**To the Calculation of the Average Value of the Volume Fraction of the Key Bulk Component at The Intermediate Stage of Mixing with an Inclined Bump.**

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**Highlights**

* The calculation of the increment angles of reflection of rarefied flows is proposed.
* Distribution functions over the states of the macrosystems are taken into account.
* The basis is the results of stochastic modeling of mixing of flowing media with brushes.
* The effectiveness of the intermediate stage of mixing with the bump is analyzed.

**1. Introduction**

The urgency of the problem of mixing loose components is explained by the diversity of the purpose of the mixtures obtained for the needs of various industries and the agro-industrial complex. The development of methods for mixing loose components in a regulated ratio of 1:10 or more requires the designers of the respective equipment to perform a system-structural analysis of this process. The basis of this analysis is a theoretical prediction of the efficiency of the mixing process at each stage. The gravitational method for obtaining a free-flowing mixture with the specified ratio of components in the finished product proposed in [1] implies the presence of three mixing stages on trays with two steps in each. In this case, the first step involves the use of additional mixing elements in the form of brushes, and the second - fender surfaces.

**2. Methods**

The aim of the work is to develop a method for calculating the average value for the volume fraction of the key bulk component at the intermediate stage of gravity mixing using an inclined - bump stop surface. This characteristic of the mixing process is necessary in assessing the quality of the mixture with a regulatory ratio of 1:10 components, as an indicator of the effectiveness of the intermediate stage of the process under study. The proposed expression for the desired characteristic of the key component was obtained on the basis of the stochastic approach [2, 3], taking into account the results of modeling the formation of rarefied streams of solid dispersed materials. In this case, at the first step for the stage of intermediate mixing, the use of brush elements on a rotating drum is supposed [4-6]. At the second step, an impact surface is used [7–9] for shock interaction with rarefied streams of mixed materials formed after scattering with brushes. The specified expression uses the function for the volume fraction of the key component depending on the angles of reflection of each of the two bulk materials from the bump stop surface [8]. In addition, the latter function takes into account the method proposed earlier by the authors for calculating the volume fractions [10, 11] for the mixed portions of the components, which correspond to the intermediate stage of this process. Note that a convenient in this case, the criterion for assessing the quality of the mixture is its coefficient of heterogeneity, which is determined in the traditional way [10, 11].

**3. Results and discussion**

The calculation of the maximum values for the reflection angles of each of the bulk components from the bump stop surface at the studied intermediate stage of their mixing is performed taking into account their increments. These increments are calculated depending on the scattering angles of the particles of the components in their rarefied flows, formed after scattering with brush elements. An expression for the nonequilibrium differential distribution function of each component in the scattering angle from brushes was used [4-6]. This function is obtained taking into account the design and operational parameters of the mixer unit "drum-brush elements". When describing the relationship between the scattering angle from the brushes and the angle of reflection from the bump stop [7, 8], the recovery factor is used, which characterizes the directions of the average velocities of the sparse fluxes of each component when striking the bump stop and when they are reflected from it. Modeling the desired average value for the volume fraction of the key bulk component at the intermediate stage of gravitational mixing using an inclined impact surface allows you to calculate the corresponding coefficient of heterogeneity.

**4. Conclusions**

Using the example of model mixing of two non-humidified components, comparable in size and density (sand and semolina), the heterogeneity coefficient of the resulting mixture for the intermediate stage was calculated. For this stage, mixing is assumed in equal proportions between the resulting mixture after the initial stage and the new portion of the key component (sand). The results of the work can be used in the formation of an engineering method for calculating a new gravity mixer of non-humidified bulk components in predetermined ratios of 1:10 or more with additional mixing elements (brushes and bump stops).

**References**

1. A.I. Zaitzev, A.E. Lebedev, A.B. Kapranova, I.I. Verloka. Patent 2586126 Russian Federation, IPC B01F3/18. Gravity-type bulk solids mixer. June 2016.
2. Y.L. Klimontovich, Turbulent Motion and Chaos Structure: A New Approach to the Statistical Theory of Open Systems, LENAND, Moscow, 2014.
3. A.B. Kapranova, I.I. Verloka, A.E. Lebedev, A.I. Zaitzev, Czas. Tech. Mech. 113 (2, 2016) 145-150.
4. A.B. Kapranova, M.N. Bakin, I.I. Verloka, A.I. Zaitzev, Vestn. TGTY Her TGTY. 58 (11, 2015) 296-304. doi:[10.17277/vestnik.2015.02.pp.296-304](https://doi.org/10.17277/vestnik.2015.02.pp.296-304).
5. A.B. Kapranova, I.I. Verloka, Theor. Found. of Chem. Eng. 52 (6, 2018) 1004-1018. doi:10.1134/S0040579518050330.
6. A.B. Kapranova, M.N. Bakin, I.I. Verloka, Chem. and Petrol. Eng. 54 (5-6, 2018) 287-297. doi:10.1007/s10556-018-0477-0. Suppl. 54 (7-8, 2018) 618. doi:10.1007/s10556-018-0524-x.
7. A.B. Kapranova, I.I. Verloka, Vestn. IGEY Her IGEY. 3 (2016) 78-83. doi:10.17588/2072-2672.2016.3.078-083.
8. I. Verloka, A. Kapranova, M. Tarshis, S. Cherpitsky, Int. J. Mech. Eng. Technol. 9 (2, 2018) 438-444.
9. A.B. Kapranova, I.I. Verloka, J. Chem. Eng. Process Technol. 8 (5 (Suppl), 2017) 59. doi:10.4172/2157-7048-C1-009.
10. A.B. Kapranova, I.I. Verloka, J. Chem. Eng. Process Technol. 9 (2018) 53. doi:[10.4172/2157-7048-C3-0](file:///D:\ANNA-2018\certificates\certificates-2015\10.4172\2157-7048-C3-0)18.
11. A.B. Kapranova, I.I. Verloka, P.A. Yakovlev, D.D. Bahaeva, [Rossiyskiy khimicheskiy zhurnal (Zhurnal khimicheskogo obshchestva im. D.I. Mendeleyeva)](https://elibrary.ru/contents.asp?titleid=4602) 62 (4, 2018) 48-50.