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ANIQ VA TABIIY FANLARNI RIVOJLANTIRISHDA RAQAMLI TEXNOLOGIYALARNING O'RNI: MUAMMO VA INNOVATSION YECHIMLAR

mavzusidagi xalqaro ilmiy-texnik anjuman materiallari

РОЛЬ ЦИФРОВЫХ ТЕХНОЛОГИЙ В РАЗВИТИИ ТОЧНЫХ И ЕСТЕСТВЕННЫХ НАУК: ПРОБЛЕМЫ И ИННОВАЦИОННЫЕ РЕШЕНИЯ

THE ROLE OF DIGITAL TECHNOLOGIES IN THE DEVELOPMENT OF EXACT AND NATURAL SCIENCES: PROBLEMS AND INNOVATIVE SOLUTIONS



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O‘ZBEKISTON RESPUBLIKASI RAQAMLI TEXNOLOGIYALAR VAZIRLIGI

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Theorem 6. *The coefficients of the optimal quadrature formulas of the form* $\int_0^1 \sin 2\pi\omega x \cdot \varphi(x)dx \cong \sum_{\beta=0}^{N} C_\beta^I \varphi(h\beta)$, *in the sense of Sard in the space* $W_2^{(1,0)}[0,1]$ *of real valued functions have the form*

$$\overset{\circ}{C}{}_0^I = \frac{2\pi\omega(e^{2h}-1)-2e^h\sin 2\pi\omega h}{(e^{2h}-1)(4\pi^2\omega^2+1)}, \quad \overset{\circ}{C}{}_N^I = -\frac{2\pi\omega(e^{2h}-1)-2e^h\sin 2\pi\omega h}{(e^{2h}-1)(4\pi^2\omega^2+1)},$$

$$\overset{\circ}{C}{}_\beta^I = \frac{2(1+e^{2h}-2e^h\cos 2\pi\omega h)}{(e^{2h}-1)(4\pi^2\omega^2+1)}\cdot\sin 2\pi\omega h\beta, \qquad \beta = 1,2,...,N-1.$$

Conclusion. Thus, in the present work it is constructed the optimal quadrature formula for approximate calculation of the Fourier coefficients $\int_0^1 e^{2\pi i\omega x}\varphi(x)dx$ of functions from the space $W_2^{(1,0)}[0,1]$. And we obtained the explicit formulas for the optimal coefficients which are very useful in applications. The obtained quadrature formula is exact for the function $\exp(-x)$. In particular, as a corollary from the main result the optimal quadrature formulas for approximate calculation of integrals $\int_0^1 \cos 2\pi\omega x \cdot \varphi(x)dx$ и $\int_0^1 \sin 2\pi\omega x \cdot \varphi(x)dx$ are obtained.

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THEORETICAL ASPECTS OF COTTON LINT HUMIDIFICATION USING A FOUR-SECTION ULTRASONIC AEROSOL DEVICE BEFORE BALING

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Abstract. *A four-section ultrasonic humidification device for cotton lint is proposed, combining a 1.7 MHz aerosol generator with alternating cross-flow. The GAB–LDF model predicts a reduction in moisture non-uniformity from 12.7% to 4.5% at 0.30 kg/(m²·s) air mass flux and 8 s residence time. For a capacity of 2.5 t/h, the design requires a 4.63 m² humidification area, approximately 4,300 m³/h airflow and 20 aerosol modules. The theoretical results provide a basis for experimental validation and industrial implementation.*

Keywords: *cotton lint; ultrasonic atomization; moisture conditioning; cross-flow chamber; GAB isotherm; LDF kinetics; moisture uniformity; baling.*

Introduction. Cotton lint is a hygroscopic material whose moisture content changes during drying, cleaning, transport and baling. Over-drying increases electrostatic effects, while excessive moisture creates storage and quality risks. The recommended bale-moisture range is 6.5–7.5%, with values above 8.0–8.5% being unfavourable [1–3]. Conventional humidification systems often produce uneven moisture distribution. This study presents the theoretical design of an ultrasonic aerosol humidifier for cotton lint and compares one-sided and alternating cross-flow arrangements.

Research methodology. Droplet size is estimated using the Lang-type capillary-wave relation (σ = 0.0728 N/m, ρw = 998 kg/m³, f = 1.7 MHz) [4], while evaporation is described by the d^2-law. The humid-air system is evaluated using humidity ratio, saturation pressure and moist-air enthalpy, with dew-point control to prevent condensation. Moisture uptake is modelled using the GAB isotherm (Wm = 0.042, C = 10, KGAB = 0.78) and LDF kinetics (k = 0.06 s^{-1}). Alternating airflow is examined for n = 1, 2, 4 and 8 sections at τ = 8 s.

Analysis and results. The predicted droplet diameter at 1.7 MHz is 2.9 μm, decreasing to 2.3 μm at 2.4 MHz. A 3 μm droplet evaporates in approximately 0.0195 s at 25 °C and 90% RH. Preheating air from 25 °C to 50 °C before adiabatic humidification increases moisture gain to 10.31 g/kg of dry air, compared with 3.37 g/kg without preheating. The recommended operating conditions are 25–30 °C and 92–95% RH. The proposed chamber alternates airflow downward and upward through four sections, ensuring three flow-direction reversals without switching dampers.

Discussion. Alternating airflow improves moisture uniformity more effectively than increasing air mass flux. Most improvement occurs when changing from one to two sections, while additional sections beyond four provide negligible gains. For a capacity of 2.5 t/h, the design requires a 4.63 m² treatment zone, approximately 4,300 m³/h airflow, 847 Pa network resistance and a 2.2 kW fan. The aerosol system comprises 20 modules with ten transducers each, providing up to 70 kg/h moisture capacity.

Conclusion. A four-section ultrasonic humidification device with alternating cross-flow was theoretically developed. The GAB–LDF model predicts a reduction in moisture non-uniformity from 12.7% to 4.5% at g = 0.30 kg/(m²·s) and τ = 8 s. The proposed 2.5 t/h design provides a basis for experimental validation and industrial scale-up. Further studies should assess moisture distribution, droplet size, condensation and bale storage quality.

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To‘plam materiallaridan foydalanganda manbani ko‘rsatish shart.
Maqola mualliflari maqolalar mazmuni va ularning nashr etilishi fakti uchun javobgardirlar.
Har doim ham mualliflarning fikrlari tashkilotchilar nuqtai nazarini ifodalamaydi va nashr etilgan ma’lumotlarning haqiqiyligi uchun javobgar emas.
Tashkilotchilar mualliflar va/yoki uchinchi shaxslar va tashkilotlarga maqolaning e’lon qilinishi natijasida yetkazilishi mumkin bo‘lgan zarar uchun javobgar emas.