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## REDUCING GLASS LOSS DURING TRANSPORTATION AND STORAGE

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## REDUCING GLASS LOSS DURING TRANSPORTATION AND STORAGE

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**Abstract:** The article discusses the processes of transportation and storage of sheet glass in the production of protective glass for cars. The experience of organizing the transportation and storage of glass in developed countries of the world was analyzed in order to study the problems of losses of raw materials during the transportation and storage of laminated glass, as well as to develop and approve a regulatory and technical document in this field. The supplies of various brands of polished laminated glass used in the production of protective glass for cars to Avtooina LLC from different addresses, from different manufacturers were studied, and statistical data were analyzed. As part of the business contract concluded between Avtooina LLC and the Tashkent State Technical University named after Islam Karimov for the development of technical requirements and regulatory and technical documents for the transportation and storage of polished laminated glass, Avtooina Limited Liability Company produced safety glass for cars of different brands and of varying quality. A regulatory technical document on losses due to breakage during transportation and storage of polished laminated glass has been developed and recommendations have been given. During testing, factors influencing breakage during transportation and storage of polished laminated glass were identified, and measures to reduce their harmful effects were developed and implemented in the process of producing safety glass.

**Key words:** laminated glass, transportation, storage, regulatory and technical document, losses due to breakdown, car, vehicle, container.

**Annotatsiya:** Maqolada avtomobillar uchun xavfsiz oynalar ishlab chiqarish jarayonida oyna listlarini tashish va saqlash jarayonlari ko'rib chiqilgan. Listli oynalarni tashish, saqlash jarayonida xom-ashyoni sinishga yo'qotishlar muammolarni o'rganish va shu soha bo'yicha me'yoriy texnik xujjat ishlab chiqish va tasdiqlashda jaxonning rivojlangan davlatlarida oynalarni tashish va saqlashni boshqarish ishni tashkil qilish tajribasi taxlil qilingan. "Avtooina" MCHJga avtomobillar uchun xavfsiz oynalar ishlab chiqarishda foydalaniladigan turli markali sayqallangan listli oynalarni xar xil manzillardan, turli ishlab chiqaruvchilardan yetkazib berilishi o'rganib chiqilgan, statistik ma'lumotlar tahlil qilingan. Sayqallangan listli oynalarni tashish va saqlashdagi texnik talablar va me'yoriy texnik xujjatlar ishlab chiqish bo'yicha "Avtooina" MCHJ va Islom Karimov nomidagi Toshkent davlat texnika universiteti o'rtasida tuzilgan xo'jalik shartnoma doirasida "Avtooina" mas'uliyati cheklangan jamiyatda avtomobillarga xavfsiz oynalar ishlab chiqarishda foydalaniladigan turli markalardagi va sifatida turlicha bo'lgan sayqallangan listli oynalarni tashish va saqlash jarayonlarida sinishga yo'qotishlar bo'yicha me'yoriy texnik hujjat ishlab chiqilgan va tavsiyalar berilgan. Sinov jarayonida sayqallangan listli oynalarni tashish va saqlash jarayonida sinishga ta'sir etidigan omillar aniqlangan va ularning zararli ta'sirlarini kamaytirish bo'yicha chora-tadbirlar ishlab chilib, xavfsiz oynalar ishlab chiqarish jarayoniga tadbiriq qilingan.

**Tayanch so'zlar:** listli oynalar, tashish, saqlash, me'yoriy texnik xujjat, sinishga yo'qotishlar, avtotransport vositasi, avtomobil, konteyner

**Аннотация:** В статье рассматриваются процессы транспортировки и хранения листового стекла при производстве защитных стекол для автомобилей. Был проанализирован опыт организации транспортировки и хранения стекла в развитых странах мира с целью изучения проблем потерь сырья при транспортировке и хранении многослойного стекла, а также для разработки и утверждения нормативно-технического документа в этой области. Были изучены поставки различных марок полированного многослойного стекла, используемого при производстве защитных стекол для автомобилей, в ООО "Автооина" с разных адресов, от разных производителей, и проанализированы статистические данные. В рамках делового контракта, заключенного между ООО "Автооина" и Ташкентским

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государственным техническим университетом имени Ислама Каримова на разработку технических требований и нормативно-технической документации по транспортировке и хранению полированного многослойного стекла, Общество с ограниченной ответственностью “Автоойна” производило защитные стекла для автомобилей различных марок и различного качества. Разработан нормативный технический документ о потерях из-за поломки при транспортировке и хранении полированного многослойного стекла и даны рекомендации. В ходе тестирования были выявлены факторы, влияющие на поломку при транспортировке и хранении полированного многослойного стекла, а также разработаны и внедрены в процесс производства безопасного стекла меры по снижению их вредного воздействия.

**Ключевые слова:** многослойное стекло, транспортировка, хранение, нормативно-технический документ, потери из-за поломки, автомобиль, транспортное средство, контейнер.

## Introduction

Glass is a special material and its transportation and storage, especially loading and unloading processes, require special attention. The article studies the problems of losses from breakage during transportation and storage of laminated glass, as well as taking into account the experience of developed countries in the development and approval of regulatory and technical documents in this area, various brands of polished glass. Laminated glass is used in the production of protective glass for cars at Avtooyna LLC. The delivery process from different addresses, from different manufacturers has been studied, and statistical data has been analyzed. The research work is the result of work carried out under agreement No. 6/23 dated 05/01/2023, concluded between the Tashkent State Technical University named after Islam Karimov and Avtooyna LLC.

## Research Methods and the Received Results

Laminated glass is made from a variety of glass materials. These materials are divided into basic and auxiliary. The main or glass-forming raw materials are materials that introduce acids, alkali and alkaline earth oxides into the glass mass, and the main materials include  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{MgO}$ ,  $\text{Na}_2\text{SO}_3$ ,  $\text{Li}_2\text{O}$ ,  $\text{CaO}$ ,  $\text{V}_2\text{O}_3$ , etc., which are included in the composition. The main part of the glass creates and determines its properties. Auxiliary materials are materials that improve the properties and quality of glass and accelerate the process of glass formation; such materials include dyes, suppressants, color removers, etc. In terms of its physical and mechanical properties, glass is a hard and extremely fragile material. Therefore, the processes of loading, unloading, transportation and storage require special measures. We'll look at them below.

Certain rules must be followed at all stages of transportation of laminated glass. These rules help ensure the safety of fragile goods. Requirements for brands, packaging, transportation and storage of glass on the territory of the Republic of Uzbekistan

Interstate standard – “ГОСТ 32530 — 2013 СТЕКЛО И ИЗДЕЛИЯ ИЗ НЕГО Маркировка, упаковка, транспортирование, хранение” [1] regulated. They are as follows:

1) Containers must be provided by the shipper. They can be boxes made of boards, containers (universal or special) and reusable. Wooden boxes are mainly used for rail transport, while reusable universal containers are used for road transport. They protect the glass from any unexpected damage.

2) Boxes with lattice windows should be handled with care and should not be shaken or turned without reason. In addition, it is not recommended to install the container with the wide side down or at an angle.

3) It is advisable to transport the window in vehicles with an awning. It is recommended to move a window intended for display cases only on brackets. The rolling stock is completed by the sender or by mutual agreement of the carrier for a certain volume of transportation.

4) Extra care should be taken when installing windows packed in wooden boxes onto a truck. (Boxes with wooden boards “ГОСТ 4295-80. Ящики дощатые для листового стекла. Технические условия” [2] manufactured according to the Interstate Standard). There should be no gaps between them, the walls of the package should be adjacent to each other. Its side should coincide with the direction of movement of the car. It is important that shipping boxes are secured (i.e. secured).

5) Several containers can be installed on the body, both transversely and longitudinally. The boxes are further strengthened by tying the corners with flexible wire or using thin boards and nails.

6) The carrier (Driver or forwarder, responsible employee) must pay attention to the condition of the windows, as well as the appearance of the containers. In most cases, such goods are not accepted for transportation if: damage to integrity, glass fragments or other defects are detected. Also, the car should move smoothly, without sudden movements. Low speed: Given the condition of most

roads, the speed should not exceed 40-50 km per hour. For this reason, experienced drivers are hired to transport glass.

Also, paragraph 81 of the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan dated August 1, 2014 No. 213 "On approval of the rules for the transportation of goods by road in the Republic of Uzbekistan" [3] specifies the following standards for the transportation of laminated glass:

To transport laminated glass, flatbed vehicles (trains or vans) equipped with an awning are used. Laminate windows intended for display cases must be transported in specially equipped vehicles.

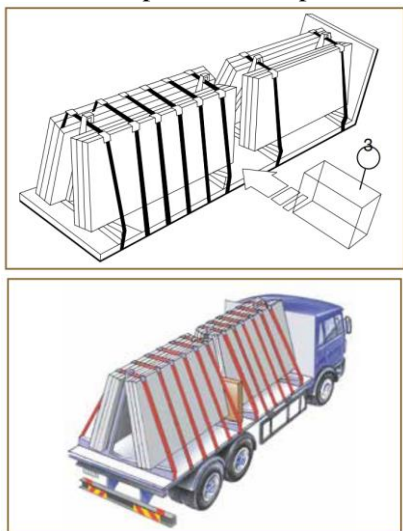
Laminated glass is transported in wooden boxes, universal or special containers, reusable bags and other bags that protect the glass from damage.

The glass panels fit tightly to each other and are located transverse to the direction of movement of the car. If the body is not full, the pockets are fixed or sewn so that they do not move or vibrate during movement.

Laminated glass in universal frames can be installed longitudinally and transversely to the car body. Fastening the rafters: it is necessary to sew them with thin boards or tie them with wire through the corners.

When placed transversely, it is necessary to install reusable containers with a slight inclination towards the vehicle cabin.

Containers with defective or broken pieces of glass will not be accepted for transportation.



**Fig 1. Placement of containers on the truck bed**

According to international experience, the general rules of cargo transportation "IRU - International Road Transport Union. International guidelines for the safe securing of loads in road transport. <https://www.iru.org/ru>" [4] also cited.

Its paragraph 7.1 states the following:

On the site, reinforced concrete slabs, laminated glass or wooden panels are installed in the

corners of the "A" shape. In addition, they themselves must be firmly secured to the loading dock. They must be of sufficient strength to prevent sliding and tipping over the vehicle platform. They are shown in the following pictures.

The following general rules for storing laminated glass will prevent damage to glass and glass products and ensure the safety of the process. (the basis, "ГОСТ 32530 — 2013 СТЕКЛО И ИЗДЕЛИЯ ИЗ НЕГО Маркировка, упаковка, транспортирование, хранение" international standard [5]). They are as follows:

- To store windows, it is necessary to ensure their protection from mechanical damage during unloading and loading.

- It is not allowed to carry all types of glass and glass containers over people.

- All employees involved in loading and unloading glass and glass products must be trained in equipment safety and how to perform these tasks.

- Glass and products made from it should be stored in closed, dry and heated rooms.

- When storing, laminated glass and products made from it (in containers or without containers) should be installed on special devices (pyramids or shelves) on shock-absorbing bases at an angle of 5-15° relative to the vertical plane.

- When storing between laminated glass and products made from it, sealing materials should be applied or sprinkled with special powders that do not damage the glass (products).

- If the shipping container or container is wet, glass or glass products should be opened indoors and the glass should be dried.

Glass destruction (natural losses) is observed as a result of various mechanical, temperature changes, humidity, internal and external defects (cracks, flying edges, bubbles) during transportation and storage, loading and unloading processes of laminated glass. Let's analyze existing regulatory documents on this issue.

"RDS 82-2003" came into force in the Russian Federation on January 1, 2004. Collection of norms for natural loss during storage and transportation of material resources in construction. <https://files.stroyinf.ru/Data1/41/41781/index.htm>

[6] the regulatory document developed a standard for the natural loss of window materials. According to it, the following weight standards have been introduced for glass and products made from it, depending on the type of transport, transportation conditions and climatic regions:

Table 1

**The rate of natural loss of building materials during transportation**

№	Name of materials	Kind of transport	Conditions of transportation	Norm, % mass					
				Climate zones					
				1 – cold		2 – moderate		3 – warm	
				Periods of the year					
				autumn-winter	spring-summer	autumn-winter	spring-summer	autumn-winter	spring-summer
1	Window glass, display glass	Railway	In special containers	0,80	0,80	0,80	0,80	0,80	0,80
		Automotive	In universal containers	1,00	1,00	1,00	1,00	1,00	1,00
		Water	In a wooden container	1,50	1,50	1,50	1,50	1,50	1,50

The table shows that for railway transport it is 0.8% of the mass of glass, for road transport - 1.0%, for water transport - 1.5%.

Also in the regulatory document “ON THE APPROVAL OF STANDARDS FOR LOSSES (WASTE) OF BUILDING MATERIALS DURING IX TRANSPORTATION BY MOTOR

TRANSPORT, STORAGE AND SALES” [7], which was developed during the times of the former Union and approved by the Ministry of Trade on November 27, 1991 by Order No. Losses during transportation, storage and use (breakage) The standard is approved. According to him:

Table 2

Types of norms	Name of building materials
	window glass, patterned glass, glass blocks, glass tiles
1. When transporting by road from suppliers to wholesale and retail trade enterprises (as a percentage of the amount of the received and inspected consignment of goods)	0,6
2. During storage and sale	
- in warehouses of wholesale bases as a percentage of the cost of goods sold and inspected	0,25
- in retail trade enterprises as a percentage of the amount of goods sold during the inter-inventory period	0,25

The table shows that for all types of windows, the rate of loss due to breakage (rich) is set at 0.6% of the price of the product during transportation by vehicle and 0.25% during storage and use.

In the course of studying the problem, the following practical work was carried out. Laminated windows are delivered to Avtooyana LLC from KVARs JSC on trucks. Tinted glass is packed in

wooden boxes and delivered by rail from China, Russia and other countries. The laminated glass imported from JSC KVARs has a thickness of 2.0, 3.0, 3.2, 3.5, 3.85, 4 and 5 mm. Their sizes are different. Windows are transported on flatbed trucks with universal racks.

Statistical data on window transportation from January to July 2023 were analyzed (Table 3).

Table 3

**Information on losses caused by vehicles and storage of ground glass at the plant**

Cutting line													
Thickness	Color glass	January			February			March			April		
		coming, m <sup>2</sup>	defective product, m <sup>2</sup>	%	coming, m <sup>2</sup>	defective product, m <sup>2</sup>	%	coming, m <sup>2</sup>	defective product, m <sup>2</sup>	%	coming, m <sup>2</sup>	defective product, m <sup>2</sup>	%
2	transparent	20988,76	179,93	0,86	88670,4	629,2146	0,71	96151,2	405,89	0,42	125625	900,89	0,72
3,2	green	1507,17	14,04	0,93	36278,1	121,68	0,34	43603,8	117	0,27	40689,7	56,16	0,14
3,5	green	27356,2	92,229	0,34	48252	182,4086	0,38	48951	121,68	0,25	47262,8	4,17	0,01
3,85	green	5372,64	4,68	0,09	4486,76	4,68	0,10	2485,08	9,36	0,38	7385,04	4,17	0,0
3,2	toned	5396,37	49,35	0,91	12943,3	121,48	0,94	8497,89	115,17	1,36	9976,34	64,37	0,65
3,5	toned	5711,38	49,36	0,86	2774,93	211,0471	7,61	18821,3	25,787	0,14	6635,21	88,57	1,33

Cutting line											Average		
Thickness	Color glass	May			June			July			January-July		
		coming, m <sup>2</sup>	defective product, m <sup>2</sup>	%	coming, m <sup>2</sup>	defective product, m <sup>2</sup>	%	coming, m <sup>2</sup>	defective product, m <sup>2</sup>	%	coming, m <sup>2</sup>	defective product, m <sup>2</sup>	%
2	transparent	128777	580,67	0,45	126750	895,98	0,71	79103	712,27	0,90	666065	4304,85	0,65
3,2	green	50974,6	51,28	0,10	31082,5	416,52	1,34	36466	308,8	0,85	240602	1085,48	0,45
3,5	green	60764,5	145,08	0,24	41350,3	159,12	0,38	51251	430,56	0,84	325187	1135,25	0,35
3,85	green	14365,9	0	0	0	4,68	0	6182,3	9,36	0,15	40278	37,44	0,09
3,2	toned	8524,5	53,35	0,63	2423,7	0	0	11264	42,372	0,38	59026	446,092	0,76
3,5	toned	11529,7	37,29	0,32	15096	265,72	1,76	14977	128,832	0,86	75545	806,599	1,07

Table 4.

2023 transport process				
Thickness, mm	Color glass	January-July		
		coming, m <sup>2</sup>	defective product, m <sup>2</sup>	%
2	transparent	666065	4304.85	0.65%
3.2	green	240602	1085.48	0.45%
3.5	green	325187	1135.25	0.35%
3.85	green	40278	37.44	0.09%
3.2	toned	59026	446.092	0.76%
3.5	toned	75545	806.599	1.07%

2023 storage process				
Thickness, mm	Color glass	January-July		
		coming, m <sup>2</sup>	defective product, m <sup>2</sup>	%
2	transparent	597225	167.08	0.03%
3.2	green	226299	745.64	0.33%
3.5	green	372263	938.12	0.25%
3.85	green	29507	0	0.00%
3.2	toned	13688	0	0.00%
3.5	toned	30073	0	0.00%

The table shows the loss of glass (rich glass) from destruction by thickness in months.

Also, during the study, ToshSTU specialists monitored the processes before the windows arrived

from JSC KVARS to the warehouse of Avtooyna LLC, and prepared documents on these processes. Their analysis is presented in the table below (Table 5).

Table 5.

№	date	Glass thickness, mm	Mirror dimensions, mm	Total number of sheets	Number of broken windows	A loss, %	Vehicle speed, km/h
1	19.05.23	2,0	1790x1475	1091	0	0	32,8
2	12.07.23	2,0	2220x1475	1093	0	0	40
3	12.07.23	2,0	2540x2100 2540x1475	714 360	0	0	27,5
4	13.07.23	3,5 (T1)	1800x2600	671	6	0,89	40
5	13.07.23	3,5 (T1)	1800x2600	657	4	0,61	40
6	25.07.23	3,5 (T1)	1800x2600	691	0	0	30
7	25.07.23	3,2 (T1)	1800x2600	745	0	0	36
8	26.07.23	2,0	1475x2220	1078	0	0	36
9	26.07.23	2,0	1475x1790	1085	1	0,09	36
10	26.07.23	3,5 (T1)	1800x2600	677	0	0	36

Note: Here the broken glass is only detected by external observation, the broken glass between the panes can only be seen by cutting the glass.

Observing the transportation process, it turned out that if safety rules are followed when placing laminated glass in reusable containers, then the glass should be fixedly attached to the container using boards and fibrous (soft) pads, and also precautions should be taken when loading and unloading the car, protecting glass from mechanical impact (impacts)

and do not exceed the speed of 40-50 km/h when driving, do not change speed sharply and ensure a smooth ride on uneven surfaces, walk slowly on sharp turns, this is an important factor in preventing glass from breaking.

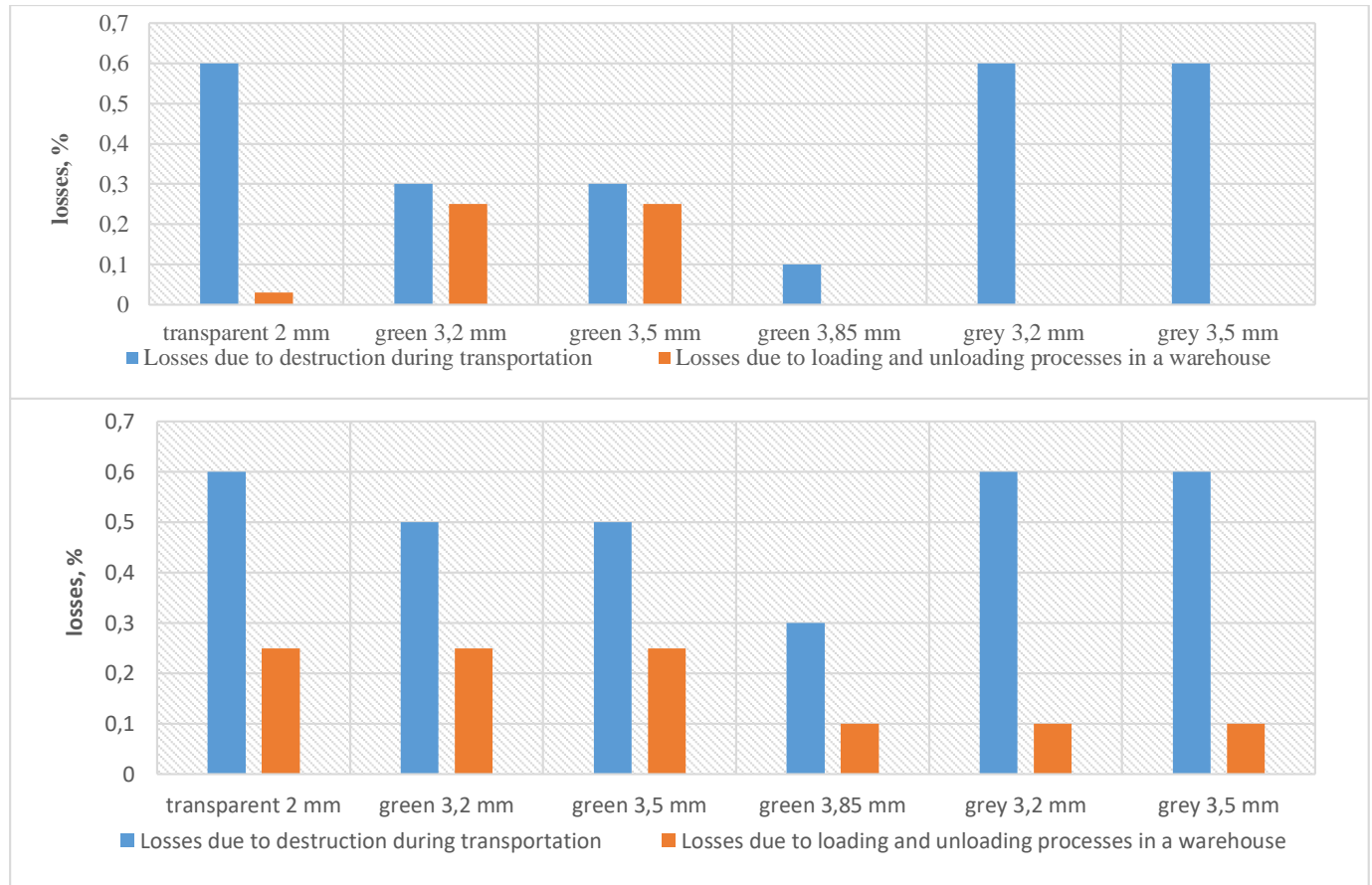
According to the results of the study, glass with a thickness of 2.0 mm has a maximum loss of 0.09%, and glass with thicknesses of 3.2 and 3.5 mm has an average loss of 0.29%.



### Conclusion

The following conclusion can be reached by analyzing the sources, standards, rules and regulations of international and foreign countries on losses from combat during the transportation and storage of laminated glass, as well as by directly studying the processes of transportation and storage of laminated glass. for Avtooina LLC. During the

loading and unloading processes of glass transportation and storage, organizing the process in compliance with all the above rules allows you to minimize losses from broken glass. In compliance with all the above requirements for the transportation and storage processes, the following standards for losses when breaking glass by thickness and color are established:



This acceptable standard must extend from the polished glass supplier to the warehouse, from the warehouse to the cutting line, and through to glass processing.

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## INFORMATION MODEL BASED ON PARAMETERS OF A COMBINED SOIL PREPARATION UNTIL FOR PLANTING

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**Abstract:** The article describes in detail the development of a combined pre-sowing machine as a result of the literature analysis of the scientific research conducted on pre-sowing tillage machines and its use and working process. In addition, the article provides scientifically based information about the factors affecting the leveler-softener and previous work on their improvement. The current state of tillage before planting in Uzbekistan and the size of the tilled fields are studied and tabulated. In order to optimize the parameters of the developed machine and minimize costs, as well as to increase its efficiency, it is devoted to the creation of an informational model of the leveler-softener, which is considered as a research object of the machine, and to justify its parameters. On the basis of the studied and analyzed data, the factors affecting it and their areas of change in order to achieve the target function are presented in the tables based on the data studied in detail from previous scientific works. On the basis of the conducted studies, the factors that have the greatest impact on energy efficiency were determined and it was concluded that the theoretical and experimental part of the scientific research work should be continued based on them.

**Keywords:** leveler, softener, research object, soil, brush-storm, factors.

**Annotatsiya:** Maqolada ekishdan oldin tuproqqa ishlov beruvchi mashinalar yuzasidan olib borilgan ilmiy tadqiqot ishlarini adabiyotlar bo'yicha taxlili natijasida ekishdan oldin ishlov beruvchi kombinatsiyalashgan mashina ishlab chiqilganligi va uning qo'lanilishi hamda ishlash jarayoni batavsil keltirilgan. Bundan tashqari, maqolada tekislagich-yumshatgichga ta'sir qiluvchi omillar va ularni takomillashtirish bo'yicha oldingi olib borilgan ishlar haqida ilmiy asoslangan ma'lumotlar keltirilgan. Tuproq ekishdan oldin ishlov berishning O'zbekistondagi hozirgi holati va ishlov beriladigan dalalarning o'lchamlari o'rganilib jadval holatiga keltirilgan. Ishlab chiqilgan

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