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DEVELOPMENT OF CLINKER AND PORTLAND CEMENT COMPOSITION BASED ON SURKHONDARYO RAW MATERIALS

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The purpose of this research work is to develop clinker and Portland cement compositions based on Surkhandarya raw materials for the planned construction of a cement plant, as well as to study their physical and chemical properties. The compositions of clinkers, including limestone, clay from the Yolgizbulok deposit and slag from the Almalyk mining and metallurgical plant, were studied. The optimal clinker composition was selected, on the basis of which Portland cement was obtained. The optimal amount of gypsum addition was determined to achieve a cement stone strength of 43,5 MPa. The developed clinker composition will provide the planned enterprise with local raw materials and will reduce the firing temperature by 5 °C, which will ensure energy saving in large-scale production. The resulting Portland cement grade 500 will provide the construction industry with high-quality building material.

Keywords: clinker, portlandcement, slag, gypsum, energy saving

РАЗРАБОТКА СОСТАВА КЛИНКЕРА И ПОРТЛАНДЦЕМЕНТА НА ОСНОВЕ СУРХОНДАРЬИНСКОГО СЫРЬЯ

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Целью данной научно-исследовательской работы является разработка энергоэффективного составов клинкера и портландцемента на основе сурхандарьинского сырья для планируемого строительства цементного завода, а также изучение их физико-химических свойств. Исследованы составы клинкеров, включающих известняк, глину месторождения Ёлгизбулок и шлак Алмалыкского горно-металлургического комбината. Выбран оптимальный состав клинкера, на основе которого получен портландцемент. Определено оптимальное количество добавки гипса при котором достигается прочность цементного камня 43,5 МПа. Разработанный состав клинкера обеспечит планируемое предприятие местным сырьем, позволит снизить температуру обжига на 5 °С, что обеспечит энергосбережение при многотоннажном производстве. Полученный портландцемент марки 500 обеспечит строительную индустрию качественным строительным материалом.

Ключевые слова: клинкер, портландцемент, шлак, гипс, энергосбережение

SURXONDARYO XOMASHYOLARI ASOSIDA KLINKER VA PORTLANDSEMENT TARKIBLARINI ISHLAB CHIQISH

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Mazkur ilmiy tadqiqot ishining maqsadi rejalashtirilgan sement zavodini qurish uchun Surxondaryo xomashyosi asosida klinker va portlend tsementning energiya tejamkor kompozitsiyalarini ishlab chiqish hamda ularning fizik-kimyoviy xossalarini o'rganishdan iborat. Klinkerlar, jumladan, Yolg'izbuloq konidan olingan ohaktosh, giltiproq va Olmaliq kon-metallurgiya kombinati shlaklari tarkibi o'rganildi. Optimal klinker tarkibi tanlangan, uning asosida Portlandsementi olingan. 43,5 MPa sement toshining mustahkamligiga erishish uchun gips qo'shilishining optimal miqdori aniqlandi. Ishlab chiqilgan klinker tarkibi rejalashtirilgan korxonani mahalliy xomashyo bilan ta'minlaydi va pishirish haroratini 5 °C ga kamaytiradi, bu esa keng ko'lamli ishlab chiqarishda energiya tejashni ta'minlaydi. Olingan portlandsementning 500 markasi qurilish sanoatini yuqori sifatli qurilish materiallari bilan ta'minlaydi.

Kalit so'zlar: klinker, portlandsement, shlak, gips, energiya tejash

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Kirish

Bugungi kunda rivojlangan davlatlarning tabiiy xomashyolardan oqilona foydalanish hamda chiqindisiz texnologiyalarni joriy etish natijasida sanoati rivojlanmoqda. O'zbekistonda ham bu borada ko'pgina ishlar amalga oshirilmoqda. Xususan portlansement ishlab chiqarishda mahalliy xomashyolardan oqilona foydalanish va sifatli portlandsement olishga e'tibor berilmoqda.

O'zbekistonda aholi jon boshiga sement iste'moli yiliga 700 kg ga etishi va keyinchalik 400 kg atrofida barqarorlashishi kutilmoqda. Mam-lakatimizda ortib borayotgan talabni qondirish maqsadida hozirdanoq bir qator yangi ishlab chiqarish quvvatlari barpo etilib, ularni qurish uchun yangi loyihalar amalga oshirilmoqda [1, 2].

Ko'pgina mamlakatlarda sement sanoati rivojlanmoqda [3-5]. Sement ishlab chiqarish katta miqdordagi energiyani talab qiladi - energiya xarajatlari yakuniy mahsulot tannarxining taxminan 35-40% ni tashkil qiladi va yoqilg'ining ulushi bevosita ushbu qiymatning yarmidan oshadi. Tadqiqotlar energiya sarfini turli usullar bilan kamaytirishga qaratilgan - xom ashyoni almashtirish,

1-Jadval

Xomashyolarning kimyoviy tarkibi

Xom ashyo nomi	Oksidlarning massa miqdori, %									k.y.f.
	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	R_2O	Qolgan oksid	SO_3	H_2O	
	"Yolg'izbuloq" koni xomashyosi									
Ohaktosh	2,98	0,90	0,21	52,99	0,83	0,31	0,508	0,25		40,19
Giltuproq	57,1	14,3	6,21	8,20	1,5	1,38	1,83	0,41		9,02
Gips	0,44	0,47	0,12	34,80	0,19	43,72	0,66	43,72	19,60	
Olmaliq kon metalurgiya konbenatining temir saqlagan sanoat chiqindisi										
Shlak	31,70	6,62	48,00	2,32	1,10	1,11	0,53	1,48		7,14

texnologik chiqindilardan foydalanish va boshqalar [6-13].

Minimal energiya sarfi bilan sement xususiyatlarini yaxshilash, shuningdek noyob xususiyatlarga ega sement tizimlarini yaratish sement kimyosining dolzarb vazifalaridan biri sifatida belgilangan [14].

Mazkur ilmiy tadqiqot ishining maqsadi rejalashtirilgan sement zavodini qurish uchun Surxondaryo xomashyosi asosida klinker va portlend tsementning energiya tejamkor kompozitsiyalarini ishlab chiqish hamda ularning fizik-kimyoviy xossalarini o'rganishdan iborat.

Tadqiqot uslullari

Klinkerning kimyoviy tahlili energiya dispersli rentgen-fluoresan spektrometri Rigaku NEX CG (AQSh) da amalga oshirildi.

XRD-6100 (Shimadzu, Yapon) qurilmasida olingan difraksion naqshlar asosida rentgen nurlari difraksion tahlili o'tkazildi.

Sement toshining mustahkamligi va qotish muddati GOST 30744-2001 asosida aniqlanadi.

Xomashyolarning kimyoviy tarkibi 1-jadvalda keltirilgan [15].

2-Jadval

Klinker olishda xomashyolarning massa nisbati keltirilgan

Xomashyolarning nomlanishi	Olingan xomashyolarning miqdori, mass % da		
	1	2	3
Ohaktosh	80,61	81,38	80,43
Giltuproq	16,94	15,78	15,0
Shlak	2,45	2,84	4,57

Kimyoviy tarkibi bo'yicha Yolg'izbuloq konining ohaktoshlari, gil va gipslari GOST 31108 -2020 talablariga javob beradi.

Natijalar va muhokamalar

Biz 1-jadvalda keltirilgan xom ashyo asosida klinker kompozitsiyalarini o'rgandik, ularning uchta tarkibi optimalga yaqin, 2-jadvalda keltirilgan.

Taqdim etilgan kompozitsiyalar 1430, 1445 va 1450 °C haroratda kuydirildi. 2-tarkibning diffraktsiya naqshlari rasmda ko'rsatilgan. Boshqa kompozitsiyalar talab qilinadigan faza tarkibining yuqori haroratga erishishini ko'rsatdi.

Berilgan diffraktsiya naqshlaridan ko'rinib turibdiki, 1445 °C otish haroratida klinkerning kerakli fazaviy tarkibiga erishiladi.

3-jadvalda optimal klinker tarkibining kimyoviy tarkibi ko'rsatilgan.

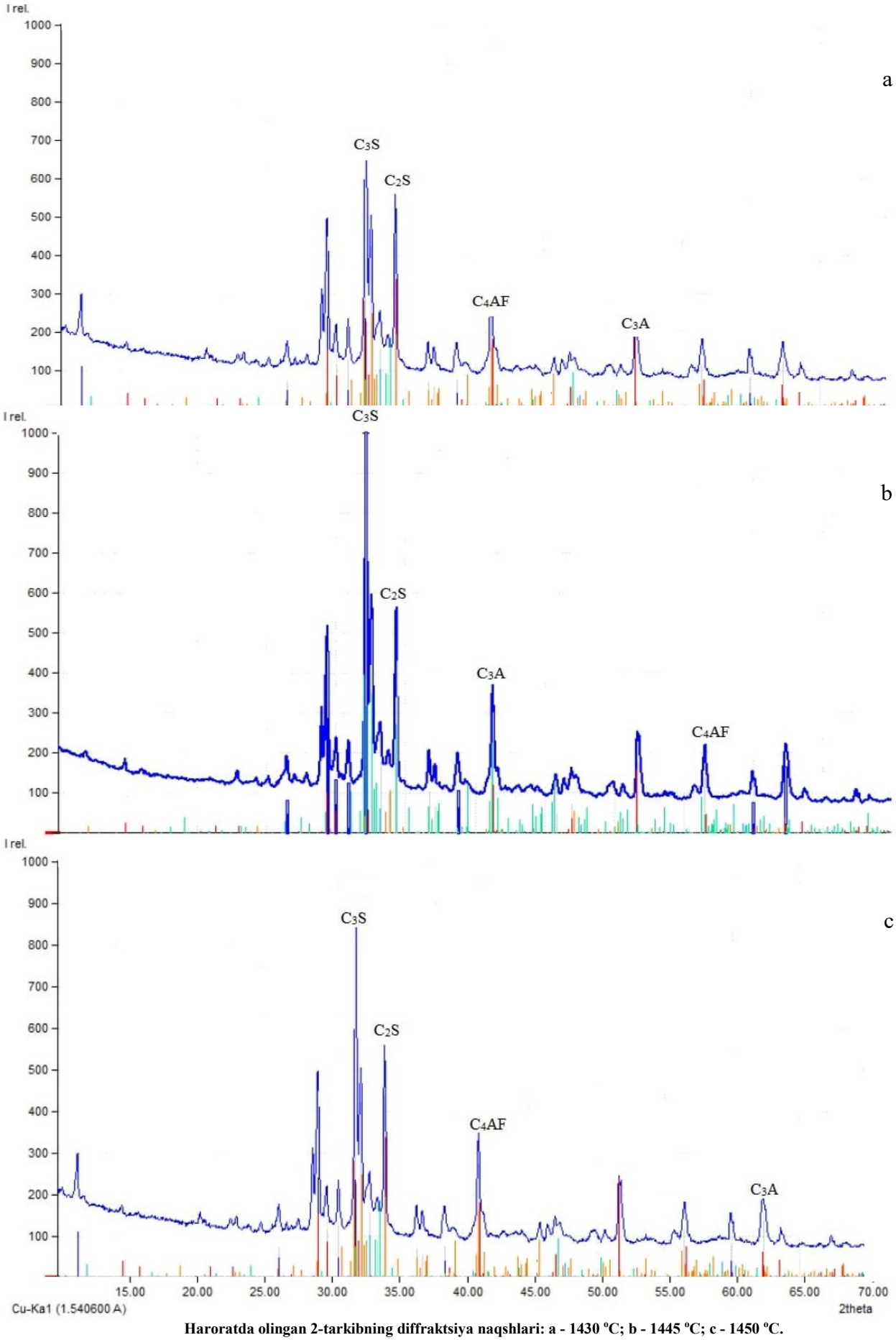
3-Jadval

Olingan klinkerlarning kimyoviy tarkibi keltirilgan

Oksidlarning massa miqdori, %							
SiO_2	Fe_2O_3	Al_2O_3	MgO	CaO	SO_3	R_2O	Jami
21,6	2,9	4,81	1,24	66,1	1,11	1,29	100

Rentgen nurlari difraksiyasi va kimyoviy tahlillar asosida klinkerning miqdoriy tarkibi hisoblab chiqildi (4-jadval). Taqdim etilgan ma'lumotlardan ko'rinib turibdiki, olingan klinkerdagi alit tarkibi GOST 31108-2020 ga muvofiq belgilangan chegaralar ichida.

Portlandsementini olish uchun optimal tarkibdagi klinker 008-sonli elakda 9% qoldiqgacha maydalangan. Olingan kukunga 2,8 dan 5% gacha bo'lgan gips qo'shilgan. Gips qo'shilishining qattiqlashuv vaqtiga ta'siri natijalari 5-jadvalda keltirilgan.



Haroratda olingan 2-tarkibning diffraktsiya naqshlari: a - 1430 °C; b - 1445 °C; c - 1450 °C.

4-Jadval

Klinkerning asosiy kimyoviy va mineralogik tarkibi

Kimyoviy tarkibi	Miqdori, % da	Mineralogik tarkibi	Miqdori, % da	Qisqartirib yozilishi
CaO	66,1	$3CaO{\cdot}SiO_2$	64,15	C_3S
Al_2O_3	4,81	$2CaO{\cdot}SiO_2$	17,03	C_2S
SiO_2	21,6	$3CaO{\cdot}Al_2O_3$	6,57	C_3A
Fe_2O_3	2,9	$4CaO{\cdot}Al_2O_3{\cdot}\ Fe_2O_3$	11,14	C_4AF

5-Jadval

Portlandsementga qo'shilgan gipsning sement toshining qotish muddatiga ta'siri keltirilgan

№	Qo'shilgan gips miqdori, % da	Qotish bosh, min	Qotish tugashi, min
1	5	110	190
2	4,8	110	195
3	4,5	110	185
4	4,3	110	185
5	4,0	65	155
6	3,8	65	125
7	3,5	60	110
8	3,2	55	100
9	3,0	45	100
10	2,8	35	80

Berilgan ma'lumotlardan ko'rinib turibdiki, 8-10 dan tashqari barcha kompozitsiyalar sement qotishining boshlanishi uchun talabga javob beradi (GOST 10178-76). Optimal sifatida 4-kompozitsiya tanlandi. 4,3% gips qo'shilishi 110 daqiqada qotishning boshlanishini va 185 daqiqada tugashini ta'minlaydi. 1-3 formulalari deyarli bir xil natijalarni beradi, lekin ko'proq gips bilan.

Sement toshining mustahkamligiga maydalanish darajasining ta'sirini o'rganish natijalari 6-jadvalda keltirilgan.

008-sonli elakda qoldiqning ko'payishi sement toshining mustahkamligini pasayishiga olib keladi. Optimal sifatida 9% qoldiq tanlandi, bunda 500 markaga mos keladigan mustahkamlikka erishiladi. 008-sonli elakdagi qoldiqning 9% dan kamayishi mayin

6-Jadval

Ushbu jadvalda portlandsement maydalanish darajasining sementtoshi mustahkamligiga ta'siri keltirilgan

Maydalanish darajasi 008 elak, %	Portlandsementning vaqt bo'yicha mustahkamligi, MPa.			
	2	7	28	Markasi (M)
95	23,9	41	45,5	550
93	22,8	40	44,2	550
91	22,5	39	43,5	500
89	19,7	39	42,5	450
88	18,0	38	41,0	400
85	17,8	38	39,9	400
83	18,1	37	40,0	400
85	17,9	36	37,8	350
81,5	18,6	37	40,7	350
83	19,1	34	35,1	300

maydalashda energiya sarf-xarajatlarining oshishi bilan bog'liq.

Xulosa

Yolg'izbuloq konining sifatli ohaktosh, giltuproq va gipsni o'z ichiga olgan xomashyosini o'rganish, shuningdek, Olmaliq kon-metallurgiya kombinatining shlaklarini qo‘shimcha sifatida kiritilishi uning asosida klinker va portlandsement olish imkonini berdi. Optimal klinker tarkibi 64% alit ishlab chiqarishni ta’minlaydi. 110 daqiqadan so'ng qotish boshlanishini va 185 daqiqadan so'ng tugashini ta’minlash uchun gipsning optimal miqdori aniqlandi. 008-sonli elakdagi qoldiq 43,5 MPa quvvatga ega sement toshini ishlab chiqarishni ta’minlaydi. Ishlab chiqilgan klinker tarkibi rejalashtirilgan korxonani mahalliy xomashyo bilan ta'minlaydi va kuydirish haroratini 5 °C ga kamaytiradi, bu esa keng ko'lamli ishlab chiqarishda energiya tejashni ta'minlaydi. Olingan portlandsementining 500 markasi qurilish sanoatini yuqori sifatli qurilish materiallari bilan ta’minlaydi.

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