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ANALYSIS OF DESIGNS AND DEVELOPMENT OF FOOTWEAR INSOLES FROM LUFFA FOR MEDICAL PROFESSIONALS

Abstract. The article analyzes the existing designs of insoles, their structure, and the materials used. Based on the research, a design of double-sided insoles for medical professionals has been developed, with improved hygienic properties, such as breathability, hygroscopicity, necessary to create an optimal microclimate for the feet.

Keywords: loofah, insole, footwear for doctors, hygienic properties, preventive footwear.



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Introduction. Protecting the health of workers in medical institutions, ensuring safe working conditions for medical professionals, eliminating occupational diseases and industrial injuries is one of the main concerns of the state. The Decree of the President of the Republic of Uzbekistan No. UP-60 dated January 28, 2022 “On the development strategy of the new Uzbekistan for 2022-2026” [1] sets such urgent tasks as “development of the healthcare system, protection of public health, increasing the potential of medical professionals, creating special-purpose products with specified properties, and when solving these problems it is necessary to be based on the use of domestic materials based on import substitution and localization”.

Medical professionals must wear safety shoes, which are part of the uniform and serve to protect their feet from external influences in working conditions for a long time [2]. These shoes are subject to special requirements, such as reliability, wear resistance during use during the working day, resistance to chemicals used for disinfection, as well as heat, gas and moisture exchange of the foot with the surrounding environment, external shape and internal configuration of the product, mass and flexibility, shock-absorbing and frictional properties of lower parts and others, which are important during operation [3]. Therefore the shoes for medical professionals should be made of materials that are easy to clean and disinfect and do not require complex care.


Today, the medical field is so diverse and multifaceted, there are a huge number of specialties and areas in it, which leads to problems in developing the design of safety shoes and improving their quality, which is due to the contradictory requirements for functional and technical-economic properties, for ensuring protection and hygiene, and multidirectional means of satisfying them [4]. Medical professionals are exposed to heavy loads during the working day, their work involves prolonged standing and walking, for example, a study showed that during a twelve-hour shift, nurses cover a distance of eight to ten kilometers [5], which can lead to general health problems such as foot and ankle diseases, fractures, joint pain problems, low back disorders, neuropathic injuries, skin infections and vascular changes, which occur in 32-90% of healthcare workers [6]. It should also be noted that all the design features of special footwear for medical professionals directly follow from its functions. It is known that hygienic, ergonomic and other requirements are imposed on shoes, and therefore the properties of shoes that determine their convenience and comfort directly depend on the design and material of the insole. Therefore, the development and implementation of insole designs for medical professionals that meet the above requirements is relevant today.

Materials and methods. The insole is the main element of the shoe that is in direct contact with the foot and serves to protect it, as well as provide comfort and reduce the load on the legs when walking. Insoles are made from a variety of materials, such as soft lining leather, textile or non-woven materials, in addition, modern insoles are made from polymer gel and other natural and synthetic materials. Today, composite materials are used in the designs of insoles, which are manufactured based on the requirements necessary to obtain specific properties.






According to their purpose, insoles can be divided into hygienic, preventive and orthopedic. The first type has antifungal, insulating or massage properties, and also neutralizes unpleasant odors. Insert orthopedic insoles, also called anatomical, support the arch of the foot and improve shock absorption when walking. They can be used for both prevention and correction of foot defects. To create special preventive insoles with improved hygienic properties for medical professionals, an analysis of existing insoles was carried out, which is presented in Table 1.

Table 1



Designs of insoles for special shoes with preventive properties

| № | Name | Drawing and design features | Material | Purpose | Characteristic |
|---|---|--|---|---|--|
| 1 | 2 | 3 | 4 | 5 | 6 |
| 1 | Therapeutic and prophylactic massage insoles Forta 89 |  <p>Special massage zones of the insoles contain elastic massage elements of different shapes and sizes; The longitudinal pad and metatarsal platform of the insoles moderately support the arches of the feet.</p> | Evaplast is a type of polyolefin, a foam material with low water absorption and good thermal and sound insulation properties. | Prevention of fatigue and pain in the legs, pain in the veins. Used for weakened immunity, decreased body tone, apathy and stress | The insole has antibacterial properties, does not cause allergies, does not absorb moisture, and is easy to clean. |

Continuation of Table 1

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|--|--|--|--|
| 2 | Therapeutic and prophylactic massage gel insoles |  <p>Shock-absorbing gel insoles with fabric coating and massage effect</p> | Gel insoles have small “pimples” and also the presence of a small pelota (elevation in the central part) and are covered with “Forte” cotton fabric. | Designed for the prevention and treatment of fractures in any part of the lower extremities, arthrosis, and intense physical activity. | The gel insole is an excellent shock absorber, taking on any load both from standing work and while walking, allowing the foot to be better fixed in the shoe and supporting the natural arch of the foot. |
| 3 | Therapeutic and prophylactic semi-insoles (art. 016/3809) |  <p>Shock-absorbing gel semi-insoles with anatomical lining under the arch</p> | Made from clear gel | -increased loads on the feet; - standing nature of work; - cracks on the heels; -arthrosis and arthritis; -prevention of longitudinal flatfoot | Possibility of using insoles for the prevention of orthopedic disorders, protection against the formation of swellings, calluses, and corns |
| 4 | Air insoles LP AIR MASSAGE |  <p>Flat insole, molded along the footprint of the last.</p> | Upper with semi-rigid cells and textile covering. The layer is made of porous POLIYOU foam. | They prevent stagnation of blood and lymph, the development of osteoarthritis, etc., perfectly cushion the foot and quickly return to its original shape | Has a universal size (can be cut to the desired length) |
| 5 | Insoles SIDAS Winter 3D |  <p>Ergonomic design with corduroy upper. EVA insert for cushioning Aluminum plate insert for temperature support</p> | Material – EVA foam | Provides correct stance and support for the leg; Special foam inserts guarantee perfect cushioning | Supports the foot in an anatomically correct position and provides additional comfort and convenience |
| 6 | Insoles SIDAS 3d Winter Comfort (Women) |  <p>Designed for use in ski boots and any other warm footwear</p> | Material – EVA foam | The three-dimensional structure provides ideal support for the foot and promotes proper body alignment | These insoles enhance warmth, comfort and hygiene |

Continuation of Table 1

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|----------------|---|------------------------|---|---|
| 7 | Loofah insole |  <p>Dense and hard edge, smooth carving</p> | loofah sponge material | Designed for everyday wear | The insoles will effectively reduce odor and absorb sweat, allowing your feet to breathe all day long |
| 8 | Loofah insoles |  <p>The insole has a bottom layer of calico, the top layer is made of loofah. The edges are trimmed with braid</p> | Loofah and calico | Stimulates blood circulation and gives a massage effect | The insole has antibacterial properties and does not cause allergies |

Research results and discussion. An analysis of the designs of insoles with preventive properties has shown that to improve the comfortable properties of shoes, modern manufacturers offer designs that use materials with shock-absorbing properties, such as foam or gel materials, which provide a massage effect and improve the overall health of a person.

However, it should be noted that in the modern world, humanity has begun to give preference to environmentally friendly materials and products. Loofah (Fig. 1) is a natural product, and we suggest trying it as a part that acts as an insole for the shoes of medical professionals. Luffa has its own benefits: stimulation of local circulation is a process that helps increase blood flow to a specific area of the body. This is necessary to increase the supply of tissues with oxygen, nutrients, and also the product is hypoallergenic, which has the least possible allergic irritation, helps cleanse the skin, in addition, the washcloth has a lymphatic drainage effect. The chemical composition of luffa is rich in micro- and macroelements, such as potassium, calcium, magnesium, phosphorus, sodium, iron, copper, selenium, as well as vitamins A, B, E and K [7]. In addition, in Uzbekistan, luffa cultivation is possible throughout the country; luffa sponges are sold at a price of 1860 sum/piece. A cylindrical washcloth 20 cm long, made from local luffa, is sold at a price of 8304 sum/piece. This shows us that using luffa in footwear can lead to high cost-effectiveness.



Fig. 1. Luffa washcloths

Studies of stiffness, strength and energy absorption characteristics Luffa studies conducted by researchers in Australia [8] found that stress-strain curves show an almost constant stress plateau over a wide range of deformations, which is ideal for the use of this material to absorb impact loads on the foot. Luffa sponge material has been found to exhibit properties such as stiffness, strength and energy absorption capacity that are comparable to those of some metallic porous materials in a similar density range. This study shows that luffa sponge is superior to many traditional construction materials.

Based on the above requirements and design analysis, we have developed a design of double-sided insoles for medical professionals with improved hygienic properties, such as air permeability, hygroscopicity, necessary to create an optimal microclimate in the internal space. Figure 2 shows the developed insole, which is a two-layer structure with a top layer of luffa. The second layer of the insole is made of cellulose material. Both layers are sewn together with edging tape. There is a loop in the heel that can be used to easily remove the insole from the shoe.



Fig. 2. Luffa insole

Conclusion. Thus, we can conclude that the use of luffa in shoes for medical professionals can improve the hygienic properties of shoes, the massage properties of luffa will improve blood circulation in the body, in addition, the hypoallergenicity of this material will allow it to be used for a long time, which is necessary under special working conditions doctors Another advantage of luffa insoles is that this natural material is biodegradable, does not harm the environment and can be considered a component of sustainable footwear production.

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LUFFA ДЕНСАУЛЫҚ САҚТАУ МАМАНДАРЫНА АРНАЛҒАН АЯҚ КИІМНІҢ ҰЛТАРАҒЫН ЖОБАЛАУ ЖӘНЕ ТАЛДАУ

Аңдатпа. Мақалада қолданыстағы ұлтарактардың конструкциялары, олардың құрылымы және қолданылатын материалдар талданды. Жүргізілген зерттеулер негізінде оңтайлы аяқ микроклиматын жасау үшін қажетті тыныс алу, гигроскопия сияқты гигиеналық қасиеттері жақсартылған медицина қызметкерлеріне арналған екі жақты ұлтарак конструкциясы әзірленді.

Тірек сөздер: ұлтарак, дәрігерлерге арналған аяқ киім, гигиеналық қасиеттері, профилактикалық аяқ киім.

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АНАЛИЗ ДИЗАЙНА И РАЗРАБОТКА ОБУВНЫХ СТЕЛЕК ОТ LUFFA ДЛЯ МЕДИЦИНСКИХ РАБОТНИКОВ

Аннотация. В статье анализируются существующие конструкции стелек, их структура и используемые материалы. На основе проведенных исследований была разработана конструкция двусторонних стелек для медицинских работников с улучшенными гигиеническими свойствами, такими как воздухопроницаемость, гигроскопичность, необходимыми для создания оптимального микроклимата для ног.

Ключевые слова: стелька, обувь для врачей, гигиенические свойства, профилактическая обувь.