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Features of concrete mix and mortar preparation process implementation considering delivery conditions

Abstract. The article investigates specific features of concrete mix and construction mortar preparation process implementation with regard to delivery conditions to the working zone of construction operation execution. The influence of mixing element kinematic parameters, medium structural-mechanical characteristics, and conveying system design parameters on technological property formation of mixtures during their movement is considered. The role of mixing regime influence on material rheological parameter formation determining pipeline transport intensity and subsequent application quality is demonstrated. Particular attention is given to mixture parameter requirements under building element layer-by-layer formation technology using 3D printing. The obtained results can be applied for mixing and feeding equipment operating parameter selection under various construction production conditions.

Keywords: concrete mix, construction mortar, mixing, pipeline feeding, rheological properties, mixer, transport, preparation technological regimes, extrusion forming, 3D printing

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Introduction.

Modern construction production technological processes are characterized by transition from isolated individual operation analysis to integrated interaction analysis of concrete mix and construction mortar preparation, transport, and placement stages. Under practical conditions, material application efficiency is determined not only by mixing parameter values but also by delivery condition features to the technological operation working zone. Mixing regime variation affects mixture structural state, directly influencing pipeline transport capability and subsequent placement or forming process applicability.

Under modern construction mechanization conditions, material rheological characteristic consideration becomes especially important for mixing

and conveying equipment operating parameter selection. Insufficient pipeline geometric parameter influence, material feed rate, and mixing element operating regime consideration leads to technological machine set productivity reduction and formed structure quality deterioration. Therefore, technological property formation process investigation with delivery condition consideration at all construction work execution stages becomes necessary.

Particular interest is associated with the application of concrete mixes and construction mortars in building element layer-by-layer formation technology using construction 3D printing, where material mobility, homogeneity, and extrusion feed capability requirements determine the possibility of target geometry product fabrication without traditional

formwork application. This necessitates refinement of mixture preparation regime selection approaches with consideration of transport conditions and forming conditions in digitally controlled construction systems.

Review of Research Resources and Publications.

Modern studies devoted to concrete mix and construction mortar preparation demonstrate a transition from analysis of individual technological operations to consideration of these processes as components of an integrated material transport and forming system in the construction working zone. Significant attention is given to structural-mechanical characteristic influence on mixture capability to move through pipeline systems, pass through pumping equipment working elements, and ensure required construction forming parameters [1, 2].

A separate research direction is associated with investigation of cement composition movement conditions in conveying channels of different geometry. It is established that medium rheological parameters, including yield stress, effective viscosity, and aggregate granulometric composition, determine mixture movement character in pipelines and influence feed process energy consumption. Therefore, a significant number of studies are focused on pumping system parameter investigation and construction material transport regime analysis within technological machine set structures [3, 4].

During recent years, the number of studies devoted to concrete mix application in building element layer-by-layer formation technology using 3D printing has significantly increased. In such technologies, the material sequentially passes through mixing, transport, and extrusion feed stages, which determines increased technological characteristic requirements at each process implementation stage. Particular attention is given to ensuring required mixture mobility during feeding and material capability to retain target shape after forming channel exit [5, 6].

Problem statement.

Under modern construction production conditions, technological property requirements for concrete mixes and construction mortars increase not only at the preparation stage but also during delivery to the work execution location. Pipeline and extrusion system application practice shows that mixing parameter values significantly influence material capability to move through conveying channels, pass through equipment working elements, and ensure required construction forming quality.

This problem becomes especially relevant under modern continuous placement and building element layer-by-layer formation technology application, particularly in construction 3D printing processes, where material must simultaneously satisfy transport and forming requirements. This necessitates investigation of mixture preparation process implementation features with delivery condition consideration in construction machine technological systems.

Main material and results.

The concrete mix and construction mortar preparation process within modern technological systems should be considered not as an isolated component mixing operation but as an initial stage of material technological property complex formation determining its subsequent behavior during pipeline channel transport, passage through pumping units, and structural element forming in the working zone. At the mixing stage, solid phase redistribution within the medium volume occurs, primary structural bond breakdown between cement stone particles takes place, aggregate grain contact formation develops, and uniform surface wetting by the binder component is achieved. As a result, a mixture structural-mechanical state is formed that subsequently determines technological channel transport conditions and feed process energy consumption [7].

A quantitative characteristic of mixing process intensity can be represented by specific energy transmitted to the mixture by mixer working elements, which is determined by the following relation

$$E = \frac{P \cdot t}{V} \quad (1)$$

where P – mixing mechanism drive power, W;

t – mixing duration, s;

V – mixture volume, m³.

With increasing specific mixing energy, cement component dispersion process intensification and medium aggregate structure breakdown occur, accompanied by rheological characteristic variation. Under practical conditions, this is manifested by effective viscosity and yield stress reduction, which creates favorable conditions for subsequent transport through conveying systems of different types [8].

An important factor determining technological property variation character during mixing is the kinematic operating regime of mixing equipment. With increasing working element motion velocity, medium particle mutual displacement process intensification occurs, which leads to more uniform component distribution throughout the volume and local high solid phase concentration zone reduction. In general form, specific mixing energy influence on mixture effective viscosity can be described by an exponential relation

$$\mu = \mu_0 e^{-kE}, \quad (2)$$

where μ_0 – initial mixture effective viscosity before mixing, Pa·s;

k – coefficient accounting for mixer design features and mixture composition;

E – specific mixing energy.

Such dependence character indicates gradual medium internal resistance reduction with increasing mixing intensity, while the most significant changes occur at initial technological process stages.

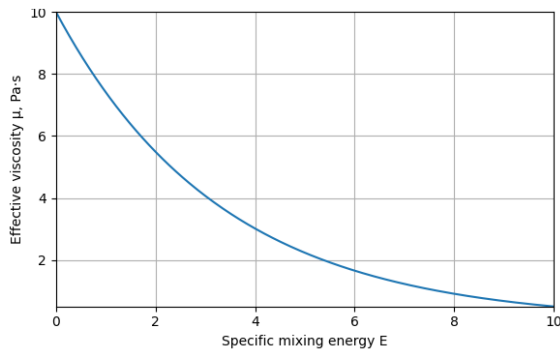


Figure 1 – Effective viscosity dependence on specific mixing energy

As shown by the graphical dependence (Fig. 1), increasing specific mixing energy causes intensive mixture effective viscosity reduction at the initial process stage, which is explained by primary structural bond breakdown between medium particles. Further mixing energy increase is accompanied by less pronounced viscosity variation, indicating gradual achievement of a rational mixture structural state.

At the same time, specific mixing energy increase is accompanied not only by medium rheological parameter variation but also by formation of conditions for mixture homogeneity improvement, which is of fundamental importance during transport through long pipeline systems. Nonuniform component distribution in the flow leads to local hydraulic resistance increase of material movement and load increase on conveying equipment working elements. Therefore, rational specific mixing energy value selection ensures the required level of mixture technological properties without excessive energy consumption increase for its preparation [9].

This approach becomes especially important under continuous construction mix feeding system application, particularly screw and extrusion mechanisms, where material flow parameters are determined not only by composition but also by structural state formed at the previous mixing stage. Under such conditions, specific mixing energy variation directly influences conveying channel filling character, material feed uniformity, and subsequent forming conditions in the technological operation working zone, including layer-by-layer material placement processes in construction 3D printing systems.

Further technological property formation of concrete mixes and construction mortars is largely determined by mixing equipment kinematic parameters, among which working element rotation frequency plays a decisive role. With increasing rotation frequency, medium particle relative displacement process intensification occurs, interaction intensity increases, and the number of local structural heterogeneities in the mixture volume decreases. This is accompanied by gradual cement–sand medium spatial structure breakdown and shear resistance reduction, which creates favorable conditions for

subsequent material transport through pipeline systems [10].

Mixture structural-mechanical characteristic variation under mixer working element action can be described by yield stress dependence on working element rotation frequency, which in the general case has an exponential character and is determined by the following relation

$$\tau_0 = \tau_{00}e^{-bn}, \quad (3)$$

where τ_{00} – initial mixture yield stress before mixing, Pa;

b – empirical coefficient accounting for mixer design features and mixture composition;

n – mixer working element rotation frequency, rpm.

The presented relation reflects medium internal resistance reduction with increasing mixing intensity and allows evaluation of material movement condition variation in conveying channels depending on equipment operating regimes.

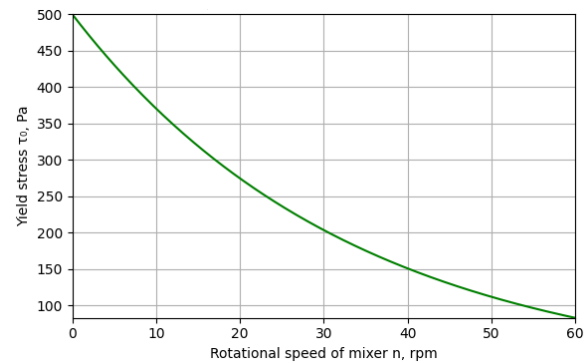


Figure 2 – Dependence of yield stress on rotational speed of the mixer

As shown by the graphical dependence (Fig. 2), increasing mixer working element rotation frequency causes mixture yield stress reduction, indicating gradual internal structure breakdown. Further rotation frequency increase is accompanied by less intensive variation of this parameter, corresponding to mixture transition to a state with minimal internal resistance to movement.

Simultaneously with yield stress reduction, mixture effective viscosity variation occurs, which also determines movement character in pipelines and forming channels. Under practical conditions, this is manifested by hydraulic resistance reduction of material movement and load reduction on pumping equipment working elements. Consideration of this phenomenon enables rational mixing element rotation frequency selection depending on conveying line length, pipeline diameter, and required feeding system capacity.

At the same time, excessive mixer working element rotation frequency increase may lead to excessive structural bond breakdown in the medium and deterioration of forming properties after forming channel exit. This is especially important under extrusion material feeding system application, where mixture capability to retain formed layer geometric

parameters after placement must be ensured. Therefore, determination of a rational mixing element rotation frequency range is one of the key tasks in technological equipment operating regime selection in concrete mix transport and layer-by-layer forming systems, particularly in construction 3D printing processes [11].

The subsequent stage of technological process implementation after formation of required mixture structural-mechanical characteristics is associated with transport through pipeline systems to the construction operation working zone. Process efficiency is largely determined by medium flow parameters in conveying channels, pipeline geometric characteristics, and mixture rheological properties formed at the previous mixing stage. At the same time, material movement resistance in the pipeline depends on particle interaction within the medium and with the conveying channel internal surface, which directly influences feed process energy consumption.

Concrete mix and construction mortar movement through pipelines should be considered as structured medium flow with yield stress presence, which allows transport process description using a generalized plastic medium model. In this case, pipeline pressure loss along the length can be determined by the following relation

$$\Delta p = \frac{4\tau_0 L}{D} + \frac{32\mu V L}{D^2}, \quad (4)$$

where Δp – mixture transport pressure loss, Pa;

τ_0 – material yield stress, Pa;

μ – medium effective viscosity, Pa·s;

L – pipeline length, m;

D – pipeline diameter, m;

V – mean flow velocity, m/s.

The presented relation allows evaluation of the combined influence of medium structural parameters and conveying system geometric characteristics on the required feeding pressure magnitude.

Analysis of the presented relation shows that with increasing pipeline length, pressure losses increase proportionally to conveying line length, which becomes especially significant during mixture feeding over long distances or in the vertical direction. Simultaneously, pipeline diameter reduction causes intensive shear stress growth in medium near-wall layers, leading to hydraulic resistance increase of material movement and load increase on pumping equipment working elements. Therefore, rational pipeline diameter selection is an important factor for efficient operation of concrete mix and construction mortar feeding systems.

Medium mean flow velocity also has a significant influence on pressure loss magnitude in the pipeline. With increasing flow velocity, shear deformation intensity in the medium volume increases, which is accompanied by hydraulic resistance growth of material movement. At the same time, insufficient mixture movement velocity may lead to nonuniform movement through conveying channels and feeding

system efficiency reduction. In the general case, material mean flow velocity is determined by the following relation

$$V = \frac{Q}{A}, \quad (5)$$

where Q – mixture flow rate, m³/s;

A – pipeline cross-sectional area, m².

This makes it possible to establish the relationship between feeding system capacity and medium flow regimes in conveying channels.

Pipeline feeding parameter consideration becomes especially important under extrusion concrete mix forming system application, where continuous material movement through forming channels determines target geometry product fabrication capability. In such technological systems, mixture feeding velocity variation directly influences material layer formation uniformity and structural element geometry reproduction accuracy, which is especially important in construction 3D printing applications.

The next stage of technological process implementation after pipeline transport of concrete mixes and construction mortars is their movement through screw or extrusion feeding mechanisms that provide directed material transport to the forming unit. Such systems are typical for plastering unit operation, continuous-action mortar pump application, and construction 3D printing installations, where the mixture is delivered through forming nozzles to obtain layers with target geometry. Under these conditions, feeding system capacity is determined both by conveying element rotation kinematic parameters and by the interflight space filling degree with material, which directly depends on its structural-mechanical characteristics.

Material flow rate evaluation in screw feeding systems is performed using the following relation

$$Q = \frac{\pi D^2 S n \varphi}{4}, \quad (6)$$

where Q – mixture feeding capacity, m³/s;

D – screw diameter, m;

S – screw helix pitch, m;

n – screw rotation frequency, s⁻¹;

φ – interflight space filling coefficient.

The presented relation shows that feeding system capacity is directly proportional to screw rotation frequency and conveying element geometric parameters, which enables material flow rate control according to technological requirements of building element forming processes.

As shown by the graphical dependence (Fig. 3), screw rotation frequency increase is accompanied by proportional mixture flow rate growth, which enables material feeding intensity control according to forming device movement velocity in extrusion forming systems, particularly in construction 3D printing technologies.

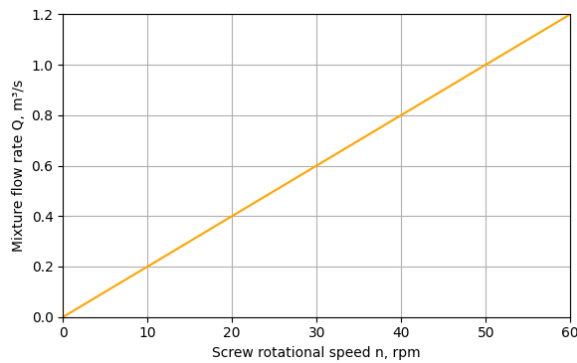


Figure 3 – Dependence of mixture flow rate on screw rotational speed

At the same time, screw interflight space filling degree is determined not only by conveying element geometric characteristics but also by mixture rheological properties formed at previous mixing and pipeline transport stages. With increasing medium effective viscosity, resistance to movement along the helical surface increases, which is accompanied by actual feeding system capacity reduction compared with theoretical values. Therefore, determination of actual material flow rate should include consideration of medium slip coefficient relative to the screw surface, which can be described by the following relation

$$Q_r = Q(1 - \psi), \quad (7)$$

where Q_r – actual feeding capacity, m³/s;

ψ – capacity loss coefficient accounting for material backflow and medium slip.

An important parameter characterizing extrusion feeding system operation is the pressure required for mixture movement through the nozzle forming channel. In the general case, its magnitude depends on channel geometric parameters and material structural-mechanical characteristics and can be determined by the following relation

$$p = \tau_0 \frac{L}{h}, \quad (8)$$

where p – forming channel pressure, Pa;

h – character cross-section dimension of the channel, m.

Forming channel length increase or cross-section reduction leads to required feeding pressure growth, which must be considered during extrusion concrete mix transport system design.

In construction 3D printing technologies, screw material feeding parameters directly influence layer formation accuracy and mixture placement uniformity along the prescribed trajectory of forming head movement. Coordination of feeding capacity with forming device movement velocity ensures required layer geometric parameters and prevents excessive material accumulation in the forming zone. Thus, determination of rational operating parameters of screw and extrusion feeding systems is a necessary condition for effective concrete mix and construction mortar

application in modern continuous building structure forming technological systems.

Concrete mix and construction mortar forming processes in the technological operation working zone of modern construction systems are often performed by extrusion material feeding through forming nozzles of different geometry. Process behavior features are determined by mixture capability to retain target geometric parameters after forming channel exit, which directly depends on structural-mechanical characteristics formed at previous mixing and transport stages. Under such conditions, coordination of material feeding parameters with forming device movement velocity becomes especially important, since excessive mixture flow rate leads to layer deformation, while insufficient flow rate causes formed element continuity violation.

During mixture passage through the forming channel, stress redistribution occurs within its volume and partial internal structural bond breakdown takes place, which influences material exit behavior from the nozzle and subsequent layer forming conditions. After forming channel exit, the mixture undergoes relaxation deformations, whose magnitude is determined by the relationship between yield stress, medium effective viscosity, and material feeding velocity. This directly influences geometric parameter reproduction accuracy of formed structural elements in continuous mixture placement processes.

For quantitative evaluation of mixture shape retention capability after extrusion feeding, it is advisable to use a shape retention coefficient determined by the following relation

$$K_f = \frac{h_1}{h_0}, \quad (9)$$

where h_0 – initial formed layer height immediately after nozzle exit, m;

h_1 – layer height after completion of material relaxation deformations, m.

With consideration of yield stress influence on the layer relaxation deformation process, functional dependence of the shape retention coefficient on mixture structural-mechanical characteristics can be presented in the following form

$$K_f = \frac{\tau_0^2}{a + \tau_0^2}, \quad (10)$$

where a – parameter accounting for mixture composition and extrusion feeding conditions through the forming nozzle.

As follows from the presented relation, increasing mixture yield stress improves its capability to retain target geometric parameters after placement, while the growth intensity of the shape retention coefficient gradually decreases when transitioning to the region of high shear stress values. This corresponds to material layer formation conditions in extrusion feeding

processes of concrete mixes and construction mortars, particularly in construction 3D printing technologies.

Dependence of the shape retention coefficient on mixture yield stress is shown in Fig. 4, which makes it possible to determine the range of rational structural-mechanical characteristic values of the material required to ensure necessary layer formation accuracy during extrusion feeding.

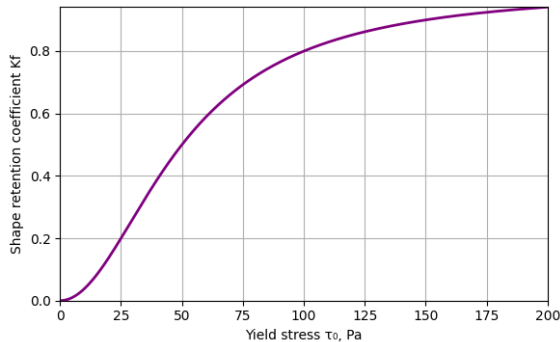


Figure 4 – Dependence of shape retention coefficient on yield stress

Thus, the performed analysis of concrete mix and construction mortar preparation and feeding processes showed that their efficiency is determined by coordination of material structural-mechanical characteristics with operating parameters of mixing, conveying, and forming equipment. It was established that specific mixing energy increase is accompanied by mixture effective viscosity reduction, which improves conditions of subsequent transport through pipeline systems. At the same time, mixer working element rotation frequency variation influences medium yield stress magnitude, which determines movement character in conveying channels and pressure loss magnitude during feeding.

It is shown that screw feeding system capacity directly depends on conveying element kinematic parameters and mixture rheological properties, while material capability to retain geometric parameters after extrusion forming is determined by yield stress magnitude and conditions of its passage through forming nozzles. The obtained relations make it

possible to determine rational preparation regimes of concrete mixes and construction mortars with consideration of delivery conditions in pipeline and extrusion systems, particularly in structural layer-by-layer forming technological processes using construction 3D printing methods.

Conclusions.

The conducted studies showed that concrete mix and construction mortar preparation process efficiency significantly depends on coordination of mixing equipment operating parameters with their structural-mechanical characteristics. It was established that specific mixing energy increase is accompanied by medium effective viscosity reduction, which improves conditions of subsequent material transport through pipeline systems and contributes to pressure loss reduction during feeding. It was also shown that mixture yield stress is determined by mixing element kinematic parameters and directly influences material movement character in conveying channels and hydraulic resistance magnitude of feeding systems.

An analytical relationship between screw feeding system capacity and conveying element geometric and kinematic parameters was established, which makes it possible to justify rational equipment operating regimes depending on mixture rheological characteristics. It was proven that material capability to retain target geometric parameters after extrusion feeding is determined by yield stress magnitude and mixture passage conditions through forming nozzles, which is of decisive importance for ensuring layer-by-layer forming accuracy of structures in continuous material placement technological systems.

The obtained relations make it possible to determine rational preparation regimes of concrete mixes and construction mortars with consideration of delivery conditions in pipeline and extrusion systems, as well as to coordinate operating parameters of mixing, conveying, and forming equipment within technological sets of construction machines. This creates prerequisites for improving efficiency of mechanized mixture preparation and feeding processes, particularly under construction 3D printing technology application conditions..

References

- Hattani, F., Menu, B., Allaoui, D., Mouflih, M., Zanzoun, H., Hannache, H., & Manoun, B. (2024). Evaluating the Impact of Material Selections, Mixing Techniques, and On-site Practices on Performance of Concrete Mixtures. *Civil Engineering Journal*. <https://doi.org/10.28991/cej-2024-010-02-016>.
- El-Motaal, A., Abdel-Reheem, A., & Mahdy, M. (2020). Effect of Low Mixing Speed on the Properties of Prolonged Mixed Concrete. *Civil Engineering Journal*, 6, 1581-1592. <https://doi.org/10.28991/cej-2020-03091568>.
- Alaneme, G., Olonade, K., Esenogho, E., & Lawan, M. (2024). Proposed simplified methodological approach for designing geopolymers concrete mixtures. *Scientific Reports*, 14. <https://doi.org/10.1038/s41598-024-66093-y>.
- Hattani, F., Menu, B., Allaoui, D., Mouflih, M., Zanzoun, H., Hannache, H., & Manoun, B. (2024). Evaluating the Impact of Material Selections, Mixing Techniques, and On-site Practices on Performance of Concrete Mixtures. *Civil Engineering Journal*. <https://doi.org/10.28991/cej-2024-010-02-016>.
- El-Motaal, A., Abdel-Reheem, A., & Mahdy, M. (2020). Effect of Low Mixing Speed on the Properties of Prolonged Mixed Concrete. *Civil Engineering Journal*, 6, 1581-1592. <https://doi.org/10.28991/cej-2020-03091568>.
- Alaneme, G., Olonade, K., Esenogho, E., & Lawan, M. (2024). Proposed simplified methodological approach for designing geopolymers concrete mixtures. *Scientific Reports*, 14. <https://doi.org/10.1038/s41598-024-66093-y>.

4. Ikumi, T., Salvador, R., & Aguado, A. (2022). Mix proportioning of sprayed concrete: A systematic literature review. *Tunnelling and Underground Space Technology*. <https://doi.org/10.1016/j.tust.2022.104456>.

5. Zhdaniuk, V., Volovyk, O., Kostin, D., & Lisovin, S. (2021). An investigation of the effect of thermoplastic additives in asphalt concrete mixtures on the properties of different types of asphalt concrete. *Eastern-European Journal of Enterprise Technologies*, 2, 61-70. <https://doi.org/10.15587/1729-4061.2021.227806>.

6. Bao, Y., Li, T., Wang, D., Cai, Z., & Gao, Z. (2020). Discrete element method study of effects of the impeller configuration and operating conditions on particle mixing in a cylindrical mixer. *Particuology*, 49, 146-158. <https://doi.org/10.1016/j.partic.2019.02.002>

7. Jadidi, B., Ebrahimi, M., Ein-Mozaffari, F., & Lohi, A. (2023). Investigation of impacts of particle shape on mixing in a twin paddle blender using GPU-based DEM and experiments. *Powder Technology*. <https://doi.org/10.1016/j.powtec.2023.118259>.

8. Nazar, S., Yang, J., Thomas, B., Azim, I., & Rehman, S. (2020). Rheological properties of cementitious composites with and without nano-materials: A comprehensive review. *Journal of Cleaner Production*, 272, 122701. <https://doi.org/10.1016/j.jclepro.2020.122701>.

9. Dejaeghere, I., Sonebi, M., & De Schutter, G. (2019). Influence of nano-clay on rheology, fresh properties, heat of hydration and strength of cement-based mortars. *Construction and Building Materials*, 222, 73-85. <https://doi.org/10.1016/j.conbuildmat.2019.06.111>.

10. Si, W., Khan, M., & McNally, C. (2025). A Comprehensive Review of Rheological Dynamics and Process Parameters in 3D Concrete Printing. *Journal of Composites Science*. <https://doi.org/10.3390/jcs9060299>.

11. Paritala, S., Singaram, K., Bathina, I., Khan, M., & Jyosyula, S. (2023). Rheology and pumpability of mix suitable for extrusion-based concrete 3D printing – A review. *Construction and Building Materials*. 402. <https://doi.org/10.1016/j.conbuildmat.2023.132962>.

4. Ikumi, T., Salvador, R., & Aguado, A. (2022). Mix proportioning of sprayed concrete: A systematic literature review. *Tunnelling and Underground Space Technology*. <https://doi.org/10.1016/j.tust.2022.104456>.

5. Zhdaniuk, V., Volovyk, O., Kostin, D., & Lisovin, S. (2021). An investigation of the effect of thermoplastic additives in asphalt concrete mixtures on the properties of different types of asphalt concrete. *Eastern-European Journal of Enterprise Technologies*, 2, 61-70. <https://doi.org/10.15587/1729-4061.2021.227806>.

6. Bao, Y., Li, T., Wang, D., Cai, Z., & Gao, Z. (2020). Discrete element method study of effects of the impeller configuration and operating conditions on particle mixing in a cylindrical mixer. *Particuology*, 49, 146-158. <https://doi.org/10.1016/j.partic.2019.02.002>

7. Jadidi, B., Ebrahimi, M., Ein-Mozaffari, F., & Lohi, A. (2023). Investigation of impacts of particle shape on mixing in a twin paddle blender using GPU-based DEM and experiments. *Powder Technology*. <https://doi.org/10.1016/j.powtec.2023.118259>.

8. Nazar, S., Yang, J., Thomas, B., Azim, I., & Rehman, S. (2020). Rheological properties of cementitious composites with and without nano-materials: A comprehensive review. *Journal of Cleaner Production*, 272, 122701. <https://doi.org/10.1016/j.jclepro.2020.122701>.

9. Dejaeghere, I., Sonebi, M., & De Schutter, G. (2019). Influence of nano-clay on rheology, fresh properties, heat of hydration and strength of cement-based mortars. *Construction and Building Materials*, 222, 73-85. <https://doi.org/10.1016/j.conbuildmat.2019.06.111>.

10. Si, W., Khan, M., & McNally, C. (2025). A Comprehensive Review of Rheological Dynamics and Process Parameters in 3D Concrete Printing. *Journal of Composites Science*. <https://doi.org/10.3390/jcs9060299>.

11. Paritala, S., Singaram, K., Bathina, I., Khan, M., & Jyosyula, S. (2023). Rheology and pumpability of mix suitable for extrusion-based concrete 3D printing – A review. *Construction and Building Materials*. 402. <https://doi.org/10.1016/j.conbuildmat.2023.132962>.

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Особливості реалізації процесів приготування бетонних сумішей і розчинів із урахуванням умов їх подачі

Анотація. У сучасних умовах механізованого будівництва підвищення ефективності технологічних процесів приготування бетонних сумішей і будівельних розчинів потребує узгодження параметрів роботи змішувального, транспортуючого та формувального обладнання з реологічними характеристиками матеріалу та умовами його подачі. Особливої актуальності це набуває при використанні трубопровідних і екструзійних систем транспортування, а також у технологіях пошарового формування конструкцій методами будівельного 3D-друку. У роботі розглянуто особливості взаємозв'язку процесів перемішування, транспортування та екструзійної подачі бетонних сумішей і будівельних розчинів як взаємопов'язаних елементів єдиної технологічної системи.

Проаналізовано вплив питомої енергії перемішування на ефективну в'язкість середовища, а також встановлено залежність граничного напруження зсуву від кінематичних параметрів змішувального обладнання. Показано, що зміна цих характеристик визначає умови руху суміші трубопровідними каналами та величину втрат тиску під час транспортування. Отримано аналітичні залежності для оцінювання впливу геометричних і кінематичних параметрів шнекових систем подачі на продуктивність транспортування матеріалу, що дозволяє обґрунтовувати раціональні режими роботи обладнання залежно від властивостей суміші та умов її переміщення.

Досліджено особливості екструзійного формування шарів будівельних сумішей після виходу з формувальних насадок та запропоновано залежність коефіцієнта формостійкості від граничного напруження зсуву середовища, яка дозволяє оцінювати здатність матеріалу зберігати геометричні параметри після укладання. Отримані результати можуть бути використані для обґрунтування раціональних режимів приготування та подачі бетонних сумішей і будівельних розчинів у трубопровідних та екструзійних системах, зокрема при реалізації технологічних процесів будівельного 3D-друку.

Ключові слова: бетонна суміш, будівельний розчин, змішування, трубопровідна подача, реологічні властивості, змішувач, транспортування, технологічні режими приготування, екструзійне формування, 3D-друк.

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