obyektlar tarkibida ishlab chiqilgan sorbsion-spektroskopik usulni uchlamchi va murakkab model aralashmalar tahliliga qo‘llanildi, S_r qiymatlar 0,33 dan kichikligi olingan natijalarning ishonchliligidan dalolat berdi. Ishlab chiqilgan sorbsion-spektroskopik usulni turli atrof-muhit obyektlari bo‘lgan

sanoat oqova suvlari va tuproq tahliliga qo‘llanildi, natijalarni qayta takrorlanuvchanligi, usulining tezkorligi, sezgirligi bilan boshqa usullardan afzalliklarga ega ekanligi isbotlandi.

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