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Laboratory synthesis of a plasticizer based on phthalic anhydride, ethylene glycol, and isoamyl alcohol

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Abstract: This article reports the synthesis of a novel high-molecular-weight plasticizer based on phthalic anhydride, ethylene glycol, and isoamyl alcohol. The optimal conditions for the synthesis process were determined, and the influence of reaction time on the yield of the resulting plasticizer was investigated. Furthermore, the reaction mechanism underlying the formation of the plasticizer from phthalic anhydride, ethylene glycol, and isoamyl alcohol was proposed.

Keywords: Phthalic anhydride, Isoamyl alcohol, Ethylene glycol, Catalyst, Sorbent

Ftal angidrid, etilenglikol va izoamil spirti asosida hosil bo'ladigan plastifikatorni laboratoriya sharoitida sintezi

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Annotatsiya: Ushbu maqolada ftal angidrid, etilenglikol va izoamil spirti asosida yangi molekulyar massasi yuqori bo'lgan plastifikator sintez qilindi hamda sintez qilingan plastifikatorni optimal sharoitlari aniqlandi. Ftal angidrid, etilen glikol va izoamil spirti asosida olingan plastifikator unumiga vaqtning tasiri o'rganildi. Ftal angidrid, etilen glikol va izoamil spirti asosida olingan plastifikatorni olish reaksiya mexanizmi ishlab chiqildi.

Kalit so'zlar: Ftal angidrid, Izoamil spirt, etilenglikol, katalizator, sorbent

1. Kirish

Bugungi kunda jahon bozorida 100 ga yaqin plastifikatorlar turlari ishlab chiqarilsada, faqatgina 50 tasi keng qo'llaniladi va tijoratda ahamiyatli hisoblanadi. Plastifikatorlar ishlab chiqarish hajmining 90% qismi PVX va egiluvchan materiallar tayyorlashda qo'llaniladi. Ular orasida murakkab efirlar alohida o'rin tutadi, jumladan adipatlar, azelatlar, sitratlar, benzoatlar, ortoftalatlar va boshqa turdagi efirlar. Bu moddalar polimerlarning egiluvchanligi va plastikligini oshirishda asosiy vosita sifatida xizmat qiladi [1-2].

Ishlab chiqarish hajmining oshishi va polivinilxlorid (PVX) birikmalarini qo'llash ko'lamining kengayishi yangi qo'shimchalarni ishlab chiqishga va ularni ishlab chiqarish uchun yangi xom ashyo manbalarini jalb qilishga yordam beradi. PVXni qayta ishlash uchun zarur bo'lgan eng muhim qo'shimchalar plastifikatorlardir. Plastifikatorlar bozori global qo'shimchalar bozorining eng katta segmentlaridan biridir. Plastifikatorlar polimer kompozitsiyalarni modifikatsiya qilishning eng sodda va iqtisodiy jihatdan maqbul yechimi hisoblanadi. Shu sababli, ularning polimer materiallarni qayta ishlash jarayonlaridagi ahamiyati va

qo'llanilishi yaqin yillarda keskin oshdi. Qo'llashda deyarli barcha polimerlarni, ayniqsa polivinilxloridni plastiklashtira oladigan efir plastifikatorlari eng amaliy hisoblanadi. Ayni paytda sanoatda uch yuzdan ortiq turdagi plastifikatorlar ishlab chiqarilmoqda, ularning aksariyati ftal kislotaning efirlaridir. An'anaviy ftalat plastifikatorlari butun dunyoda eng ko'p qo'llaniladigan plastifikatorlardan biri hisoblanadi[3].

Ushbu adabiyotda assimetrik adipin kislotasi diefirlarining fizik-kimyoviy xossalari bo'yicha sintez va tadqiqot ishlari natijalari, ularning efir plastifikatorlarini ishlab chiqarishdagi ahamiyatini ochib berish maqsadida keltirilgan. Asimetrik adipatlar p-nonilfenoksietanol va C₄ - C₁₀ alifatik spirtlar bilan ikki bosqichli eterifikatsiya yo'li bilan olingan. Tahlillar natijalari polivinilxlorid va loyihalashtirilgan plastifikatorlar tarkibini tayyorlash orqali ushbu birikmalardan PVXga plastifikator sifatida foydalanish imkoniyatini ko'rsatdi. Aralashmalarining xususiyatlari siqilishga bardoshlilik va rang barqarorligi GOST yordamida o'rganilgan. Xususan, efir plastifikatori bilan plastiklashtirilgan aralashmalar PVXda diizooktil ftalat (DIOF) aralashmalari bilan deyarli bir xil xususiyatlarga ega edi. Sintezlangan efirlarning barchasi

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PVXda muqobil plastifikator sifatida foydalanish qobiliyatini ko'rsatdi.

2. Tadqiqot metodologiyasi

Polivinilxlorid kompozitsiyalari har xil turdagi mahsulotlarni olish uchun keng qo'llaniladi [4]. PVX kompozitsiyasining tarkibida plastifikator asosiy tarkibiy elementlardan biri sifatida mavjud bo'lib, uning qo'shilishi tayyor polimer materiallar va mahsulotlarning fizik-kimyoviy va texnologik xususiyatlarini modifikatsiya qilishga xizmat qiladi. Shu bilan birga, plastifikatorning mavjudligi ularning qo'llanish imkoniyatlarini kengaytirishga imkon beradi. Polivinilxlorid kompozitsiyalarini qayta ishlash samaradorligi plastifikatorning fizik-kimyoviy yaroqliligi hamda iqtisodiy samaradorligi bilan belgilanadi va bu jarayonda hal qiluvchi omil hisoblanadi. Zamonaviy dunyoda mahsulotlarning yuqori sifati ularning ekologik xavfsizligi bilan bevosita bog'liq. Shu munosabat bilan ishda adipin kislotasi va epoksidlangan butanol asosida ekologik toza plastifikatorlar ishlab chiqarish yulga quyilgan. Ularning fizik-kimyoviy ko'rsatkichlari o'rganilgan. Olingan qo'shimchalarning PVX kompozitlarining reologiyasiga ta'siri o'rganildi. Butil butoksietil adipat bilan plastiklashtirilgan PVX kompozitsiyalari ishlab chiqilgan eritmalarning oqim xususiyatlarining qiymatlari baholandi. Eritmalarning suyuqligi sanoat dioktilftalatini o'z ichiga olgan shunga o'xshash tarkibdagi birikmalar bilan solishtirganda, undan ham biroz yuqoriroq ko'rsatkichlar bilan tavsiflanadi [5-7].

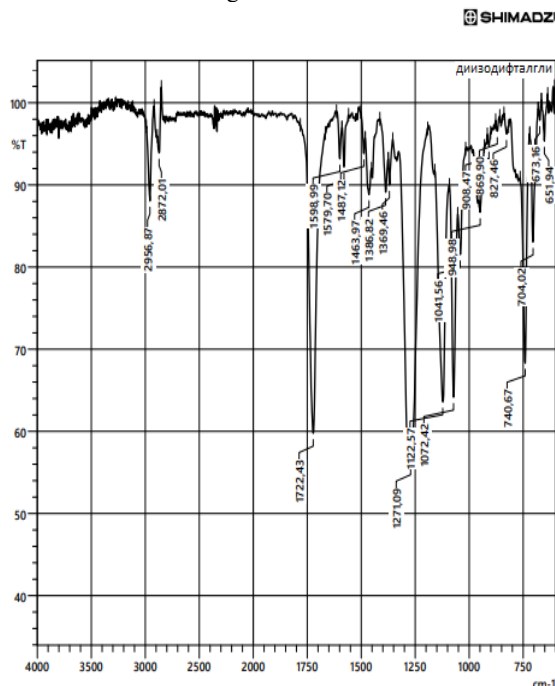
PVX pollar yuqori intensivlikdagi foydalanish sharoitida 20 yilgacha xizmat qilishi mumkin. Bunda plastifikatorlar ultrabinafsha nurlanishi va harorat o'zgarishlariga bardoshli bo'lib, materialning rang barqarorligini va moslashuvchanligini saqlab qoladi. Polivinilxlorid turli qalinlik va egiluvchanlikdagi plyonkalar shaklida ishlab chiqarilib, oziq-ovqat mahsulotlari, elektron qurilmalar, ehtiyot qismlar, gigiyena vositalari, asbob-uskunalar va o'yinchoqlar uchun qadoqlash materiallari sifatida foydalaniladi.

Yevropada qadoqlash materiallari ishlab chiqarishda yiliga 500 ming tonnadan ortiq PVXdan foydalaniladi, bu esa uning sanoat va iste'molchilar ehtiyojlarini qondirishdagi ahamiyatini ko'rsatadi [6-8].

Ftal angidrid izoamil spirti va etilenglikol asosida olinadigan plastifikator sintezi uchun ftal angidrid izoamil spirti va etilen glikol 2:1:2 mol nisbatlarda olindi. Qaytarma sovutgich, Dina-Stark, xarorat o'lchagich va tomchilatgich voronka bilan ta'minlangan, uch og'izli, yassi tubli kolbaga moddalar solindi va xarorat asta-sekin 140 °S gacha ko'tariladi. Reaksiyon massa magnitli aralashtirgich yordamida doimiy aralashtirildi. Reaksiya tetrabutoksitanat (TBT) katalizator ishtirokida, 8 soat davomida olib boriladi. Reaksiya harorati 0,5 °C/min harorat ko'tarilish tezligida 140 °C dan 180 °C gacha asta-sekin o'sib boradi. Nazariy jixatdan hisoblangan reaksiyon suv ajralib chiqqandan so'ng, reaksiyon massadan namuna olinib, kislotasi aniqlanadi. Tayyor bo'lgan diizoamildiftalatglikol polivinilxlorid (PVX) uchun plastifikator sifatida qo'llanishi uchun ma'lum GOST 8728-88 talabiga mos kelishi talab etiladi, GOST 8728-88 bo'yicha plastifikator rangi tiniq rangsiz bo'lishi talab etiladi, shuning uchun, plastifikatorning umumiy massaga nisbatan 5% gacha miqdorda sorbent qo'shib, 20-30 daqiqa

davomida, 90-100 °C haroratda ishlov berildi, hamda vakuum fil'tr yordamida filtrlandi.

Mahalliy xom ashyolar asosida olingan diizoamildiftalatglikol plastifikatorni IQ-spektroskopiya tahlili 1-rasmda keltirilgan.

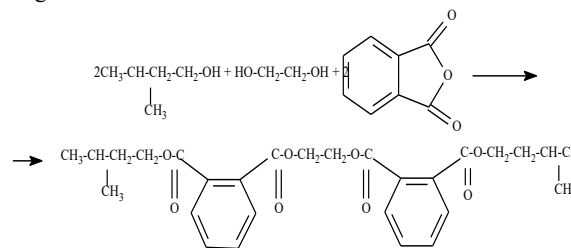


1-rasm. Izoamil spirti, ftal angidrid va etilenglikol asosida olingan plastifikatorning IQ-spektri

Izoamil spirti, ftal angidrid va etilenglikol asosida olingan plastifikatorning IQ-spektrida shuni ko'rishimiz mumkinki 2956-2872 cm^{-1} yutilish sohasida SN_3 - SN_2 guruhlar intensivligining oshishini ko'rsatadi. Siklik angidrid bilan

bog'liq bo'lgan pik 1722,43 cm^{-1} sohadagi ftal angidridning IQ-spektridagi yutilish cho'qqisi reaksiya davomida ON spirt guruhi o'rtasida bo'lganligi sababli, sintez qilingan plastifikatorning IQ-spektrida bu yutilish cho'qqisi kuzatilmadi, C-O-C bog'lari bilan bog'liq sohada 1271,09 cm^{-1} cho'qqisi namoyon bo'ldi. Shunga asoslanib, biz efir guruhlar hosil bo'lgan degan xulosaga kelishimiz mumkin.

Yuqoridagi taxlillar asosida izoamil spirti etilenglikol va ftal angidrid asosida diizoamildiftalatglikol plastifikator olish jarayoni amalga oshirildi. Ushbu jarayonni quyidagi tenglama asosida ifodalash mumkin:



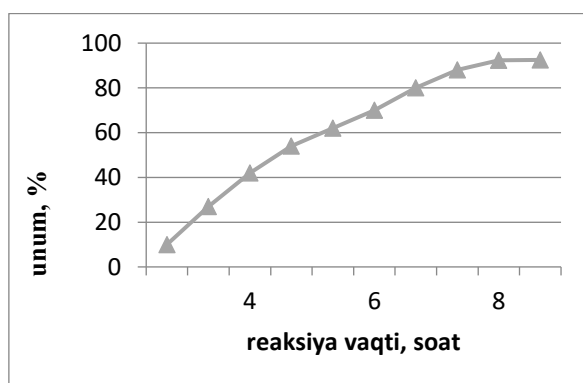
Maxalliy xom-ashyolar asosida olingan diizoamildiftalatglikol plastifikatorni olish uchun bajarilgan dastlabki ishimiz reaksiya uchun olingan xomashyolarning mol nisbatlari hamda reaksiya davomiyligining mahsulot chiqish unumiga ta'sirini o'rganishdan iborat bo'ldi. Reaksiya ftal angidrid etilen

glikol va izoamil spirtining turli mol nisbatlarida va 8 soat vaqt oralig'ida amalga oshirildi. Diizoamildiflatglikol plastifikatorini sintez qilishda o'tkazilgan reksiya natijalari quyidagi jadvalda keltirilgan, hamda jadvaldagi ma'lumotlar jadval va rasm holatida tasvirlangan.

1-jadval

Diizoamildiflatglikol plastifikatorining hosil bo'lish unumiga dastlabki xom-ashyolarni mol nisbatlari va jarayon vaqtining ta'siri

№	Mol nisbatlar	Vaqt, soat	Unum, %
1	2:2:1	6	28,1
2	2:2,2:1		45,5
3	2:2,5:1		64,3
№	Mol nisbatlar	Vaqt, soat	Unum, %
4	2:2:1	8	38,5
5	2:2,2:1		67,5
6	2:2,5:1		90,7



2-rasm. Ftal angidrid, etilen glikol va izoamil spirti asosida olingan plastifikator unumiga vaqtning tasiri

Sintez qilib olingan natijalardan ko'rish mumkinki reaksiya 8 soatgacha davom etganda maxsulotni chiqishi unumi ortib boradi, shuningdek eng yuqori chiqish unumiga dastlabki xom-ashyolarni mol nisbatlari 1:2 nisbatda bo'lganda yuqori unumga erishildi.

3. Xulosa

Ftal angidrid, etilen glikol va izoamil spirti asosida sintez qilingan plastifikatorning hosil bo'lish unumiga dastlabki xom-ashyolarni mol nisbatlari va jarayon vaqtining ta'siri aniqlangan. Tayyor bo'lgan diizoamildiflatglikolni PVX kompozitsiyasiga plastifikator sifatida qo'llash uchun, GOST8728 bo'yicha plastifikator rangi tiniq rangsiz bo'lishi talab etiladi, shuning uchun, plastifikatorning umumiy massaga nisbatan 5 foizgacha miqdorda sorbent qo'shib, 20-30 daqiqa davomida, 90-100 °C haroratda ishlov berildi, hamda filtr yordamida ishlov beriladi. Mahalliy xom ashyolar asosida sintez qilib olingan plastifikatorni IQ-spektroskopiya tahlil natijalari o'rganildi.

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