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**“WOMEN IN INNOVATION AND SCIENCE”
XALQARO ILMIY-AMALIY KONFERENSIYA VA FORUMI
ILMIY ISHLARI TO‘PLAMI**

Toshkent davlat transport universitetida 2026-yil 27-mart kuni “Women in Innovation and Science” xalqaro forumi ilmiy ishlari to‘plami chop etildi.

Mazkur nufuzli tadbirlar O‘zbekiston Respublikasi Oliy ta’lim, fan va innovatsiyalar vazirligi hamda Transport vazirligi hamkorligida tashkil etilib, mamlakatimizda ilm-fan, innovatsiyalar va zamonaviy texnologiyalarni rivojlantirish, shuningdek xalqaro ilmiy hamkorlikni yanada kengaytirishga qaratilgan muhim platforma hisoblanadi.

Konferensiya ochilish marosimida davlat organlari, xalqaro tashkilotlar va yetakchi oliy ta’lim muassasalari vakillari ishtirok etdi. Jumladan, Toshkent davlat transport universiteti rektori G‘ulomov Abdulaziz Abdullayevich, O‘zbekiston Respublikasi Transport vazirligi vakili Ulmasova Lobarkhon Adilovna, Osiyo taraqqiyot banki eksperti Claire Charnac, Istanbul Aydin universiteti vasiylik kengashi raisi Mustafa Aydin, Belarus davlat transport universiteti rektori Kazakov Nikolay Nikolayevich hamda Qirg‘iziston Respublikasi Transport vazirligi vakili Dinara Moldokalieva ishtirok etdilar.

Konferensiya ilmiy dasturi doirasida plenar va panel sessiyalar, shuningdek ilmiy ma’ruzalar taqdimoti o‘tkazilib, ularda sun’iy intellekt va raqamli texnologiyalarni iqtisodiyot va ta’limga joriy etish, transport va aviatsiya sohasida innovatsion yechimlar, sanoat va IT sohasida texnologiya transferi, shuningdek ta’limda raqamli platformalar va intellektual tizimlar kabi dolzarb masalalar yoritildi.

2026-yil 27-mart kuni o‘tkazilgan “Women in Innovation and Science” xalqaro forumi ayollar yetakchiligi, innovatsiyalar va STEM sohalariga bag‘ishlangan bo‘lib, mamlakatimizda ayollarning ilm-fan va texnologiya sohalaridagi ishtirokini kengaytirish, ularning yetakchilik salohiyatini rivojlantirish hamda xalqaro hamkorlikni mustahkamlashga qaratilgan strategik maydon sifatida tashkil etildi.

Forum doirasida ayollar yetakchiligini rivojlantirish va rag‘batlantirish, xalqaro tajriba almashinuvi va ilmiy tarmoqlarni kengaytirish, yosh tadqiqotchi ayollar va PhD talabalarni qo‘llab-quvvatlash hamda innovatsion ekotizimlarda gender tenglikni ta’minlash kabi ustuvor vazifalar amalga oshirildi. Shuningdek, forumda ayollar yetakchiligi va STEM, gender tenglik va ilm-fan institutsional rivoji, ayollar tadbirkorligi va innovatsion startaplar, innovatsiya ekotizimlari va xalqaro hamkorlik, yosh ayol tadqiqotchilarni rivojlantirish, mentorlik va akademik tarmoqlar yo‘nalishlarida tematik sessiyalar tashkil etildi.

Forumda davlat organlari, xalqaro tashkilotlar, yetakchi oliy ta’lim muassasalari va ilmiy markazlar vakillari, jumladan “OLIMA” uyushmasi raisi Murtazayeva Raxbar Hamidovna, “Sharq ayoli” xalqaro ayollar jamoat fondi raisi Tursunbayeva Saodat Gafurovna, Osiyo taraqqiyot banki eksperti Claire Charnac, O‘zbekiston Respublikasi Transport vazirligi vakili Ulmasova Lobarkhon Adilovna, Toshkent davlat transport universiteti rektori G‘ulomov Abdulaziz Abdullayevich, Qirg‘iziston Respublikasi Transport vazirligi vakili Dinara Moldokalieva hamda Indoneziyadan universitet dekani Yoga Prihatin ishtirok etdilar.



Shuningdek, forumda Yevropa va Osiyo davlatlaridan yetakchi olimlar, ekspertlar va yosh tadqiqotchilar keng qatnashdi.

Forum dasturiga ochilish marosimi, panel muhokamalar, ilmiy chiqishlar hamda professional rivojlanish bo'yicha workshoplar kiritilgan bo'lib, ular doirasida gender tenglik, ayollar karyerasini rivojlantirish, ilmiy tadqiqotlar va innovatsion boshqaruv bo'yicha amaliy seminarlar tashkil etildi.

Mazkur tadbirlar Osiyo taraqqiyot banki (ADB), "OLIMA" — O'zbekiston xotin-qizlar olimlari uyushmasi, "Sharq ayoli" xalqaro ayollar jamoat fondi, Germaniya xalqaro hamkorlik jamiyati (GIZ), shuningdek Rossiya, Turkiya, Indoneziya va Qirg'iziston oliy ta'lim muassasalari hamda Belarus Milliy fanlar akademiyasi ilmiy institutlari hamkorligida o'tkazildi.

Mazkur xalqaro ilmiy-amaliy konferensiya va forumning ahamiyati shundaki, ular xalqaro ilmiy hamkorlikni mustahkamlash, innovatsion ishlanmalarni amaliyotga joriy etish, raqamli va barqaror rivojlanishni ta'minlash, shuningdek ayollarning ilm-fan va innovatsiya sohalaridagi rolini kuchaytirishga xizmat qiladi. Shu bilan birga, mazkur tadbirlar yosh olimlar va tadqiqotchilarni qo'llab-quvvatlash, ilmiy tajriba almashish hamda global ilmiy makonga integratsiyalashuvni jadallashtirishda muhim ahamiyat kasb etadi.

Mazkur xalqaro ilmiy-amaliy konferensiya va forumning maqsadi zamonaviy ilmiy tadqiqot yo'nalishlarini muhokama qilish, innovatsion yondashuvlar va ilg'or texnologiyalar bo'yicha ilmiy natijalar almashuvini ta'minlash, shuningdek xalqaro ilmiy hamkorlikni rivojlantirishdan iboratdir.

Tadbirda O'zbekiston Respublikasi hamda xorijiy mamlakatlarning oliy ta'lim muassasalari va ilmiy-tadqiqot institutlari olimlari, shuningdek amaliyotda muhim natijalarga ega bo'lgan mutaxassislar o'z ilmiy ishlari bilan ishtirok etdilar.

Ushbu ilmiy to'plamda muhandislik, transport, raqamlashtirish, sun'iy intellekt, innovatsion boshqaruv, gender tenglik va barqaror rivojlanish sohalarida faoliyat yuritayotgan yetakchi olimlar, professor-o'qituvchilar va tadqiqotchilarning ilmiy ishlari jamlangan. To'plamda dolzarb ilmiy muammolar, zamonaviy yechimlar, nazariy va amaliy tadqiqot natijalari yoritilib, ushbu yo'nalishlarning bugungi holati va istiqboldagi rivojlanish tendensiyalari aks ettirilgan.

Mazkur nashr mamlakatimizda ilm-fan va innovatsion rivojlanishni ta'minlash, xalqaro ilmiy aloqalarni mustahkamlash hamda yosh olimlar va tadqiqotchilarni qo'llab-quvvatlash yo'lidagi muhim qadamlardan biri sifatida e'tirof etiladi.

Shuningdek, mazkur ilmiy to'plamda keltirilgan natijalar kelgusida ilmiy tadqiqotlar samaradorligini oshirish, amaliyotga yo'naltirilgan innovatsion yechimlarni keng joriy etish hamda sohalararo integratsiyani chuqurlashtirish uchun muhim ilmiy asos bo'lib xizmat qiladi. To'plam materiallari nafaqat ilmiy jamoatchilik, balki ishlab chiqarish sohasi mutaxassislari, doktorantlar va talabalar uchun ham foydali manba hisoblanadi.

Mazkur nashrda yoritilgan ilmiy g'oyalar va ilg'or yondashuvlar asosida yangi ilmiy izlanishlar olib borilishi, xalqaro ilmiy aloqalarning yanada rivojlanishi hamda innovatsion rivojlanish strategiyalarining takomillashishiga xizmat qilishi kutilmoqda.



Influence of silica gel dispersion and superplasticizer on the properties of cement paste

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Abstract:

The influence of the dispersion and content of ground silica gel on the properties of cement paste in the presence of a polycarboxylate-based superplasticizer was investigated. Silica gel was introduced in amounts of 5, 10, and 15% by mass of cement, while the superplasticizer dosage was 1%. It was established that an increase in the fineness of silica gel promotes the intensification of hydration processes and the formation of a denser cement paste structure. It was shown that the optimal silica gel content is 5%, at which the maximum strengthening effect is achieved. The incorporation of the superplasticizer reduces the water-to-cement ratio and enhances the compressive strength of the cement paste; however, it is accompanied by an increase in setting time. The highest strength was obtained for the composition containing 5% finely dispersed silica gel and 1% superplasticizer. The observed effect is attributed to the combined action of the additives and the densification of the cement paste structure.

Keywords:

silica gel, fineness, cement paste, superplasticizer, water-to-cement ratio, compressive strength, setting time, modification of cementitious systems

1. Introduction

The development of non-autoclaved foamed concrete is associated with the need to improve the strength characteristics and structural homogeneity of the cement paste while simultaneously reducing the material density. One of the most effective approaches is the use of active mineral additives capable of participating in pozzolanic reactions and promoting the formation of additional calcium silicate hydrate (C–S–H) phases [1, 2].

The pozzolanic activity of silica-containing materials is governed by their interaction with calcium hydroxide, leading to the formation of low-basic calcium silicate hydrates, which contribute to the densification of the cement paste structure and an increase in its strength [3]. The intensity of these processes is largely determined by the fineness of the additive and the content of amorphous silicon dioxide [4].

Silica fume is the most widely used silica-containing additive, as it accelerates cement hydration, reduces the content of portlandite, and contributes to the formation of a denser microstructure [5]. At the same time, studies show that the efficiency of such additives strongly depends on their dosage; exceeding the optimal content leads to a dilution effect in the cement system [6].

In recent years, increasing attention has been paid to the use of silica gel as an alternative source of amorphous SiO₂. Due to its high specific surface area and reactivity, silica gel can actively participate in pozzolanic reaction, contributing to the additional formation of C–S–H phases [7]. However, the effect of silica gel fineness on the properties of cement paste remains insufficiently studied, especially under conditions of complex modification.

An additional factor influencing structure formation processes is the use of superplasticizers, which affect hydration kinetics, the water-to-cement ratio, and setting time [8]. However, the combined effect of silica gel fineness and superplasticizer on the properties of cementitious systems requires further investigation.

In this regard, the aim of this study is to investigate the effect of the fineness and content of ground silica gel on the setting time and strength characteristics of cement paste in the presence of a superplasticizer.

2. Materials and methods

Portland cement CEM II/A-K (Z-I) 42.5N produced by JSC “Ahangarancment” was used as the binder.

Technical silica gel was used as a mineral additive and ground under laboratory conditions in a ball mill to three levels of fineness: 9215, 4310, and 1866 cm²/g. Different degrees of fineness were achieved by varying the grinding duration. The obtained powders were characterized by different specific surface areas, determined using a PVKh-11A apparatus, which made it possible to evaluate the effect of fineness on the reactivity of the additive.

A polycarboxylate-based superplasticizer of German origin (“Master Glenium”) was used as a chemical admixture to regulate the rheological properties of the mixture. The dosage of the superplasticizer was 1% by mass of cement and was selected based on preliminary experimental studies as optimal, ensuring effective water reduction without adverse effects on hydration processes and the strength characteristics of the cement paste.

The water-to-cement ratio was adjusted for each composition according to the standard consistency, determined by the Vicat method (with plunger) in accordance with GOST 310.3–76, which ensured identical rheological conditions and the reliability of the comparative analysis of the studied systems.

The initial and final setting times were determined using the Vicat method with a needle in accordance with GOST 310.3–76 “Cements. Methods for determination of standard consistency, setting time, and soundness.”

The initial setting time was defined as the moment when the Vicat needle failed to reach the bottom of the mould by

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1–2 mm, while the final setting time corresponded to a penetration depth of not more than 1 mm.

All measurements were carried out at a temperature of (20 ± 2) °C.

Cube specimens with dimensions of $20 \times 20 \times 20$ mm were prepared from the investigated compositions and kept in moulds for 24 hours. After demoulding, the specimens were stored in a standard curing chamber at a temperature of (20 ± 2) °C and a relative humidity of at least 95%, in accordance with GOST 10180–2012.

For convenience of analysis, the investigated compositions were designated as follows:

R — cement paste without additives;
SP — cement paste with superplasticizer Master Glenium (1% by mass of cement);
SG5C — cement paste with silica gel (5%) and superplasticizer Master Glenium (1%);

FSG — compositions with finely dispersed silica gel;
MSG — compositions with medium-dispersed silica gel;
CSG — compositions with coarsely dispersed silica gel.

Within each series, the silica gel content was 5, 10, and 15% by mass of cement. The content of additives is given as a percentage of the cement mass.

Compressive strength was determined at the age of 28 days using a hydraulic press (model to be specified) in accordance with GOST 10180–2012.

The tests were carried out on six parallel specimens for each composition.

3. Results and Discussion

It was established that the fineness of ground silica gel has a significant effect on the structure formation processes of the cement paste. The appearance of silica gel with different degrees of fineness is shown in Figure 1.

An increase in grinding time leads to a reduction in particle size and an improvement in powder homogeneity, indicating an increase in the specific surface area of the material.

The water-to-cement ratio for the investigated compositions was selected in accordance with the standard consistency of the cement paste. The obtained W/C values are presented in Table 1.

The greatest increase in the W/C ratio was observed for compositions with finely dispersed silica gel, which is attributed to its high specific surface area.

Despite the increase in the water-to-cement ratio with the incorporation of silica gel, an increase in compressive strength is observed, confirming the active participation of silica gel in the pozzolanic reaction and its strengthening effect.

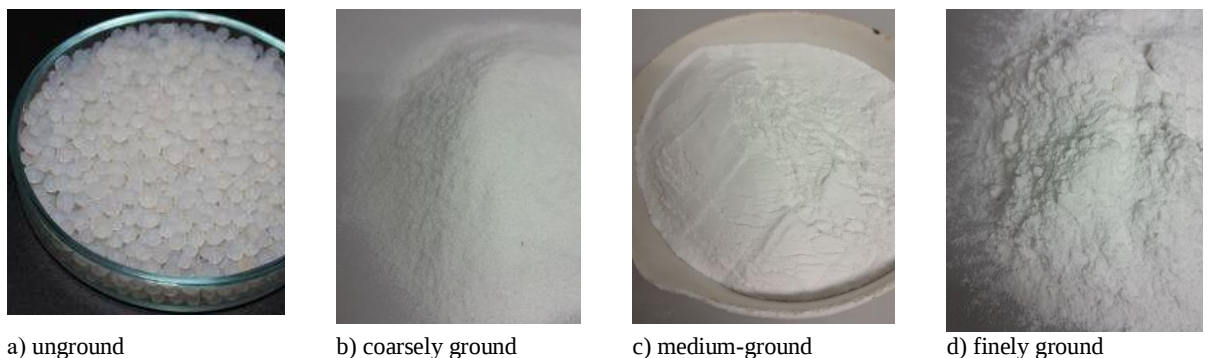


Fig.1. Appearance of silica gel with different degrees of fineness

Table 1

Composition of cement mixtures and their water-to-cement ratio determined based on standard consistency

№	Composition	W/C	Silica gel, % by cement mass	Silica gel, g	Penetration depth, mm*
1	R	0,30	—	—	5
2	FSG	0,32	5	20	6
3		0,34	10	40	6
4		0,38	15	60	5
5	MSG	0,32	5	20	5
6		0,34	10	40	6
7		0,37	15	60	6
8	CSG	0,32	5	20	5
9		0,33	10	40	5,5
10		0,33	15	60	6

* Distance between the Vicat plunger and the bottom of the mould.

The results of compressive strength tests at the age of 28 days are presented in Figure 2.

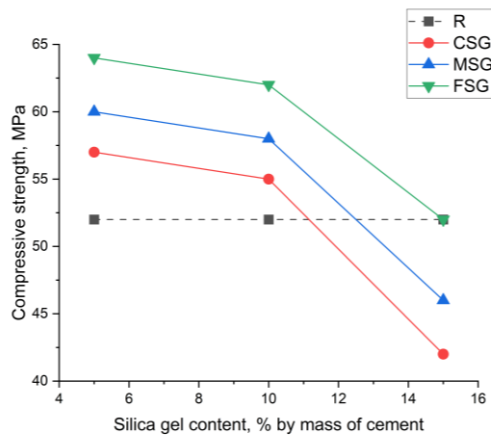


Fig. 2. Effect of silica gel content and fineness on the compressive strength of cement paste

It was established that the incorporation of silica gel leads to an increase in the compressive strength of the cement paste, while the magnitude of the effect depends on both the content of the additive and its fineness.

At a silica gel content of 5%, the strength increase reaches up to 9–10% for coarsely dispersed, up to 15% for

medium-dispersed, and up to 23% for finely dispersed material compared to the reference composition.

With an increase in silica gel content to 10%, the effect is maintained; however, the magnitude of the strength gain slightly decreases, amounting to approximately 6%, 11%, and 19%, respectively.

A further increase in content to 15% results in a reduction in strength, reaching up to 19% for coarsely dispersed and up to 11% for medium-dispersed silica gel, whereas for finely dispersed material the strength remains at the level of the reference composition.

It should be noted that the increase in strength occurs despite the rise in the water-to-cement ratio, which indicates the active progression of the pozzolanic reaction and the formation of additional C–S–H phase, leading to densification of the cement paste structure.

It was established that the optimal silica gel content is 5%, with the maximum strengthening effect observed when finely dispersed silica gel is used.

Based on the obtained results, further studies were carried out for compositions with the indicated silica gel content, incorporating a polycarboxylate superplasticizer in an amount of 1% by mass of cement to evaluate their combined effect on hydration processes, setting time, and strength characteristics of the cement paste.

The results of setting time determination for the selected compositions are presented in Table 2.

Table 2

Water-to-cement ratio, compressive strength, and setting time of cement paste composition

Composition	W/C	Compressive strength at 28 days, MPa	Initial setting time	Final setting time
R	0,3	52,3	2 h 10 min	2 h 50 min
SP	0,21	59,62	6 h 40 min	3 h 30 min
SG5C	0,22	95,4	5 h 25 min	4 h 55 min

It was established that the incorporation of the MasterGlenium superplasticizer (1%) leads to a significant increase in the initial setting time compared to the reference composition, indicating its retarding effect.

The addition of 5% silica gel in the presence of the superplasticizer contributes to a reduction in the initial setting time, which is attributed to its high fineness and the acceleration of hydration processes.

A similar trend is observed for the final setting time.

It was shown that the superplasticizer exerts a retarding effect on the setting processes, whereas silica gel partially compensates for this effect.

The test results demonstrated that the incorporation of the superplasticizer leads to an increase in the compressive strength of the cement paste, which is consistent with literature data and is attributed to a reduction in the water-to-cement ratio and densification of the structure.

The highest strength was observed for the SG5C composition containing 5% silica gel and 1% superplasticizer. The strength increase is approximately 60% compared to the SP composition.

The observed effect is explained by the combined action of the additives. The superplasticizer reduces the water-to-cement ratio, while finely dispersed silica gel, owing to its high specific surface area, intensifies the pozzolanic reaction, leading to additional formation of the C–S–H phase. Similar trends in strength enhancement with the incorporation of silica-containing additives have been reported in several studies [2, 4, 5].

It was observed that the combined use of the superplasticizer and silica gel provides a pronounced

synergistic effect and results in a significant increase in the strength of the cement paste.

Thus, the use of ground silica gel in combination with a superplasticizer is an effective approach for modifying cementitious binders and can be recommended for application in non-autoclaved foamed concrete.

4. Conclusion

The results obtained demonstrate that the fineness and content of silica gel have a significant effect on the properties of cement paste.

It was shown that an increase in silica gel fineness enhances its reactivity and intensifies the pozzolanic reaction. The optimal silica gel content is 5% by mass of cement, at which the maximum strengthening effect is achieved.

It was found that the incorporation of a polycarboxylate-based superplasticizer at a dosage of 1% reduces the water-to-cement ratio and increases the compressive strength of the cement paste; however, it is accompanied by an increase in setting time.

It was demonstrated that the combined use of the superplasticizer and finely dispersed silica gel provides a pronounced synergistic effect, resulting in a significant increase in strength while maintaining the workability of the mixture.

The obtained results are consistent with X-ray diffraction analysis data, confirming a decrease in portlandite content and an increase in the proportion of amorphous C–S–H phase.



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