

ISSN 2181-8622

**Manufacturing technology problems**



# **Scientific and Technical Journal Namangan Institute of Engineering and Technology**

INDEX  COPERNICUS  
I N T E R N A T I O N A L

**Volume 10  
Issue 1  
2025**



**SLIB.UZ**  
Scientific library of Uzbekistan

# THEORETICAL RESEARCH OF A HEAVY POLLUTANT CLEANING DEVICE

## OBIDOV AVAZBEK

Professor, Namangan Institute of Engineering and Technology

Phone.: (0593) 941-7775, E-mail.: [aobidov@list.ru](mailto:aobidov@list.ru)

*\*Corresponding author*

## MIRZAAKHMEDOVA DILNOZA

Researcher, Namangan Institute of Engineering and Technology

Phone.: (0594) 302-2199, E-mail.: [dmiraaxmedova@gmail.com](mailto:dmiraaxmedova@gmail.com)

## IBROHIMOV ILGORBEK

Researcher, Namangan Institute of Engineering and Technology

Phone.: (0593) 401-1311, E-mail.: [iibrohimov@gmail.com](mailto:iibrohimov@gmail.com)

**Abstract:** In this article, an improved design of the device for trapping heavy impurities in raw cotton material is recommended. Theoretical studies have been conducted on this design and the results have been obtained. As a result of observing the operation of the crusher, it was established that even at an acceptable angle of deviation of the deflectors and deflectors, a sufficient amount of cotton raw materials will fall into the bunker intended for the impurities based on the turbulence of the air.

**Keywords:** Cotton raw materials, stone, heavy mixture, stone catcher, pipe, elastic coating, air velocity, pressure, efficiency.

**Introduction.** Currently, linear stone separators are widely used in enterprises. Because, in addition to their high efficiency in trapping heavy objects, they are also structurally quite simple [1-2].

A study of various linear stone separator designs has shown that all existing devices of this type have a low efficiency in trapping stones and that a large amount of cotton raw material is trapped in their bunkers designed for heavy mixtures.

In order to create optimal designs of linear stone separators that fully meet the requirements of the cotton industry, the author has created a model of the design that allows increasing the efficiency of various separation principles from cotton raw material (Fig. 1).

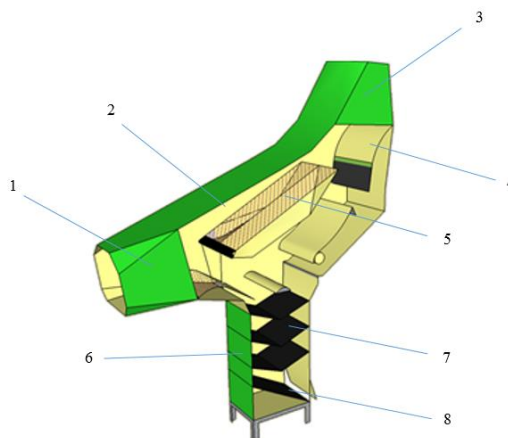


Fig. 1. Model of a heavy impurities separator

1-inlet pipe, 2-working chamber, 3-cotton outlet pipe, 4-elastic (rubber) coating, 5-cotton-squeezing barrier, 6-pocket for heavy impurities, 7-automatic heavy impurities discharge gates, 8-stone discharge plate

In this device, not only the effectiveness of various principles of separating heavy impurities was studied, but also methods for eliminating the main drawback of stone separators - the presence of cotton in the chamber - a pocket designed to collect stones were studied. The general view of the device shown in Figure 1 has an upper chamber 2, designed to study the speed of movement of mixtures of different weights. Here, the air speed is controlled by a movable barrier 5. Elastic coatings serve to determine the efficiency of separation as a result of the impact of stones on it, while the barrier 5, which periodically discharges heavy impurities and supplies air from the atmosphere to adjust the impact force, ensures that the cotton is thoroughly shaken in the separation chamber and does not get stuck with heavy impurities.

**Theoretical research.** Large and heavy mixtures move in pneumatic pipelines. Taking the observed movement of a large body along the wall as a forward motion [3-5], we write the kinetic energy change theorem, in which its final velocity must be equal to 0 (Fig. 2.7):

$$\frac{Gv_k^2}{2g} = \left( fG\cos\alpha + G\sin\alpha - Fk\frac{v_{0tr}^2}{2g} \right) l \quad (1)$$

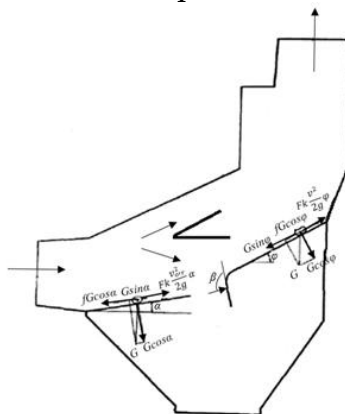
In formula (1), we substitute the following:

$$\cos\alpha = \frac{1-tg^2\frac{\alpha}{2}}{1+tg^2\frac{\alpha}{2}} \text{ va } \sin\alpha = \frac{2tg\frac{\alpha}{2}}{1+tg^2\frac{\alpha}{2}}$$

$$\text{and } \frac{Gv_k^2}{2g} = \left[ \left( fG\frac{1-tg^2\frac{\alpha}{2}}{1+tg^2\frac{\alpha}{2}} + G\frac{2tg\frac{\alpha}{2}}{1+tg^2\frac{\alpha}{2}} \right) - Fk\frac{v_{0tr}^2}{2g} \right] l \quad (2)$$

The speed of the object (weight 1 kg, dimensions 80x80x100 mm) is approximately 2.3 m/s, the average speed of the air flow is 6.1 m/s, and the length of the guide wall is  $l = 0.6$  m.

Based on these data, solving equation (2), we obtain the angle of deflection of the guide wall  $\alpha = 8^\circ$ , which agrees with the experimental data.

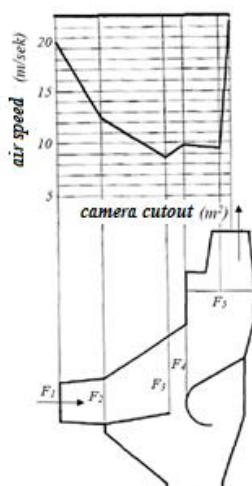


**Figure 2.** Scheme for determining the force and direction of impact of the body in different positions of the working bodies

Heavy impurities, having reached the bottom edge, have a somewhat higher kinetic energy and hit the opposite wall of the housing. In order to increase the efficiency of separation of heavy impurities, the return chute should have such a shape that the trajectory of the stones after impact should be directed downwards or along the inclined bottom. As a result, the rear wall of the bunker should be located at an angle of  $\beta = 90^\circ$  to the inclined bottom [6-7].

Small and medium-sized stones moving together with cotton are poorly separated here, as a result of which the linear stone separator should be equipped with a special device for this device.

Operation of linear stone separators of various designs In practice, small impurities are separated more effectively in this case when the speed of the carrier air flow drops below their rotational speed to a value smaller than the speed of their rotation. For this purpose, the shape and dimensions of the stone crusher were chosen so that the air speed gradually decreases to 11-12 m/s, which is slightly lower than the rotation speed of the small stones. However, it is sufficient for continuous transportation of cotton, even cotton weighing 200 g.



**Figure 3.** Variation of air velocity in different sections of the chamber

Based on the condition of constant air velocity at different points of the body (Figure 3), Table 1 was compiled. The data in this table correspond to a capacity of the crusher of 10-12 t/h.

**Table 1.** Air velocity versus chamber volume

Indicators	Plot number					
	1	2	3	4	5	6
Cross-sectional area of the stone catcher chamber (m <sup>2</sup> )	0,12	0,195	0,292	0,282	0,291	0,125
Air speed (m/sec)	20,0	14,0	8,8	10,14	9,5	21,0

(The air flow rate at the inlet to the ash collector is 2.5 m<sup>3</sup>/sec, the amount of air sucked in through the outlet pipe is 0.2 m<sup>3</sup>/sec).

To experimentally test the effect of the above chamber dimensions on the separation efficiency of heavy impurities, the stone separator was operated on grade III cotton at a load of 8-9 tons per hour in 2 positions of the wall.

The results of this study are presented in Table 2. The above-mentioned reduction of air velocity to an acceptable value due to the enlargement of the chamber showed an increase in the retention efficiency of the device to an average of 98%, which is higher than that of stone separators of the old design.

**Table 2.** Results of the study

Cotton variety	Capture efficiency, %				Average of 3 experiments
	For stones 5 – 40 mm in size	For stones 40 – 60 mm in size	By metal objects	General	
I	88,1	97,4	98,4	92,8	92,8
	90,8	97,3	98,8	94,6	
	91,1	98,0	99,2	94,2	
	98,4	99,2	99,8	99,1	
III	96,0	98,1	99,6	98,4	98,6
	97,5	99,1	99,5	98,5	

Since the cotton raw material falls on the return wall along with heavy impurities, the heavy impurities must move along the wall towards the pocket, and the cotton raw material, in turn, must continue to move along the flow direction, and when the flow stops, the cotton raw material will stop on the wall.

Based on the above, the angle of deviation of the wall should be greater than the angle of friction of the stones, and less than the friction of the cotton raw material.

The angle of friction should be 15° for stones ( $f = 0.29$ ), 35° for cotton raw material ( $f = 0.67$ ), then

$$15^\circ < \varphi < 35^\circ$$

$\varphi = 30^\circ$  we accept.

Therefore, installing the return wall at a greater or equal angle to the bunker, heavy and even fine impurities roll down in this place, as a result of which the stone crusher operates continuously.

In this case, part of the cotton raw material hits the back wall or the inclined part of the return wall and loses its initial speed, as a result of which it sinks down. Therefore, at a large angle of deviation of the return wall, the cotton raw material moves and falls into the bunker, as a result of which a blockage is observed in the stone crusher. To eliminate this drawback, it is necessary to eliminate the movement of cotton slivers into the bunker.

The cross-section of the first-grade cotton slivers that are not well spread is  $F=0.0015$  m<sup>2</sup>, the weight is  $G_b=0.2$  g,  $K=0.7$ , and the coefficient of friction with steel is  $f=0.67$ .

In this case, to eliminate the fall of cotton into the stone crusher bunker, it is necessary to:



$$\varphi \leq 30^\circ$$

Thus, the acceptable deflection of the return wall, which ensures the effective operation of the stone crusher, should be within the following range:

$$\varphi = 26 \dots 30^\circ$$

To determine the resistance coefficient ( $\xi$ ) of the damper, we divide its chamber into 6 sections, the area of which is equal to the previously selected dimensions (Figure 3):

$$F_1 = 0,126 \text{ m}^2; F_2 = 0,197 \text{ m}^2; F_3 = 0,29 \text{ m}^2; \\ F_4 = 0,28 \text{ m}^2; F_5 = 0,29 \text{ m}^2; F_6 = 0,126 \text{ m}^2$$

As a result of the expansion of the chamber, the resistance coefficient at the entrance to it becomes the same as in a rectified flow diffuser [8], that is:

$$\xi_1 = \varphi \left(1 - \frac{F_1}{F_3}\right)^2 \quad (3)$$

$$\text{here } \varphi = 0,024\alpha - 0,1\sin 7\alpha = 0,35$$

( $\alpha = 30^\circ$  - angle of expansion of the stone holder chamber)

For the assumed dimensions of the diffuser,  $\xi_1 = 0.12$ .

Atmospheric air is sucked in between the walls of the diffuser and the deflector, and it is equal to the actual speed and air consumption, and the local resistance coefficient is  $\xi_2 = 0.11$ .

When it reaches the vertical pipeline, the chamber expands and the direction of air movement changes.

The resistance coefficient at this point is equal to:

$$\xi_3 = \left(\frac{F_5}{F_4}\right)^2 + 0,2 \left(\frac{F_4}{F_5}\right)^2 = \left(\frac{0,29}{0,28}\right)^2 + 0,2 \left(\frac{0,29}{0,28}\right)^2 = 1,24$$

As the air exits the cooler, the chamber becomes smaller again. Here, the resistance coefficient is:

$$\xi_4 = 0,7 \left(1 - \frac{F_6}{F_5}\right) - 0,2 \left(1 - \frac{F_6}{F_5}\right)^3 = 0,7 \left(1 - \frac{0,126}{0,29}\right) - 0,2 \left(1 - \frac{0,126}{0,29}\right)^3 = 0,35$$

The total value of the resistance coefficient of the heater is:

$$\xi = \xi_1 + \xi_2 + \xi_3 + \xi_4 = 1,82$$

Based on aerodynamic measurements, the air consumption in the pipeline to the hopper at a rate of  $Q = 2.5 \text{ m}^3/\text{sec}$  is equal to the loading of the hopper with 10–12 tons of cotton raw material.

The static pressure in the pipeline at a distance of 2 meters from the hopper to the hopper is 220 mm.w.s., the dynamic pressure is 58.4 mm.w.s., and the pressure is 732 mm.w.s., at a humidity of 1.15 kg/m<sup>3</sup> of 10–12%. Thus, the total pressure in the pipeline to the hopper is equal to:

$$H_n = H_{abv} - H_{d1} = 161,1 \text{ mm above water.}$$

In the pipeline 2 meters after the sprinkler, the static pressure is 302 mm.w.s., and the dynamic pressure is 38.9 mm.w.s., i.e. the total pressure is:

$$H_{n_2} = H_{abv_2} - H_{d2} = 213,1 \text{ mm above water.}$$

Also, the pressure loss in the rocker at the indicated loads is equal to:

$$H_n = H_{n_2} - H_{n_2} = 51,5 \text{ mm above water.} \quad (4)$$

**Result.** The increase in dynamic pressure after the thresher occurred as a result of atmospheric air being sucked in through a slot in the pocket cover ( $0.2 \text{ m}^3/\text{sec}$ ). Due to the insufficient hermeticity of the thresher prototype body ( $0.21 \text{ m}^3/\text{sec}$ ), the working bodies were adjusted to prevent cotton from clogging in the bunker.

Thus, the data from aerodynamic measurements confirmed the previously calculated coefficient of local resistance of the thresher.

Theoretical analysis of the operation of the linear thresher made it possible to determine the optimal dimensions of its main working bodies and the design of the device.

As a result of observing the thresher operation, even at the optimal angle of deviation of the deflectors and deflectors, a sufficient amount of cotton raw material falls into the bunker intended for mixtures due to air turbulence, resulting in clogging.

To eliminate this drawback, the distance between the guide wall, the pocket cover and the return walls was increased to 130-150 mm. However, it was not possible to completely eliminate the falling of cotton balls into the pocket.

Therefore, a slot was installed in the pocket cover to suck in atmospheric air, with the help of which all the cotton raw materials that fell into the bunker were sprayed out.

In future tests of the thresher, it was aimed to determine the effect of loading the working bodies in optimal conditions on the separation of heavy impurities and the exit of cotton with these impurities.

### References

1. Kattakhodjaev R.M., Ziyaev H.A., Kodirkhadjaev S.Kh., Influence of the design of pneumatic transport units on the formation of defects in the fiber and seed damage. // Cotton industry. - Tashkent. 1983. №3. -12-13 p.
2. Ziyaev H.A. Study of the influence in geometric transportation. // Cotton industry. - Tashkent, 1980.-№1, 15-16 p.
3. Amirov R., Tikhomirov G.A., Suslin A.K. On the issue of seed damage during transportation of raw cotton // Cotton industry. - Tashkent, 1975.- №1, 4-5 p.
4. Gulyaev R.A. and others. "Comprehensive improvement of the technological process of primary processing of cotton through the development of production and the introduction of new models of equipment and technology". I-2013-20. Report on the Research Institute of Industrial Technologies T.2014.
5. A.Obidov, S.Khusanov, I.Ibrokhimov. Fundamentals of improving the stone separator device for removing heavy impurities from cotton raw materials. Educational Research in Universal Sciences VOLUME 3, ISSUE 8, p.59-64.
6. Ibrokhimov Ilgorbek, Khusanov Sadi. Principles of improvement of heavy mixtures from cotton raw materials. Scientific and Technical Journal of NamIET, Vol. 9 Issue 3 2024, p. 236-240.
7. Muradov R. Ensuring the continuous discharge of heavy mixtures in sanding machines. FarPI. Folk.ilm.practice.conf. Lecture thesis. - Ferghana. 1994. p. 170-171.
8. Maxametov T.D. "Study of processes, establishment of modes and search for optimal shapes and sizes of working elements of linear stone traps". Dissertation of candidate of technical sciences – Tashkent, 1972.

## CONTENTS

### TECHNICAL SCIENCES: COTTON, TEXTILE AND LIGHT INDUSTRY

<b>Rakhimov R., Sultonov M.</b>	<b>3</b>
Inspection of the strength of the column lattice of the improved fiber cleaner	
<b>Turdiyev B., Rosulov R.</b>	<b>10</b>
The influence of technological parameters of the elevator on cotton seed damage	
<b>Khuramova Kh.</b>	<b>15</b>
Graphic analysis of the obtained results on cotton regeneration	
<b>Sharifbayev R.</b>	<b>20</b>
Optimizing feature extraction in Ai-based cocoon classification: a hybrid approach for enhanced silk quality	
<b>Akramov A., Khodzhiev M.</b>	<b>24</b>
The current state and challenges of the global textile industry: key directions for the development of Uzbekistan's textile sector	

### TECHNICAL SCIENCES: AGRICULTURE AND FOOD TECHNOLOGIES

<b>Sattarov K., Jankurazov A., Tukhtamyshova G.</b>	<b>30</b>
Study of food additives on bread quality	
<b>Madaminova Z., Khamdamov A., Xudayberdiyev A.</b>	<b>37</b>
Determination of amygdalin content in peach oil obtained by pressing method	
<b>Kobilov N., Dodayev K.</b>	<b>43</b>
Food safety and industrial importance of corn starch. the impact of the hydration process on the starch content in the grain	
<b>Mustafaev O., Ravshanov S., Dzhakhangirova G., Kanoatov X.</b>	<b>50</b>
The effect of storing wheat grain in open warehouses on the "aging" process of bread products	
<b>Erkayeva N., Ahmedov A.</b>	<b>58</b>
Industrial trials of the refining technology for long-term stored sunflower oil	
<b>Boynazarova Y., Farmonov J.</b>	<b>64</b>
Microscopic investigations on the effect of temperature on onion seed cell degradation	
<b>Rasulova M., Xamdamov A.</b>	<b>79</b>
Theoretical analysis of distillators used in the distillation of vegetable oil miscella	



## CHEMICAL SCIENCES

<b>Ergashev O., Bazarbaev M., Juraeva Z., Bakhronov H., Kokharov M., Mamadaliyev U.</b>	<b>84</b>
Isotherm of ammonia adsorption on zeolite CaA (MSS-622)	
<b>Ergashev O., Bakhronov H., Sobirjonova S., Kokharov M., Mamadaliyev U.</b>	<b>93</b>
Differential heat of ammonia adsorption and adsorption mechanism in Ca <sub>4</sub> Na <sub>4</sub> A zeolite	
<b>Boymirzaev A., Erniyazova I.</b>	<b>101</b>
Recent advances in the synthesis and characterisation of methylated chitosan derivatives	
<b>Kalbaev A., Mamataliyev N., Abdikamalova A., Ochilov A., Masharipova M.</b>	<b>106</b>
Adsorption and kinetics of methylene blue on modified laponite	
<b>Ibragimov T., Tolipov F., Talipova X.</b>	<b>114</b>
Studies of adsorption, kinetics and thermodynamics of heavy metall ions on clay adsorbents	
<b>Muratova M.</b>	<b>123</b>
Method for producing a fire retardant agent with nitric acid solutions of various concentrations	
<b>Shavkatova D.</b>	<b>132</b>
Preparation of sulphur concrete using modified sulphur and melamine	
<b>Umarov Sh., Ismailov R.</b>	<b>139</b>
Analysis of hydroxybenzene-methanal oligomers using <sup>1</sup> H nmr spectroscopy methods	
<b>Vokkosov Z.</b>	<b>148</b>
Studying the role and mechanism of microorganisms in the production of microbiological fertilizers	
<b>Mukhammadjonov M., Rakhmatkarieva F., Oydinov M.</b>	<b>153</b>
The physical-chemical analysis of KA zeolite obtained from local kaolin	
<b>Shermatov A., Sherkuziev D.</b>	<b>160</b>
Study of the decomposition process of local phosphorites using industrial waste sulfuric acid	
<b>Khudayberdiev N., Ergashev O.</b>	<b>168</b>
Study of the main characteristics of polystyrene and phenol-formaldehyde resin waste	

## TECHNICAL SCIENCES: MECHANICS AND MECHANICAL ENGINEERING

<b>Kudratov Sh.</b>	
UZTE16M locomotive oil system and requirements for diesel locomotive reliability and operating conditions	174
<b>Dadakhanov N.</b>	181
Device studying the wear process of different materials	
<b>Dadakhanov N., Karimov R.</b>	189
Investigation of irregularity of yarn produced in an improved drawn tool	
<b>Mirzaumidov A., Azizov J., Siddiqov A.</b>	196
Static analysis of the spindle shaft with a split cylinder	
<b>Mirjalolzoda B., Umarov A., Akbaraliyev A., Abduvakhidov M.</b>	203
Static calculation of the saw blade of the saw gin	
<b>Obidov A., Mirzaumidov A., Abdurasulov A.</b>	208
A study of critical speed of linter shaft rotation and resonance phenomenon	
<b>Khakimov B., Abdurakhmanov O.</b>	217
Monitoring the effectiveness of the quality management system in manufacturing enterprises	
<b>Bayboboev N., Muminov A.</b>	232
Analysis of the indicators of the average speed of units for the process of loading into a potato harvesting machine	
<b>Kayumov U., Kakhkharov O., Pardaeva Sh.</b>	237
Analysis of factors influencing the increased consumption of diesel fuel by belaz dump trucks in a quarry	
<b>Abdurahmonov J.</b>	244
Theoretical study of the effect of a brushed drum shaft on the efficiency of flush separation	
<b>Ishnazarov O., Otabayev B., Kurvonboyev B.</b>	250
Modern methods of smooth starting of asynchronous motors: their technologies and industrial applications	
<b>Kadirov K., Toxtashev A.</b>	263
The influence of the cost of electricity production on the formation of tariffs	
<b>Azambayev M.</b>	271
An innovative approach to cleaning cotton linters	
<b>Abdullayev R.</b>	277
Theoretical substantiation of the pneumomechanics of the Czech gin for the separation of fiber from seeds	
<b>Siddikov I., A'zamov S.</b>	282
Study of power balance of small power asynchronous motor	

<b>Obidov A., Mirzaakhmedova D., Ibrohimov I.</b>	<b>288</b>
Theoretical research of a heavy pollutant cleaning device	
<b>Xudayberdiyeva D., Obidov A.</b>	<b>294</b>
Reactive power compensation and energy waste reduction during start-up of the electric motor of uxk cotton cleaning device	
<b>Jumaniyazov K., Sarbarov X.</b>	<b>302</b>
Analysis of the movement of cotton seeds under the influence of a screw conveyor	
<b>Abdusalomova N., Muradov R.</b>	<b>310</b>
Analysis of the device design for discharging heavy mixtures from the sedimentation chamber	
<b>Ikromov M., Shomurodov S., Boborajabov B., Mamayev Sh., Nigmatova D.</b>	<b>318</b>
Study of obtaining an organomineral modifier from local raw materials to improve the operational properties of bitumen	
<b>Ikromov M., Shomurodov S., Boborajabov B., Mamayev Sh., Nigmatova D.</b>	<b>324</b>
Development of composition and production technology for polymer-bitumen mixtures for automobile roads	
<b>Muradov R., Mirzaakbarov A.</b>	<b>332</b>
Effective ways to separate fibers suitable for spinning from waste material	

## ADVANCED PEDAGOGICAL TECHNOLOGIES IN EDUCATION

<b>Xoliddinov I., Begmatova M.</b>	<b>336</b>
A method of load balancing based on fuzzy logic in low-voltage networks with solar panel integration	
<b>Murodov R., Kuchqarov A., Boynazarov B., Uzbekov M.</b>	<b>345</b>
Research on the efficiency of using hydro turbines in pumping mode and for electricity generation	
<b>Abdurakhimova M., Romanov J., Masharipov Sh.</b>	<b>353</b>
A literature review of settlement land trends (past, present, and future) based on english-language articles indexed in the web of science database from 2014 to 2023	
<b>Muhammedova M.</b>	<b>360</b>
Development and scientific justification of the design of orthopedical footwear for patients with injuries to the soul-foot joint	
<b>Akbaraliyev M., Egamberdiyev A.</b>	<b>367</b>
Methods of effective organization of fire and rescue operations	

---

**A'zamxonov O., Egamberdiyev A.**

Principles of organizing material and technical support in emergency situations **373**

---

**Tuychibayeva G., Kukibayeva M.**

The module of developing communicative competence of seventh and eighth-grade students in uzbekistan secondary schools **379**

---

**Ismoilova Z.**

Methods for enhancing the competence of future english teachers **383**

---

**ECONOMICAL SCIENCES**

---

**Yuldashev K., Makhamadaliev B.**

The role of small business entities in the program "From poverty to well-being" **389**

---

**Mirzakhlikov B.**

Organizational mechanism for the development of state programs for poverty reduction **397**

---

**Rustamova S.**

Specific characteristics of administration in developed countries **402**

---