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Content

Obsah

ERGONOMICS AND ANTHROPOMETRY OR HOW TO LIVE EVERYDAY LIFE WITH A HANDICAP

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Abstract: *The article focuses on physically handicapped persons on wheelchairs and on their needs with regards to ergonomics and anthropometry at everyday activities in combination of requirements for the clothing they wear every day. To set the needs we use measurements of the body in static position, i.e. in sitting or lying positions, and measurements of dynamic dimension, i.e. while the body moves. The results of anthropometry can be applied according to ergonomic needs into equipment of the environment, which is adapted to the needs of the wheelchair users. The results can be applied into constructions of clothing for wheelchairs users too. An example of the solution is realized in jeans, the cut of which is adapted to the persons sitting on wheelchair. This issue might address a clothing company that could extend its production for the range of clothing for wheelchair users.*
Key words: *Ergonomics, anthropometry, dynamic dimension, physical disability, wheelchair users, sitting person, wheelchair users' clothing.*

1 INTER-DISCIPLINARY SYSTEM APPROACH OF ERGONOMICS

Ergonomics as a system discipline integrates and uses the knowledge of humanities and technical sciences and it complexly solves persons' activities and their connection with technology and environment, psychophysical strain of individuals and development of their personalities. Scientific disciplines overlap. This occurs in ergonomics and anthropometry, also in psychology, sociology and others. Anthropometry is a part of anthropology, the most general science about humans. It monitors the impact of persons' bodily dimensions on labour efficiency and it has a broad practical application.

Ergonomics is based on the knowledge that the unit of person – technology - environment is not only a composition, compounding of these elements but that a new quality, new integration, so called **system**, with specific characteristics and values is established by their grouping and creating relations among them.

Quality of the objects, equipment and tools, with which persons are permanently in contact grows if they are universally adapted to persons - not only to their dimensions but to all their abilities and qualities. Person is the most important component of the person - technology - environment system.

In this work, we can meet a group of wheelchair users who have their specific qualities in this system.

2 THEORY AND PRACTICE WHEELCHAIR USERS' BASIC ACTIVITIES

People living with handicap differ from "healthy" people "only" by the fact that they are blind, deaf or cannot walk. However, all of us are the same inside. Whatever the handicap is, our society often does not understand that these people want and can live common lives. The cause for a person's handicap is usually a disease, permanent disablement due to injury or congenital abnormality.

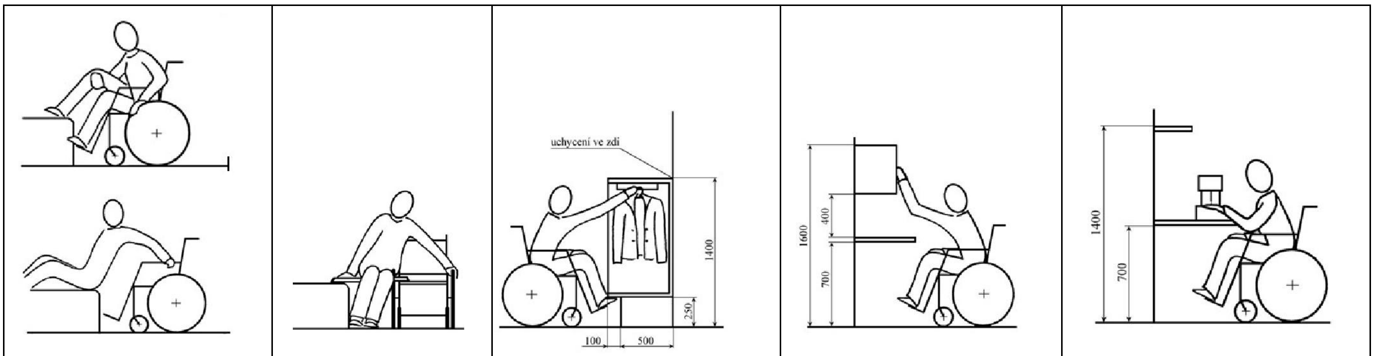
"Healthy" people do not realize how many barriers a physically handicapped person must overcome every day; in the street, in shops or at home. Some wheelchair users normally commute to work by cars, do their shopping and maintain their household practically independently. It is very important, especially as for the psychological aspects, for all physically handicapped persons to be devoted to an activity not to have time to think about their destiny.

Daily routines of each of us are individual but there are some activities that all of us do, so the wheelchair users do them too. Common activities such as going to toilet or getting a coat from wardrobe are banal for "healthy" people. But for a wheelchair user it is not always like that. That is why the wheelchair users have more demands on equipment of their flats as well as accessibility of public buildings.

2.1 Activities carried out at home

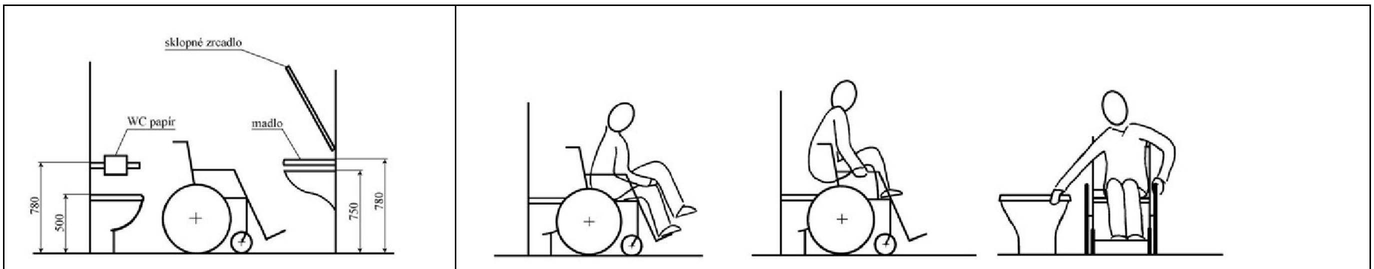
It is necessary to assess wheelchair user's activities with respect to ergonomics so that the wheelchair user feels comfortable at home while working or resting. Life on a wheelchair is a big strain for spine. Lying position is the maximum relief for spine. Bed must have certain parameters even if the wheelchair user uses it only for rest as other people do. Wheelchair users do the following activities at home: rest, placing objects, work in the kitchen, hobbies and work (Figure 1) and sanitary facilities (Figure 2).

As for the height of bed, all furniture in the kitchen and sanitary facilities, it is very important for the wheelchair users to think primarily of spaciousness but also to think over all details so that the wheelchair user could move freely and independently from other person [1].



The way of changing from wheelchair to bed | Movement to bed using a sliding board | Arrangement of wardrobe | Dimensional layout of the kitchen unit | Dimensional layout of the desk

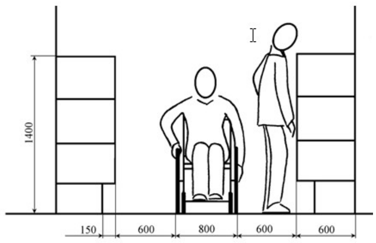
Figure 1 Wheelchair user's activities carried out at home [1, 2]



Dimensions and layout of toilet | The way of moving to toilet

Figure 2 Wheelchair user's activities carried out when moving to toilet [1, 2]

Transferring the wheelchair to the car using a sliding board



Dimensional layout of a shop

Figure 3 Wheelchair user's activities when moving to car and when shopping [1, 2]

2.2 Activities carried out in the city

The greatest problem in wheelchair user's everyday life is inaccessibility of public buildings such as cinemas, theatres, offices, shops, medical facilities and many others. The wheelchair user is found in a very unpleasant situation - only one step in front of the building is a problem. It is practically impossible to rearrange and reconstruct entire cities but a lot has already changed in our cities. There are barrier-free entrances to public buildings, means of transport, etc. To provide some examples two of the activities carried out outside were chosen - going by car and shopping (Figure 3).When changing to the car it is good to use a sliding board, thanks to which the distance between the wheelchair and car can easily be bridged.

In shops, the pass-through width between the shelves is important. Minimum width for a person on wheelchair is 80 cm and for a person standing by the shelves 60 cm on both sides of the aisle. So the pass-through width must be 2 m as a minimum. The wheelchair user's limited range of reach and the level of the top shelf above the floor may not be omitted [1].

3 THE RELATION OF ERGONOMICS AND ANTHROPOMETRY AND WHEELCHAIR USERS' CLOTHING

Knowledge of human body is very important when constructing clothing products. In the course of life, human body changes and particularly significant changes occur in the individual phases of growth. Changes of body shapes can be seen when a person is moving, particularly in wheelchair users with limited motion abilities who can do only some moves. This causes that the same parts of the body are constantly strained and such fact should not be omitted in construction of clothing for handicapped persons on wheelchair [3].

3.1 Differences of physically handicapped persons

Defects of locomotor and supporting systems, i.e. of bones, joints, tendons and muscles and blood distribution as well as defects of the nervous system if they manifest in a motion handicap, are understood as physical handicaps. Physical handicap can be congenital or acquired during the life. Cerebral palsy in children is the most frequent cause of a handicap. Impairment occurs in embryo during pregnancy, childbirth or immediately after it. Its after-effect is a defect in the ability to move and other so called associated symptoms such as mental, sense impairments, etc. Impairment occurs due to several factors, they are, for example:

- physical - RTG radiation
- chemical - gases
- biological - bacteria, viruses

Cerebral palsy manifests in three basic forms diparetic form when both lower limbs are impaired, hemiparetic form when one half of the body is impaired and quadruparetic form when all limbs are impaired (Figure 4).

The cause of deformities acquired during life is usually an injury, inflammatory diseases of brain and spinal core and many others [4].

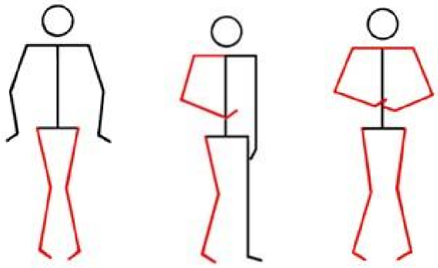


Figure 4 Diparetic, hemiparetic and quadru-paretic forms of impairment [1]

The wheelchair users differ significantly:

- Some need a wheelchair only for moving outside because they cannot stand or walk for a long time.
- In another group, there are the wheelchair users who depend on other person's assistance for 24 hours a day. They are persons with all four limbs paralyzed.
- Then there are the wheelchair users who need other person's assistance for some actions, e.g. when moving from a wheelchair to bed, at personal hygiene or when moving outside.
- There is a special group of people moving on electric wheelchairs. Mostly they are persons with paralyzed arms.
- Then there are the wheelchair users who are bound to orthopaedic wheelchair but who are fully independent. They live a life equal to this of the others. They go to work by car, raise children and do many other common activities - they "only cannot walk" [1].

3.2 Factors influencing successfulness of integration of handicapped persons

Among the most important factors helping in proper and adequate integration of handicapped persons into society, there are primarily:

- parents and family
- friends
- school and teachers
- consultancy and diagnostics
- means of special pedagogical support
  - supporting teacher
  - personal assistant
  - transport
  - rehabilitation, compensation and didactic aids
  - primarily, approach of the society itself

Among other factors, there are:

- architectonic barriers
- social psychological barriers
- organisation of disabled persons [5]

These factors (and integration itself, which is realized by these factors) are, however, emphasized by the kind and level of impairment and handicapped person's determination.

4 EXPERIMENTAL WORKS

The thesis focuses not only on working comfort but, with regard to wheelchair users' possibilities, also on relaxing in connection with clothing. Physically handicapped people (children, youth, adults) usually differ from "normal standardized" figures, that is why the range of clothing offered on the market is not satisfactory for them.
The aim of the experts in clothing is to make clothing that is fully satisfactory for the consumer. For this purpose dynamic dimensions that are measured in sitting position and, in two cases, in lying position are necessary (Figures 5-8, [1]).
Measuring of each dimension is based on the dynamics of the move, i.e. wheelchair user's activities that are basic and thus essential for wheelchair users' everyday lives. In each dimension, the method of measuring is characterised and ergonomic aspect is assessed too; it means what is the influence of given dimension on wheelchair user's comfort while working and relaxing in connection with clothing.
Investigation was carried out on a set of eighteen children aged 11 to 14 years. The results of measuring body dimensions by are displayed in Figure 9.

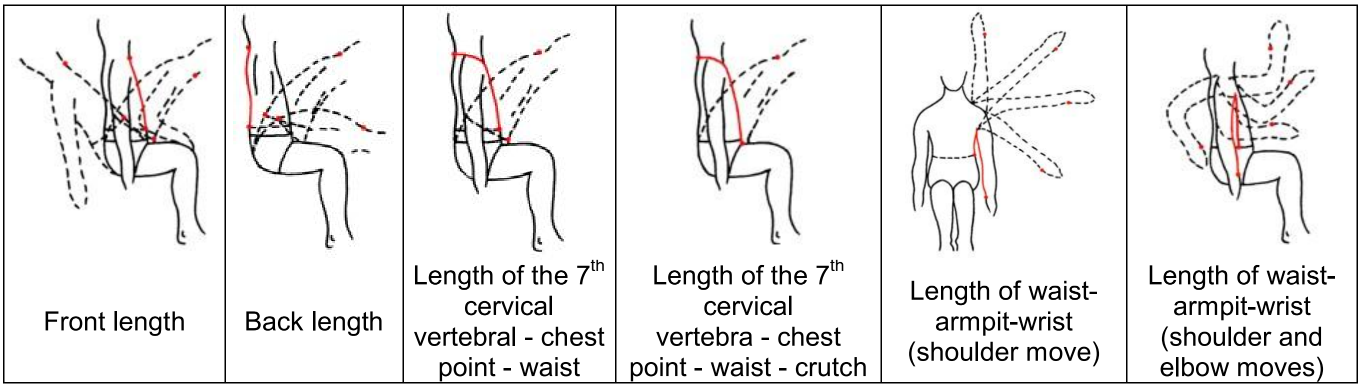


Figure 5 The method of measuring dynamic dimensions measured in sitting position - upper body part

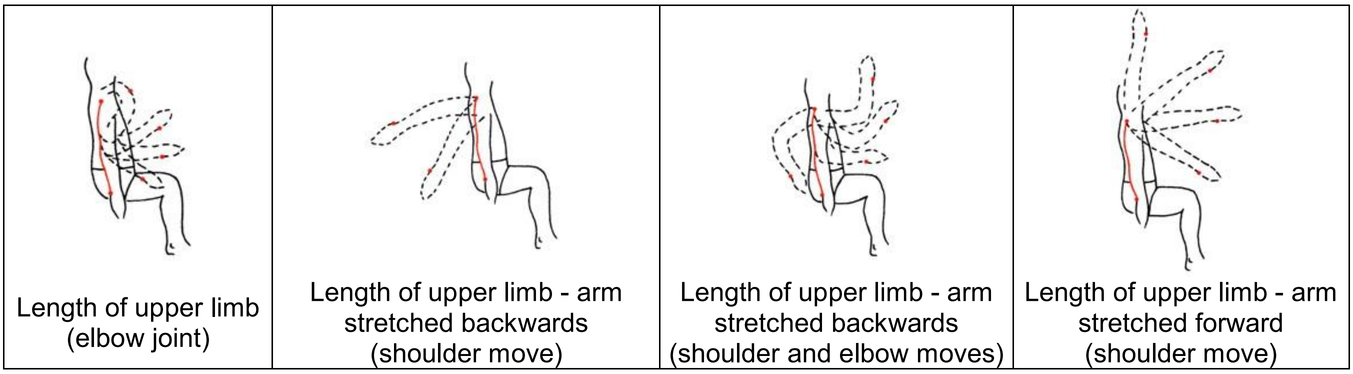


Figure 6 The method of measuring dynamic dimensions measured in sitting position - length of upper limb

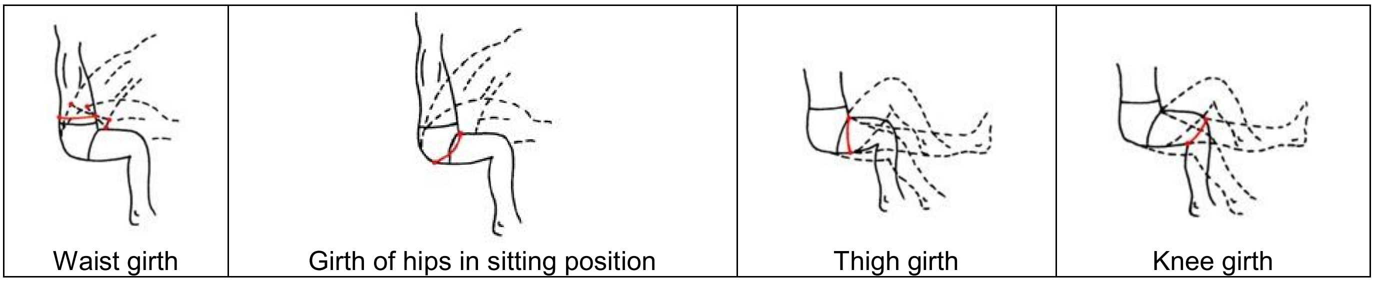


Figure 7 The method of measuring dynamic dimensions measured in sitting position - girth dimensions

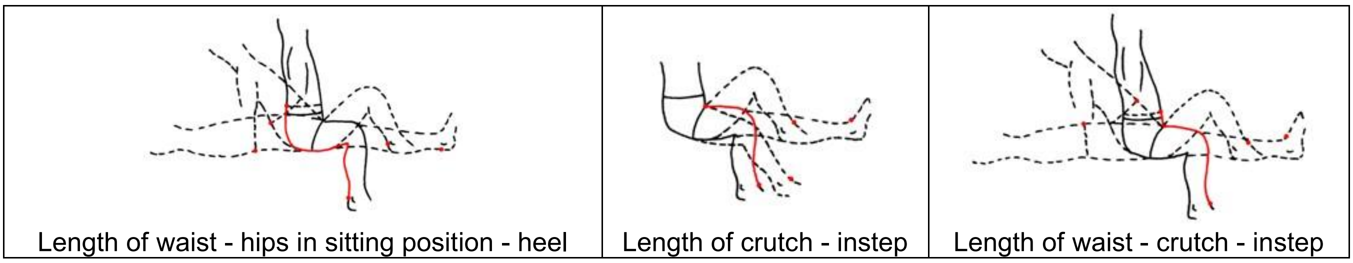


Figure 8 The method of measuring dynamic dimensions measured in sitting position – lower limb lengths

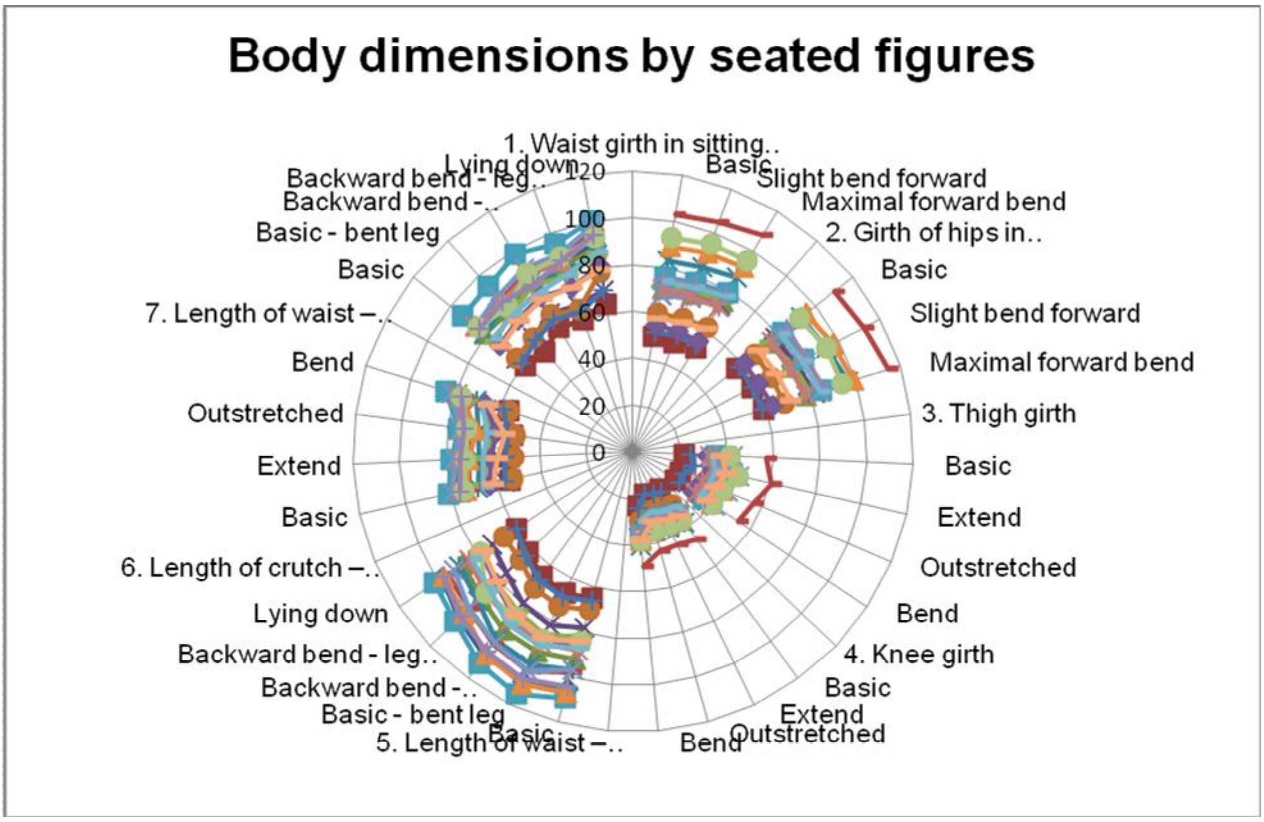


Figure 9 The results of measuring body dimensions by wheelchair users

In selected bodily dimensions, the dynamics of move was calculated, i.e. difference between static and dynamic positions expressed in centimetres for implementing into constructional dimensions but also in percentage.

$$d_i = \chi^{(d)} - \chi^{(s)} [cm] \quad (1)$$

$$\overline{\chi}^{(s)} = \frac{1}{n} \sum_{i=1}^{n} \chi_i^{(s)} [cm] \quad (2)$$

$$\overline{d} = \frac{1}{n} \sum_{i=1}^{n} d_i [cm] \quad (3)$$

$$\chi = \frac{\overline{d}}{\overline{\chi}^{(s)}} * 100 [\%] \quad (4)$$

where:
d_i - dynamic effect,
$\chi_i^{(d)}$ - bodily dimension at set move,
$\chi_i^{(s)}$ - bodily dimension in static position,
$\overline{\chi}^{(s)}$ - selective mean of statistic sign,
n - number of measured values,
$\overline{d}$ - selective mean of dynamic effect,
χ - ratio of dynamic effect from measured bodily dimension.

5 RESULTS AND DISCUSSION

The average dimensions sitting persons and dynamic effect are stated in Table 1 that are required for construction of clothing for sitting persons.
Clothing must serve its purpose and be in compliance with human body dimensions and shapes. So clothing for physically handicapped persons must be functional, fashionable, aesthetical and practical. We may not, however, omit the comfort of wearing but also of dressing and undressing which are complicated for handicapped persons.

Table 1 Change dynamic dimensions sitting persons - lower bodies

Lower bodies	Average value $s_i^{(d)}$ [cm]	Difference $\bar{d}$ [cm]	Difference χ [%]
1. Waist girth in sitting position			
Basic	71.67		
Slight bend forward	72.89	1.22	1.7
Maximal forward bend	74.56	2.89	3.9
2. Girth of hips in sitting position			
Basic	78.22		
Slight bend forward	79.33	1.11	1.4
Maximal forward bend	81.11	2.89	3.6
3. Thigh girth			
Basic	36.78		
Extend	39.50	2.72	6.9
Outstretched	36.78	0.00	0.0
Bend	35.94	-0.83	-2.3
4. Knee girth			
Basic	32.50		
Extend	31.17	-1.33	-4.3
Outstretched	30.83	-1.67	-5.4
Bend	34.94	2.44	7.0
5. Length of waist - hips in sitting position - heel			
Basic	88.83		
Basic - bent leg	92.94	4.11	4.4
Backward bend - bent leg	91.11	2.28	2.5
Backward bend - leg stretched out	86.39	-2.44	-2.8
Lying down	82.89	-5.94	-7.2
6. Length of crutch - instep			
Basic	68.17		
Extend	66.11	-2.06	-3.1
Outstretched	64.94	-3.22	-5.0
Bend	71.00	2.83	4.0
7. Length of waist - crutch - instep			
Basic	77.72		
Basic - bent leg	78.33	0.61	0.8
Backward bend - bent leg	81.44	3.72	4.6
Backward bend - leg stretched out	80.17	2.44	3.0
Lying down	86.06	8.33	9.7

Constructional defects of trousers in common sale are shown on handicapped persons by short back part in the pelvic area, long front part in the stomach area and short front parts due to permanent knee bending. That is why the results of measurements are applied into construction of fashionable jeans for handicapped persons with accent to wheelchair users (Figures 10 and 11).

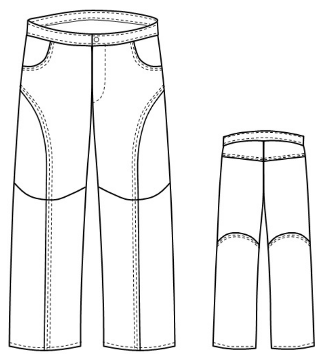


Figure 10 Technical drawing of jeans [6]

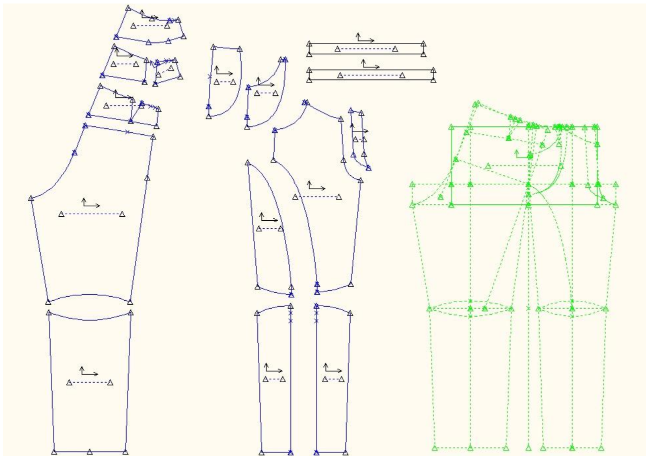


Figure 11 Construction and parts of jeans for wheelchair users [6]

Construction is processed in AccuMark CAD system in module macro [7, 8] and can be set on individual dimensions of the wheelchair user.

A great benefit of clothing made this way is especially its shape adapted to handicapped person's anatomy, which provides more comfort for the users and makes their lives more pleasant.

6 CONCLUSION

Ergonomic and anthropometric knowledge has its place in wheelchair users' lives. Based on the activities mentioned, bodily dimensions that can be applied in equipment at home and out of home and into construction of clothing for wheelchair users were selected and measured. There is a chance of the wheelchair users' better realization and involvement in joys of life despite their personal obstacles.

Knowledge gained by measuring external characteristics of human body can be applied in practice in clothing construction as well as at solving the size of workplace, construction of furniture and other equipment of workplace.

The issue can be an appropriate inspiration especially for architects but also for clothing companies that own AccuMark CAD system and wish to use the module of macros with regard to particular individual requirements and needs of handicapped persons but also for companies that are motivated by wheelchair users' demands to such extent that they wish to make their offer of clothing wider for various kinds, models and sizes for wheelchair users.

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ERGONOMIE A ANTROPOMETRIE ANEB JAK ŽÍT S HANDICAPEM KAŽDÝ DEN

Translation of the article

Ergonomics and anthropometry or how to live everyday life with a handicap

Tento článek se zaměřuje na osoby tělesně postižené upoutané na vozíček a na jejich potřeby z hlediska ergonomického a antropometrického při zvládání denních běžných činností v kombinaci požadavků na oděv, v němž se denně pohybují. Pro stanovení potřeb se vychází z měření těla ve statické poloze, tj. vsedě, případně vleže a z měření dynamických rozměrů, tj. při pohybu těla. Výsledky antropometrie lze aplikovat dle ergonomických potřeb do vybavení prostředí, které se přizpůsobuje potřebám vozíčkáře. Dále je lze aplikovat do konstrukcí oblečení pro vozíčkáře. Ukázka řešení je realizována na džínových kalhotách, které jsou střihově přizpůsobeny sedícím osobám na vozíčku. Jde o téma, které by mohlo oslovit některou z oděvních firem, která by mohla rozšířit svoji výrobu o nabídku oděvů pro vozíčkáře.

DISCRETE TWO-DIMENSIONAL MODEL OF MOISTURE SPREADING IN TEXTILE MATERIALS

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Abstract: *In this paper with the use of methods of differential and integral calculation a discrete model of moisture distribution on the surface of textile material has been developed. It considers a material microstructure and simultaneously its integrity and enable to predict a moistened material state at any point of time, geometrical parameters of the moistened surface and time of moisture spreading process end.*
Key words: *textile materials, discrete model, moisture spreading, moistening border, concentration, structure.*

1 INTRODUCTION

Textile materials moistening processes provoke are of significant interest both in industrial engineers and specialists in products operation. In the first case the process of spreading on the surface or moisture distribution through internal ways in the material can be realized in the processes of dyeing, moisture-heat treatment, etc. Prediction of liquid and material behavior can improve considerably technological process conditions, improve the product quality. During dyeing, for example, it is possible to improve accuracy of patterning on the material and toning uniformity.
Prediction of moisture spreading processes is also important from the point of view of comfortability as in case of availability of a reliable model it is possible to predict the extent and area of moistening in the sections of increased perspiration. Unfortunately, exact solutions of moisture distribution on the surface of material are practically absent that is connected with the complexity of mathematical modelling of process.

2 PROBLEM STATEMENT

Solution of the problem of liquid penetration on the surface of material consists of two ways. The first one provides study of kinetics of spreading on the surface. This problem has been studied, for example, by means of high-speed video filming [1]. However in this case, in the main, the surface of material has been investigated instead of the process of moisture penetration in its structure. In [2] it is noted that a borderline (maximum) case of moistening is liquid spreading. As a rule, it occurs as a result of interaction (collision) of bodies, whose structure of molecules is similar. However, by no means, moisture penetration in the structure of materials is analyzed. The work [3] describes processes of adhesion that play a significant role in technology of obtaining textile and composite materials. The existing thermodynamic theories of adhesion are based on the results of researches of surface tension energy, contact angles at the substrate-adhesive borderline and also adhesive moistening and spreading at the interphase borderlines in view of viscosity and different contribution of intermolecular forces. The above works should be observed as theories of microprocesses that take place during moistening. They can be confirmed experimentally, but creation of a real theory on their basis is quite a difficult problem.
A real model can be built on the basis of solution of differential equations of diffusion along the surface of material. The attempts to solve similar problems are given in some

works [4-5]. The results obtained in [6-7] consider a dynamic process of penetration deep into material. It should be noted that the results of these works cannot be used directly in practice. Moreover, they solve a problem taking into account one coordinate - depth of penetration. When adding a longitudinal and a transverse coordinate the problem of solving becomes actually impossible. The results of solution of practical problems of liquid penetration efficiency determination which, for example, was done in [8], enable to increase contour definition when printing and to reduce its spreading have not been theoretically confirmed.

Thus, contradiction is observed between the availability of microtheories and continuous models, any of which cannot really present the results of process, between the availability of experimental bases on elementary specimens and impossibility of their spreading on real products, between the necessity of determination of real moistening borderlines and the absence of models that could foresee these processes. Therefore the purpose of this work is development of a discrete model of moisture spreading on the surface of material that realizes micro-bases of the structure along with the integrity of material and enables to predict a moistened material state at any point of time.

3 RESULTS AND DISCUSSION

For analysis of moisture distribution processes in elementary specimens let's observe colored water spreading along the elementary section of material (Figure 1). These curves were obtained in the Materials Science laboratory for elementary samples of linen fabrics.

Analysis of data given in Figure 1 enables to approximate the process of moisture distribution along the element by the following dependence:

$$f(x,t) = e^{-\frac{ax}{t}} \qquad (1)$$

where x - coordinate, t - time, a - coefficient specific to the material.

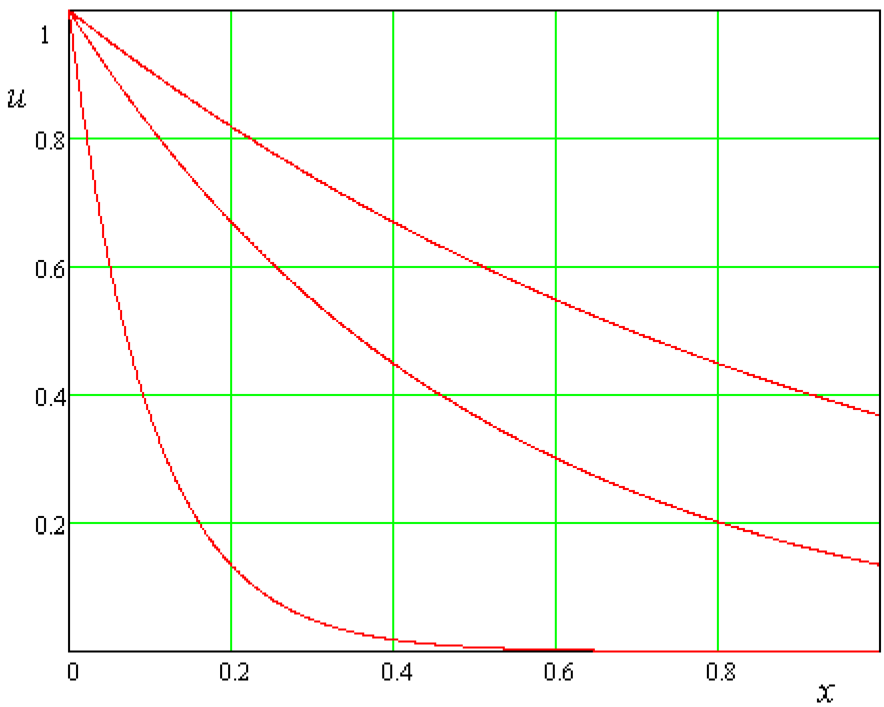

Figure 1 Change of moisture concentration when changing a distance from the source of moistening for different points of time

Moisture passing by the element proceeding from initial concentration u_0 can be described by the following dependence:

$$u = u_0 \cdot f(x,t) \quad (2)$$

where u - moisture concentration at an arbitrary distance in time t, u_0 - initial concentration.

If at the beginning concentration changes in time it is possible to indicate a change of concentration in differentials. When initial concentration changes by du_0 small value, concentration at any point changes by du value that is determined according to the rules of differentiation:

$$\frac{du}{dt} = \frac{du_0}{dt} f(x,t) + u_0 \frac{df(x,t)}{dt} \quad (3)$$

where derivative of the concentration is performed according to the rule for differentiating of function multiplication.

Taking into consideration a proposed expression for liquid distribution it is possible to find:

$$\frac{du}{dt} = \frac{du_0}{dt} e^{-\frac{a_x x}{t}} + \frac{a_x}{t^2} u_0 \cdot e^{-\frac{a_x x}{t}} = \left(\frac{du_0}{dt} + \frac{a_x}{t^2} u_0 \right) e^{-\frac{a_x x}{t}} \quad (4)$$

This dependence enables to find concentration at any point of element if initial concentration changes in time.

Let's build a discrete model of moisture distribution. At the contact points of elementary sections the moisture crossflow occurs and depending on the properties of materials such a crossflow can be asymmetrical. The below diagram (Figure 2a) shows such a crossflow in case of moisture movement on longitudinal and cross elements. The diagram shows that separation of fluid flows between elements happens at the points of collision. Let's consider an elementary collision number as m. Then intensity of moisture that comes to this cross-point is $u_y^{(m)}$. A part of moisture keeps on moving along a longitudinal element, this part is determined by the corresponding coefficient and its portion is equal to $k_{yy} \cdot u_y^{(m)}$. Two letters at the coefficient means that this part of moisture that has moved in the y direction and keeps on moving in the y direction. In the transverse directions take place liquid movement the part of which has got when touching the cross-point of elements. Its portion is equal to $k_{xy} \cdot u_y^{(m)}$. Two letters at the coefficient means that this is a part of moisture that has moved in the y direction and keeps on moving in the x direction. In general case a part of liquid that moves on the left side and on the right side can be different.

Similar considerations can be given for liquid movement in the transverse direction. At this, liquid movement goes on in the same direction in $k_{xx} \cdot u_x^{(m)}$ ratio, and $k_{yx} \cdot u_x^{(m)}$ - in the perpendicular direction.

So in this cross-point initial liquid concentration is formed for its further movement. This initial concentration is determined by the sum of liquids arriving from two directions:

$$\begin{aligned} u_{x0}^{(m)} &= k_{xx} \cdot u_x^{(m)} + k_{xy} u_y^{(m)} \\ u_{y0}^{(m)} &= k_{yx} \cdot u_x^{(m)} + k_{yy} u_y^{(m)} \end{aligned} \quad (5)$$

Total liquid distribution can be considered in relation to a real structure of discrete material. For a start let's consider a rectangular mutually perpendicular structure of elements (Figure 2b).

In this structure let's designate longitudinal elements with i letters, and cross elements - with j letters. Let's designate a distance between longitudinal elements with h_x, and a distance between cross elements - h_y. For such a structure in case of concentration that changes in time it is possible to write down a concentration addition for i, j cross-point.

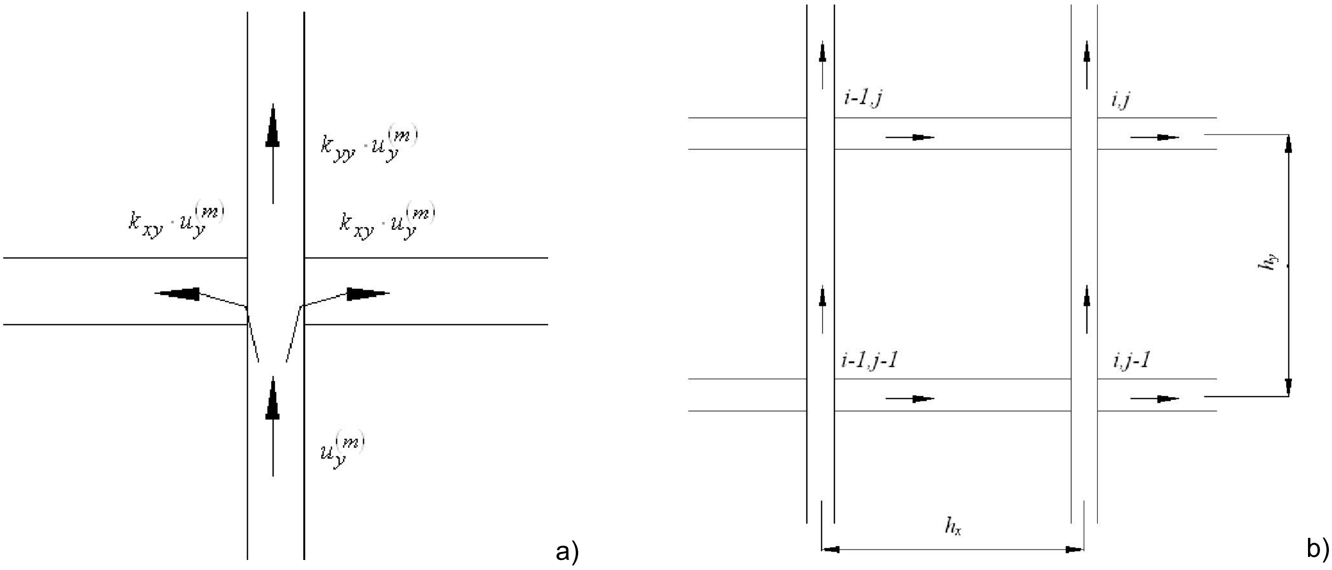

Figure 2 a) process of liquid crossflow at the points of elements collision; b) discrete model of liquid movement

$$du_{x,0}^{i,j}=\left\{k_{xx}\left[\frac{du_{x,0}^{i-1,j}}{dt}f(x,t)+u_{x,0}^{i-1,j}\frac{\partial f(x,t)}{\partial t}\right]+k_{xy}\left[\frac{du_{y,0}^{i,j-1}}{dt}f(y,t)+u_{y,0}^{i,j-1}\frac{\partial f(y,t)}{\partial t}\right]\right\}dt$$

$$du_{y,0}^{i,j}=\left\{k_{yx}\left[\frac{du_{x,0}^{i-1,j}}{dt}f(x,t)+u_{x,0}^{i-1,j}\frac{\partial f(x,t)}{\partial t}\right]+k_{yy}\left[\frac{du_{y,0}^{i,j-1}}{dt}f(y,t)+u_{y,0}^{i,j-1}\frac{\partial f(y,t)}{\partial t}\right]\right\}dt \quad (6)$$

If to write down similar expressions for all cross-points, it is possible to obtain a system of usual differential equations for finding of moisture concentration at any point of time. As a first step let's try to write down expressions in increments taking time intervals with Δt period as a basis. Let's designate a step number for concentration finding with τ, then time under consideration can be found as $t=\tau\cdot\Delta t$. In such assumptions the liquid concentration increments in a certain cross-point shall be as follows:

$$\Delta u_{x,0}^{i,j,\tau}=\left\{\begin{aligned}&k_{xx}\cdot e^{-\frac{a_x h_x}{\tau\cdot\Delta t}}\left[\frac{\Delta u_{x,0}^{i-1,j,\tau-1}}{\Delta t}+u_{x,0}^{i-1,j,\tau-1}\frac{a_x}{(\tau\cdot\Delta t)^2}\right]+\\&k_{xy}\cdot e^{-\frac{a_y h_y}{\tau\cdot\Delta t}}\left[\frac{\Delta u_{x,0}^{i-1,j,\tau-1}}{\Delta t}+u_{x,0}^{i-1,j,\tau-1}\frac{a_x}{(\tau\cdot\Delta t)^2}\right]\end{aligned}\right\}\Delta t \quad (7)$$

Let's pay attention to that formulae have a recurrence view, i.e. a value of concentration in the cross-points written down on the left can be completely found with the use of values found at a previous step. Considering that records have been made for concentration increments, full concentration for a certain point of time can be found at each step as follows:

$$u_{x,0}^{i,j,\tau} = \sum_{s=0}^{\tau-1} \Delta u_{x,0}^{i,j,s}$$

$$u_{y,0}^{i,j,\tau} = \sum_{s=0}^{\tau-1} \Delta u_{y,0}^{i,j,s} \tag{8}$$

For finishing the algorithm it is necessary to specify initial conditions of moisture distribution. They are determined by a technological process in case of solution of a problem of the first direction or operational conditions in case of solution of a problem of the second direction.

On the basis of the proposed model the algorithm, which is realized in the textile material calculation program, has been built. The case of moisture dripping in the center of material has been taken as an example. The picture of moisture concentration distribution for different points of time is shown in Figure 3.

An additional advantage of this algorithm is a possibility of moistened borderline geometry determination in material that has been rather difficult to perform in other models. These results can be very useful when designing technological processes of dyeing, cleaning or other chemical treatment processes. On the basis of obtained results it is possible to provide exact borderlines of moistening in view of anisotropy of material, its real structure, crossflow conditions. The change of a moistening borderline at the point initial process is shown in Figure 4.

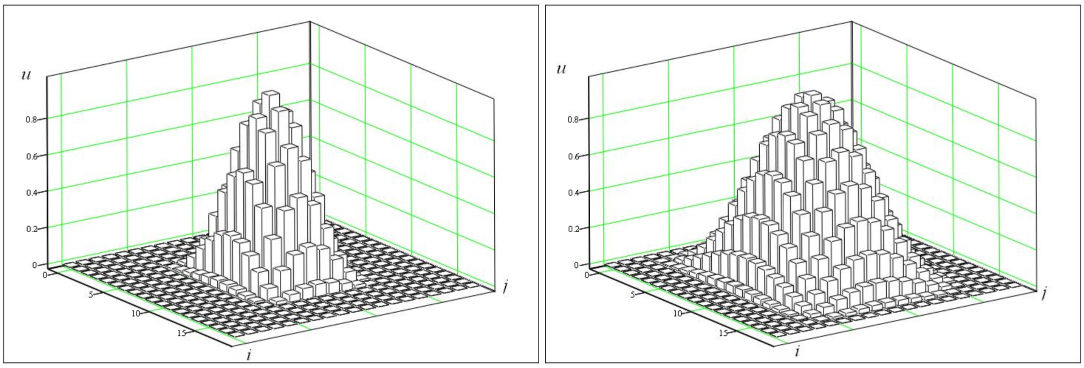

Figure 3 Moister concentration in the material along two axes

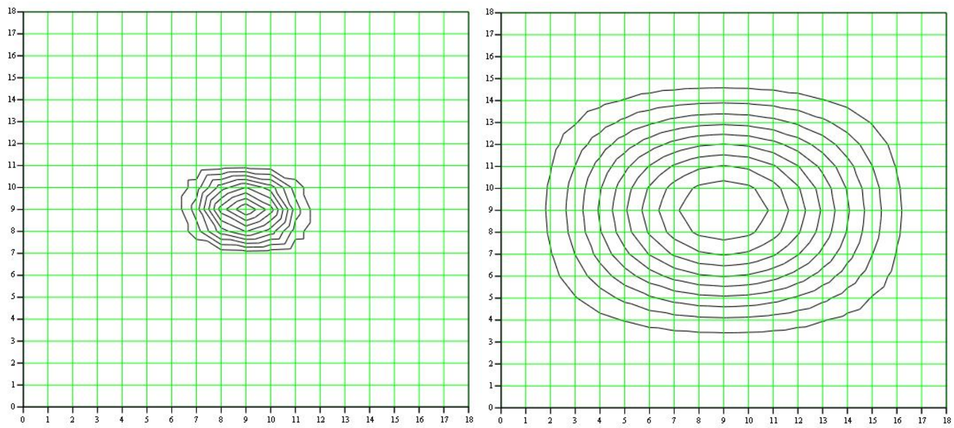

Figure 4 Discrete model-based change of moistened area borderline

4 CONCLUSIONS

This article solves an actual problem of development of a discrete model of moisture spreading on the surface of material that considers micro-bases of the structure and simultaneously the integrity of material, and enables to predict a moistened material state at any point of time. The dependence, which enables to find concentration at any point of a textile material element if initial concentration changes in time, has been revealed. For the first time a discrete model of moisture spreading in textile material, which enables to solve problems of moisture concentration determination at any point of the surface of material, has been developed. The geometrical borderlines of the moistened area have been determined.

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NESPOJITÝ DVOJ-DIMENZIONÁLNY MODEL ŠÍRENIA VLHKOSTI V TEXTILNÝCH MATERIÁLOCH

Translation of the article

Discrete two-dimensional model of moisture spreading in textile materials

V tomto príspevku, s použitím metód diferenciálnej a integrálnej kalkulácie, bol vypracovaný nespojitý model rozloženia vlhkosti na povrchu textilného materiálu. Predpokladá, že mikroštruktúra materiálu a súčasne jeho integrita umožňujú predpovedať stav navlhčeného materiálu v každom okamihu, geometrické parametre zvlhčeného povrchu a dobu šírenia vlhkosti.

EFFECT OF SEWING THREAD PRETENSION ON THE SEAM FOR CAR SEAT LEATHER COVER STITCHING

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Abstract: *In this research the effect of sewing thread tension (upper and bobbin thread) on the seam quality and seam strength is determined. The research is performed on car seat covers made from leather and foam. It is found that the bobbin thread tension has insignificant effect on the seam quality and strength, where as too lose or too tight thread causes the thread breakage and weaker seam strength. Furthermore the effect of thread pretension on seam binding point is examined and it is observed that the seam strength is poor when thread upper thread pretension is too tight or too lose whereas the bobbin thread pretension caused insignificant influence to the binding point of the seam. The visual examination also showed that the binding point of the seam is made towards the back side of the fabric layer when upper thread tension is low and in case of higher upper thread tension the bobbin thread is pulled to the face of the fabric.*
Key words: *car-seat cover, seam strength, sewing thread tension, lockstitch.*

1 INTRODUCTION

The influence of pretension on sewing thread is still a big concern for technical sewing companies like manufacturers of car seat cover and technical garments. There is no standard available for defining the pretension of the upper and bobbin thread and based on the experience the worker, the tension in adjusted in such a way that the stitches are formed in the middle of the seam.

The pretension and dynamic tension of sewing thread are mainly caused by machine speed, thread type, tension devices on sewing machine, needle types and fabric thickness. All this factors are not of our interest as in the car seat industry the factors like machine speed, sewing thread, needle type and fabric are already well defined. The objectives of this research are to determine the:

1. The effect of upper thread tension on stitch formation
2. The effect of bobbin mechanism tension on the stitch formation
3. The influence of thread tension on stitch binding point
4. The influence of the thread tension on the seam strength.

1.1 Lockstitch sewing

A sewing machine is one of the most common machine of any clothing, automobile, footwear or home textile products. Sewing machines were invented during the first Industrial Revolution to decrease the amount of manual sewing work performed in clothing companies. Thomas Saint in 1790 is considered as the inventor of first working sewing machine [1]. Lockstitch sewing machines due to strong stitch and easy use are the major sewing machine used in any clothing industry.

Lockstitch is a stitch performed in most household and industrial sewing machines (single needle). Lockstitch is formed by interlacement of upper thread and lower thread [2]. The upper thread runs from a spool near the machine, through guides, tension devices, take-up arm, and finally runs through the needle eye. Meanwhile the lower thread is wound on the bobbin, which is inserted in the bobbin assembly located under material in lower case of the machine [3]. To make one stitch, the machine moves downwards the threaded needle through the material and into the bobbin assembly, where a rotating hook catches the upper thread just

after it passes near the needle. The hook assembly carries the upper thread entirely around the bobbin case, so that it has made one wrap of bobbin thread. Then the take-up arm pulls the excess upper thread to tighten the stitch. Finally the feed-dogs move the fabric along one stitch length, and the cycle is repeated similarly.
Ideally, the lockstitch is formed in the center of the thickness of the material. The thread tension mechanisms, one for the upper thread and one for the lower thread, prevent either thread from pulling the entwine point from out of the middle of the material. A small length of the needle thread (depending on stitches/cm) is consumed in the stitch formation and excess is pulled back. Therefore the needle thread passes nearly 20-25 times through the guides, tension regulator, take-up lever, needle and the fabric before becoming incorporated with the seam [4].

1.2 Sewing thread tension and seam quality

The high quality of garments does not depend only on fabric quality but also seam quality. Fabric and sewing thread are the basic materials of apparel industry. Characteristic of the raw material influences the seam quality of the garment. Proper selection of raw material not only gives comfort to the wearer but also helps in smooth working of manufacturing process and lead to defect free garment [5]. Good seams are essential for durability, quality, and aesthetic appearance of the garments. Seam performance is influenced by a selection of seam type, appropriate sewing thread, sewing process parameters, and ease of sew ability of the fabric [6, 7]. To maximize a potential seam to ensure that seam will interact with the components of the fabric to ensure the best product durability [8]. In the stitch formation process, the thread is exposed to dynamic loading, inertia, forces, friction forces and bending with a small radius of the thread curvature. In addition the thread is also exposed to the effects of heat, compression, torsion and attrition [8-12], the pretension and dynamic tension determines the sewing productivity [13-25].

2 EXPERIMENTAL PART

The SIRUBA lockstitch machine mainly used for technical textile and car seat cover will be used at constant speed of 3000 r/min, with appropriate sewing needle, leather and sewing thread from the car seat cover manufacturer and seams are made under different pretension of sewing upper and bobbin thread. Changing the pretension will causes the seam shape to change, the higher upper thread tension will cause the bobbin thread to appear on the top of the seam whereas the lower tension will cause the thread to be pulled at the bottom side of the leather layers. The sewing machine used for the experiment is shown in Figure 1.

Figure 1 Lockstitch sewing machine used for the experiments

The seams will be analysed to see the formation of stitches under different tension of sewing thread and finally the seam strength will be measured to determine the effect of thread pretension on the seam strength.
The experiments are performed with the single needle lockstitch machine (SIRUBA) at 3000 r/min. The needle, upper thread, bobbin thread, leather seat cover and polyurethane foam are obtained from the car seat manufacturing company (JOHNSON CONTROL). The properties of material are shown in Table 1. The car-seat cover sewing thread properties are shown in Table 2.

Table 1 Material properties

Material	Areal mass [g/m^2]	Thickness [mm]
Leather cover	234	1
Polyurethane foam layer	820	0.8

Table 2 Thread properties

Thread	Count [tex]	Material	Twist	Number of twist
Upper thread	70	Polyester corespun	z/s	402
Bobbin thread	70	Polyester corespun	z/s	408

The tension of sewing thread and bobbin thread is pre-adjust at chosen values by turning the tension knob of the tension device on machine for upper thread and tightening the screws for the bobbin thread. The tension of thread is measured by the thread tension measuring device from company MODUS (Figure 2). The mechanism of changing the thread tension on a sewing machine is governed by two devices (Figure 3).

Figure 2 Thread tension measuring device

Figure 3 Upper thread tension adjustments

The bobbin assembly screw is shown in the Figure 4.

Figure 4 Bobbin thread tension adjustment

The thread tension is measured by the thread tension measuring device and possible tension settings are shown in Table 3

Table 3 Possible thread pretension settings

Sewing thread pretension [cN]	Bobbin thread pretension [cN]
200	100
600	200
800	300
1200	
1600	
2000	

3 RESULTS AND DISCUSSION

The tensile properties of the upper and bobbin thread were measured by the international standard ISO2062 on tensile tester machine. The gauge length is 500 mm and the speed of extension is 500 mm/min. The tensile properties of sewing thread are shown in Table 4. The sewing operation is performed on the leather and foam sandwich material and visual observation were recorded as shown in Table 6.

Table 4 Thread tensile properties

Thread	Breaking strength [N]	Extension at break [mm]	Elongation at break [%]
Upper thread	50.955	105.408	21.042
Bobbin thread	49.911	99.974	19.982

Based on the visual observations, the only possible upper thread tension is 800-1400 cN and bobbin thread mechanism can only be adjusted from 100-300 cN. The design of experiment is made to see the effect of upper thread and bobbin thread tension on the seam strength.

Table 5 Design of experiment

Design of experiment	
Sewing thread pretension [cN]	**Bobbin thread pretension [cN]**
800	100
800	200
800	300
1200	100
1200	200
1200	300
1600	100
1600	200
1600	300

The car seat cover seams are made as shown in the Figure 5 and standard test method EN ISO 13935 is used to open the seam using tensile tester.

The experiment is performed 5 times for each thread tension. A total of 45 samples of seams are made for the tensile testing.

Figure 5 Seams strength testing sample by standard EN ISO 13935

All 45 samples were tested for seam strength by standard EN ISO 13935.The results are shown in Table 7.

Table 6 Visual observation for the seam quality

Sewing thread pretension [cN]	Bobbin thread pretension [cN]	Visual observation
200	100, 200, 300	Thread breaks on machine, thread tension is low
600	100, 200, 300	Thread breaks after few second of stitching, thread tension is low
800	100, 200, 300	Stitch is performed towards the bobbin thread, tension is low for upper thread
1200	100, 200, 300	Stitch is performed in middle of seam
1400	100, 200, 300	Stitch is performed towards upper thread, upper thread tension is high
2000	100, 200, 300	Upper thread too tight, thread breaks

Table 7 Seam strength

Sewing thread pretension [cN]	Bobbin thread pretension [cN]	Breaking force SEAM [N]	Standard deviation	Extension at break SEAM [mm]	Standard deviation
800	100	648.64	24.7	70.98	2.4
800	200	675.26	35.7	69.31	1.8
800	300	618.24	28.2	69.33	1.9
1200	100	1264.1	5.6	61.91	2.2
1200	200	1258.56	4.8	60.92	2.5
1200	300	1260.77	4.6	60.21	1.5
1600	100	931.28	25.6	70.38	1.9
1600	200	980.23	35.7	69.17	1.4
1600	300	922.28	39.8	68.82	1.5

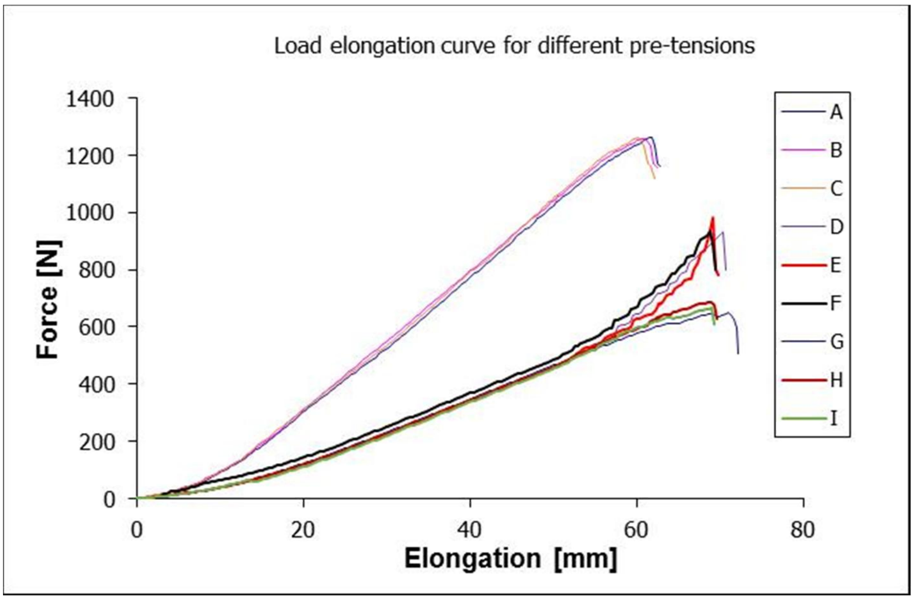

Figure 6 Load elongation curve of the seam

There is a non-significant (at 95% confidence interval) effect of bobbin thread tension on the seam strength. The breaking elongation curve shows all the seams at different tension settings.

Table 8 Legends of the stress-strain curve

Serial letter legends	Sewing thread pretension [cN]	Bobbin thread pretension [cN]
A	1200	100
B	1200	200
C	1200	300
D	1600	100
E	1600	200
F	1600	300
G	800	100
H	800	200
I	800	300

It is observed from the graph that the bobbin tension has insignificant effect on the seam strength whereas the sewing thread is maximum when the seam is made at the middle of the seam followed by the seam made at the upper side of the seam and the most weakest seam is observed when the seam is made towards the bobbin thread.
The thread tension of 1200 cN is ideal tension for the upper thread and makes the seam to binding exactly in the middle of the seam. The Figure 7 is shown for the category A, B and C.

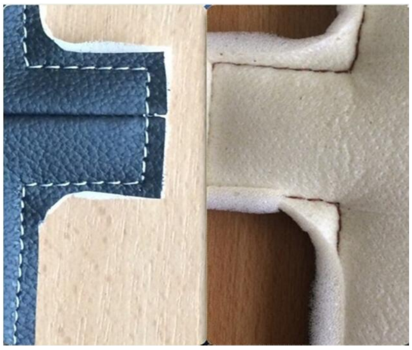

Figure 7 Ideal seam with the binding point in the middle of the seam

The thread tension of 800 cN is low tension for the upper thread and makes the bobbin thread to pull the upper thread. The Figure 8 is shown for the category G, H and I.

Figure 8 Upper thread pulled towards the bobbin thread

The thread tension of 1600 cN is high tension for the upper thread and pulls the bobbin thread to the upper layer. The Figure 9 is shown for the category D, E and F.

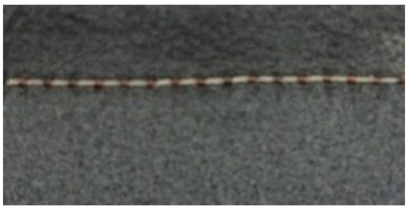

Figure 9 Bobbin thread pulled towards the face of the fabric layer

The data is further analyzed to predict the seam strength at different tension of upper and bobbin thread tension. The regression analysis is performed on software SYSTAT and surface plot shows the effect of upper and bobbin thread tension on the seam strength. Table 9 shows the coefficient of regression analysis data.

Table 9 Coefficients of regression analysis

Estimates of the regression coefficients		
Effect	**Coefficient**	**p-value**
CONSTANT	-3426.28	0
U	7.322	0
B	0.987	0.466
U*U	-0.003	0
B*B	-0.003	0.132
U*B	0	0.644

where adjusted squared R is 0.994

The graph (Figure 10) shows that there is minor effect of bobbin thread pretension on the seam strength where as a significant effect is observed with respect to the upper thread tension. Too tight upper thread tension increases the friction between the thread and the needle eye and causes the thread damage or breakage, whereas too loose thread is pulled to the back side of seam due to higher bobbin pull force and causes a weak seam.

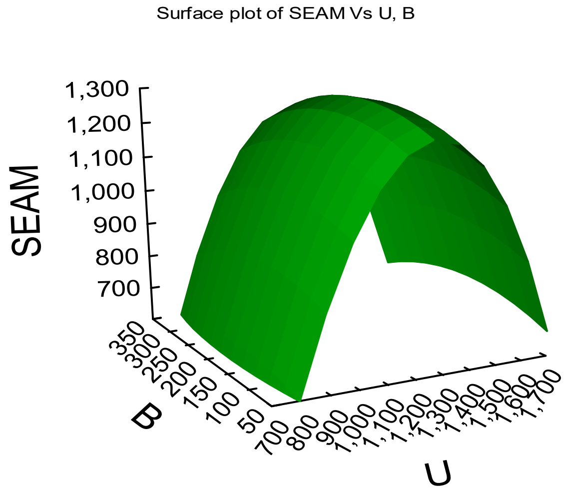

Figure 10 Surface plot to represent effect of upper and bobbin thread on the seam strength
where B is bobbin thread tension, U upper thread tension and SEAM shows the seam strength

4 CONCLUSION

It can be concluded from our research that the thread tension has a significant role in determining the seam strength and quality .The bobbin thread has insignificant effect on the seam strength and enough tension of bobbin thread is required so the bobbin thread does not unwind freely. The upper thread tension can be adjusted by the tension regulator and use of tension measurement devices. The binding point in the middle of the seam shows the maximum seam strength. It upper thread tension should be carefully taken in account during sewing process to obtain maximum seam strength.

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VLIV NAPĚTÍ ŠICÍ NITĚ NA PEVNOST ŠVŮ U KOŽENÝCH AUTOSEDAČEK

Translation of the article

Effect of sewing thread pretension on the seam for car seat leather cover stitching

Výzkumné práce se zabývaly vlivem napětí šicí nitě (horní a spodní nitě) na jakost a pevnost švu. Výzkum se prováděl u automobilových potahů vyrobených z kůže a laminované polyuretanovou pěnou. Bylo zjištěno, že napětí zejména spodní niti má zanedbatelný vliv na kvalitu a pevnost švu, pouze když bylo příliš malé nebo příliš vysoké napětí způsobilo poškození provázání a menší pevností švů. Kromě toho byl zkoumán vliv napětí nití na vazný bod a bylo zjištěno, že pevnost je nižší, když napětí vrchní nitě je příliš vysoké nebo příliš nízké. Napětí spodní nitě má nevýznamný vliv na polohu vazného bodu. Vizuální pozorování také ukázalo, že vazný bod švu se posune na rubní stranu, když napětí horní nitě je nízké a v případě velkého napětí horní nitě se spodní nit se vytahuje na líc.

THE DEVELOPMENT OF INFORMATION DATABASE FOR DESIGNING OF HATS

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Abstract: *The article deals with the problem of designing hats. As follows from the analysis of the design processes the information base used in the solution of design tasks are cross-cutting, this mainly refers to anthropometric databases. There was conducted a consumers' survey that showed that the main complaints about hats concern their bad fit, discomfort and pressure that hats make on certain parts of the head. As follows from the research of the supporting surfaces of a human head there are 8 types of three-dimensional forms.*
Key words: *design, construction, anthropometric base, design database, stages of designing, hats.*

1 INTRODUCTION

The development of the garment industry in Ukraine has the priority areas of research to develop new modern methods of product design, such as automated systems for intensification of process design process and improvement of the quality of work. The analysis of the nature and structure of the stages of the design process revealed that each component of the design process, such as design, engineering and technology integrated into each other at the information level, and information components meet in various stages of design. Improvement of the design hats process requires optimization of informational database. Past studies have shown the need to develop the classification of space forms bearing surfaces of the human head.
The aim of this study is to determine the characteristics of a single original project design framework for designing hats.

2 THE STRUCTURE OF THE DATABASES FOR DESIGN-DESIGN

Modern industrial production is growing rapidly and uses computers more and more often. High demand on clothes, namely on hats, is determining and forming requirements that are mainly connected to the demand and manufacturing. Nowadays, the activity of manufactures is occurring in the conditions of high competition, amplification of manufacturing processes and lack of resources. The process of construction is being formed by the set of basic constituents, each of which is being made with a certain specialist (Figure 1). The process of designing is composed from three stages: draft design, constructive design and technical project.
Nowadays each stage of design construction is realized with a separate specialist. It retards projecting process and worsens its final result. The analysis of a character and structure of stages of the process of construction [1, 7-9] allowed determining, that each constituent part of the construction process is integrated in one another. Relatively designer, constructive and technical projects are interconnected informatively, and final information is used to complete one or another task on a certain stage of draft designing reechoes with the constructive design and technical project.
The survey had revealed the fact that the task is not being solved in complex, because each stage of it is being completed by different

specialists, which retards the construction process. Also the adaptation of existing informational database and development of total database for provision of transparent construction is required. The informative base is needed to provide designing and manufacturing of a garment for a typical and untypical figure type (Figure 1). The problem of transparent designing is actual and up-to-date nowadays and is being realized in CAD system.

The analysis of stages and ways of designer projects realization in modern manufacturing had shown that its implementation is being formed from the following tasks: determination of visual structure, determination of anthropomorphic structure, creation of the material structure.

The question of forming of visual structure has been envisaged in many scientific works and articles connected to solutions of the project in a virtual environment. Modern automatized methods of graphic images forming allow deciding the problem of adequacy of draft interpretation, which has no real scale or scope and proportions if it is created in a traditional way (painting of imaginary picture or drawing of a designer). Besides, such draft cannot be used in further automatized construction of clothes and hats [2-5]. Determination of anthropomorphic structure is above all connected to the parameters of anthropometric structure of human's head that allows determining a type of a head and its size to complete the designing project (Figure 2).

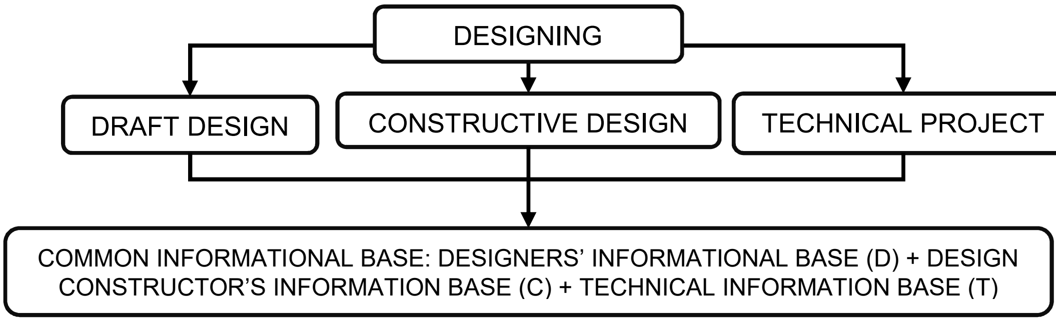


Figure 1 Structural scheme of improvement of a hats designing process

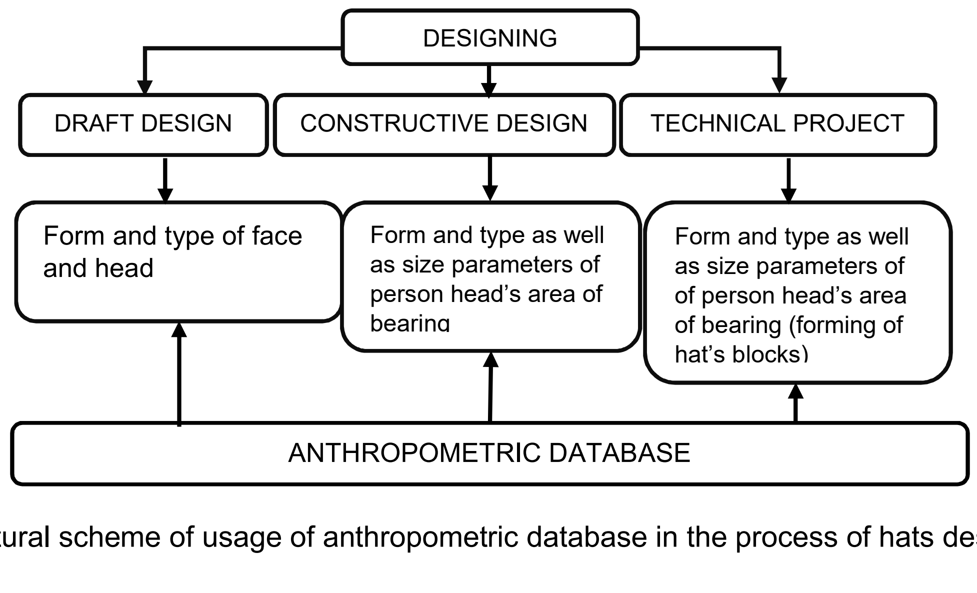


Figure 2 Structural scheme of usage of anthropometric database in the process of hats designing

3 DETERMINATION OF ANTHROPOMETRIC PARAMETERS FOR HATS DESIGN

On the modern stage of development, the most up-to-date decision of such problem lies in a 3D manikins modelling, which will allow not only making the closest to reality garment draft but also estimate its real proportions and receive precise data about parameters of head or future garments' pattern. In other words such virtual three-dimensional manikins can be used practically on any stage of design construction. Analysing substituent parts of each state of construction of hats it is possible to say that precise anthropometric base that would reflect not only sizes but also would give an opportunity to set parameters of human head's form, is necessary in all stages. Analysis of anthropometric database for construction of hats has shown that sizes used while projecting do not reflect real three-dimensional form of human's head. Existing classifications are based on descriptive features and are not evaluated in numbers [10]. Classification of three-dimensional forms of humans' head is absent, and the existing one is only working with plans of head under different angles separately. Thus this information can barely be used and useful while projecting and construction (Figure 3).

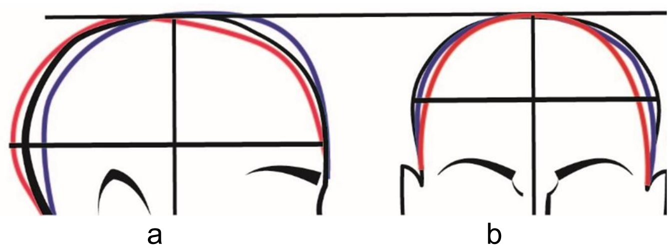


Figure 3 Projection pictures of different types of heads under different angles: a) sagittal, b) frontal

Priority consumer preferences based on a questionnaire survey of consumers younger and middle age groups and processing the results of mathematical statistics methods were defined. The criteria for selection of hats in almost equal measure are the following factors as a fashion, a comfort, a color and a good fit of the product. "A comfort and a fashion" or "a comfort and a good fit of the product" were often chosen when selecting two defining characteristics. The main disadvantages of a product that indicate consumers are discomfort and poor fit of the product.

Analysis of methods of hat construction has shown that in production of hats and development of drawings from them typical matrixes are used, the construction of which is simplified and doesn't reflect peculiarities of head building [6, 10, 11]. But the survey of consumers about quality of garments and requirements for hats has shown that choosing modern garments of this assortment group only 19% do not have problems with fitting and do not feel any discomfort wearing the garment (Figure 4).

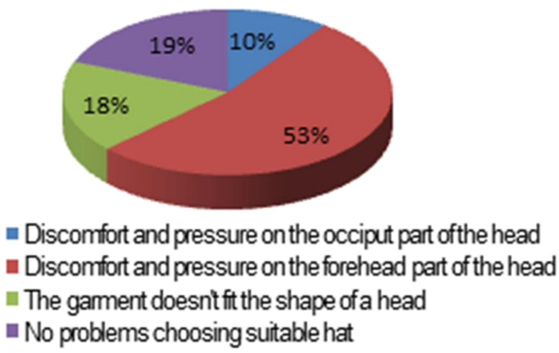
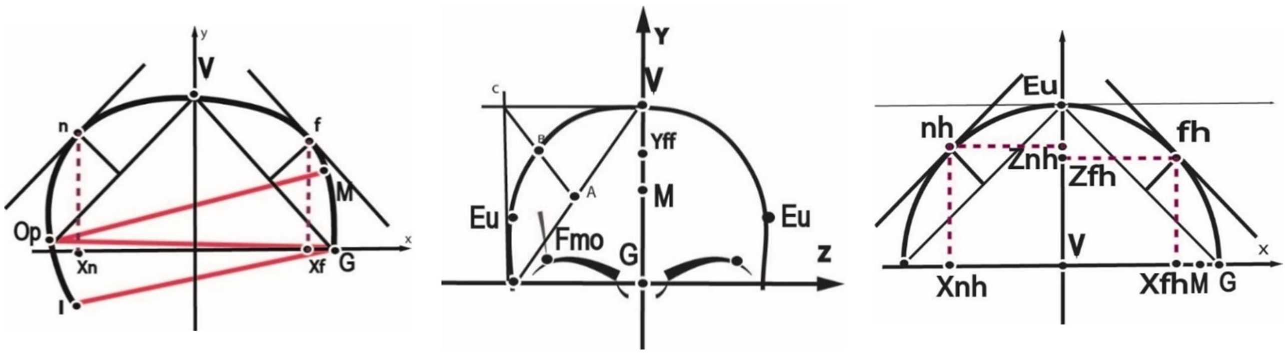


Figure 4 Usual complaints of consumers on faults of hats

As follows from the survey results there is a need to conduct studies of a human head and to identify existing three-dimensional types. To solve the problem of improvement of the information database for designing hats there is a need to conduct anthropometrical surveys of heads. Sample size was 240 women of young and middle age groups [12].

To conduct the study there was determined an anthropometric basis of points and there was proposed a layout of the head in the sagittal, frontal and horizontal projections in the coordinate system XYZ (Figure 5).



a b c

Figure 5 Scheme to define the head type in a) sagittal projection b) frontal projection c) horizontal projection

Sagittal view of the head shown in a coordinate system YX, where point V (vertex) is situated on the axis Y (Yn, X0), and point G (glabella) - on the X axis (Y0; Xn). Front projection is represented in a coordinate system ZY, where point G is at the origin (Y0; Z0), and point T on the axis Y (Yn, Z 0). Ground plan is presented in the coordinate system Zx, where point V is at the origin (Z0, X0), and point G on the axis X (Z0; Xn).
To characterize the convexity of the head in the sagittal plane there were auxiliary tangent lines introduced (Figure 5a). They are parallel to segments |Op-V| and |VG|, that determine points n and f, describing a sagittal arc in the occipital and frontal parts (Table 1).

Table 1 Human head types in sagittal projection

Head type	Defining relation between areas of the head	Defining proportional values
Frontal	Fts = Xf > Xn	$\frac{Xf}{Xn} = 1.3 \div 1.9$
Symmetric	Rts = Xf ≈ Xn	Xf ≈ Xn
Occipital	Nts = Xf < Xn	$\frac{Xf}{Xn} = 0.5 \div 0.7$

In frontal projection the outline of a human's head is characterized by the allocation of points Eu (euryon) (Figure 5b), t (tragion) that V (vertex) relative to the zero point of the coordinates (Table 2).

Table 2 Human head types in frontal projection

Head type	Defining the projective discriminant
Platicephalic	$f_p = (1.301 \div 1.481)$
Obrculocephalic	$f_o = (0.988 \div 1.104)$
Lofocephalic	$f_l = (1.190 \div 1.300)$

To characterize the convexity of the head in the horizontal plane there were introduced auxiliary tangent lines that are parallel to segments |Eu-Op| and |Eu-G|. Also there are points nh and fh that characterize the convexity of the frontal and occipital parts of the arc G-Eu-Op (Figure 5c). The results of the research are shown in Table 3.
According to the results of researching of models of heads, received in this survey, it has been defined that in horizontal plane brachycephalic head (round) can be seen for only 20% consumers, only 53% of surveyed women have symmetrical (normal double-sided type) in a sagittal plane, and the obrculocephalic (taken as standard) type of frontal plane can be seen only within 54% of women (Figure 6).

Table 3 Human head types in horizontal projection

Head type	Defining relation between areas of the head	Defining proportional values
Oval	$(Xnh \approx Xfh) \approx (Znh \approx Zfh)$	$\frac{Xnh}{Znh} \approx \frac{Xfh}{Zfh} = 1.2 \div 1.8$
Round	$(Xnh \approx Xfh) \approx (Znh \approx Zfh)$	$\frac{Xnh}{Znh} \approx \frac{Xfh}{Zfh} = 1.0 \div 1.1$
Egg-shaped	$(Xnh \approx Xfh);\ (Znh > Zfh)$	$\frac{Xnh}{Xfh} \approx 1;\ \frac{Znh}{Zfh} = \frac{1.2 \div 1.4}{1}$
Sphenoidal	$(Xnh \approx Xfh);\ (Znh > Zfh)$	$\frac{Xnh}{Xfh} \approx 0.8 \div 0.7;\ \frac{Znh}{Zfh} = \frac{1.5 \div 1.8}{1}$

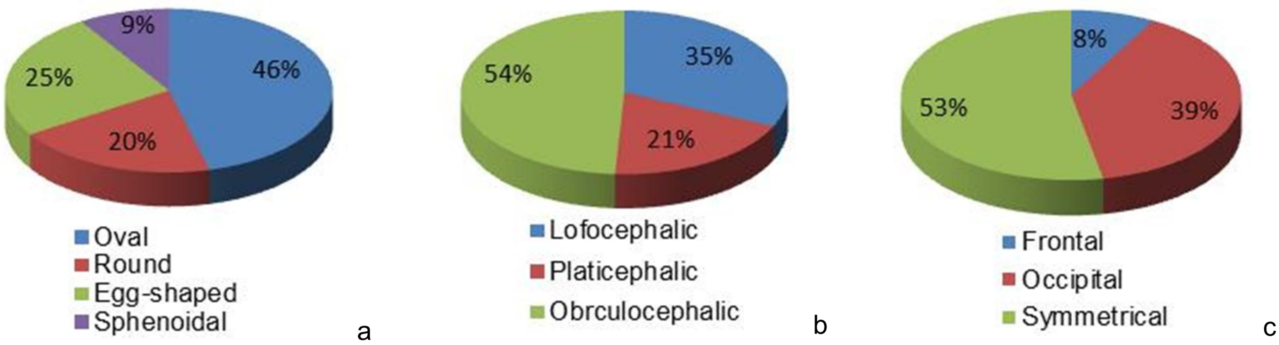


Figure 6 Percentage ratio different types of heads in a horizontal (a), frontal (b) and sagittal (c) planes under the results of anthropometric survey

Just 6% of surveyed women possess all "ideal" types and the area of bearing of the hat has "ideal" plane shape of a hemisphere (ORS type).

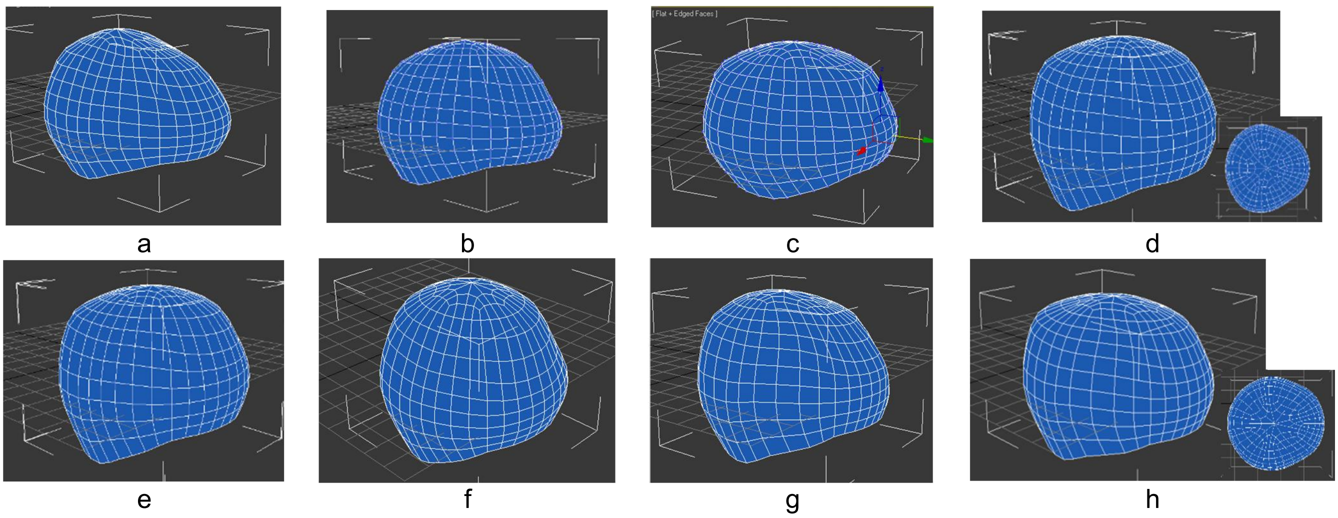


Figure 7 Determining the of types of three-dimensional forms of human heads: a) Orbicular, ellipsoid occipital type (OEO) type, b) Orbicular, ellipsoid, symmetrical type (OES), c) Lofocephalic, ellipsoid, symmetric type (LES), d) Orbicular ,pentagonal, symmetric type (OPS), e) Orbicular, ovoid, symmetric type (OOS), f) Orbicular, round, symmetric type.(ORS), g) Orbicular, pentagonal, occipital type (OPO), h) Lofocephalic, egg-shaped, symmetric type (LESS)

Therefore, existing today dummy-pattern may correct only a small group of women, as well as hats, developed on its basis. By results of the analysis of the anthropometric data types were allocated the types of three-dimensional forms of human heads (Figure 7) as the most frequently meet: OEO type (orbicular, ellipsoid occipital type) 14%, OES type (orbicular, ellipsoid, symmetrical) 10%, LES type (lofokran, ellipsoid, symmetric) 8%, OPS type (orbicular, pentagonal, symmetric) 6%, OOS type (orbicular, ovoid, symmetric) 6%, ORS type (orbicular, round, symmetric) 6%, OPO type (orbicular, pentagonal, occipital) 6%, LESS type (lofokran, egg-shaped, symmetric) 7%.

4 CONCLUSION

Analysing the nature and structure of the stages of the design process the following conclusions can be made:

1. Each part of the process design and related design is integrated with each other. Conceptual design, design and technology are interrelated on the informative level (background information is needed to perform a particular task in a certain stage of the project design echoes the design and technical one). The adaptation of existing databases and development of a common database for transparent design on basis of basis of designer, draft and technological information that would provide manufacturing of quality and ergonomic industrial garment.
2. Anthropometric information base is used at every stage of planning and design and requires updated data on the form, proportions and size.
3. Surveys and anthropometric studies conducted among consumers had showed imperfections in existing anthropometric databases for designing hats and confirmed the need to develop a classification of types of three-dimensional forms.
4. Studies that were carried out identified the classification of types of three-dimensional forms of the human head. From the data was singled out eight common types of the human head.

These results confirmed the need for further research and improvement of data bases for designing hats

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VÝVOJ INFORMAČNEJ DATABÁZY PRE NAVRHOVANIE KLOBÚKOV

Translation of the article
The development of information database for designing of hats

Článok sa zaoberá problémom navrhovania klobúkov. Ako vyplýva z analýzy dizajnových procesov, informačné bázy použité pri riešení konštrukčných úloh sú prielomové, čo sa týka predovšetkým antropometrických databáz. Prieskum vykonaný u nositeľov klobúkov ukázal, že hlavné nedostatky týkajúce sa ich nosenia sú, že klobúky zlé padnú, sú nepohodlné a vyvíjajú tlak na niektoré časti hlavy. Ako vyplýva z výskumu povrchov ľudskej hlavy existuje 8 typov troj-dimenzionálnych tvarov hlavy.

PRESSURE DISTRIBUTION OF CAR SEAT AT DIFFERENT ANGLE OF BACKREST

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Abstract: *In this research work the pressure distribution of driver is discussed regarding maximum force on the seat and comfort of the driver. Experiment is performed with 50 randomly chosen people; who have different weight and height. Each person sits in three different angles (90°, 100° and 110°) of sitting position. Results are evaluated for the effect of the human parameters and the sitting angle on the sitting pressure distribution. It is observed that the weight of person does not present any relationship with peak pressure points, but the maximum cover area and low number of peak pressure points are observed at 100° of car seat angle. The maximum pressure of 28-110 mmHg and maximum covered area of 45 to 86% was observed depending on the mass and height of the person.*
Key words: *Car seat, pressure distribution, car seat comfort.*

1 INTRODUCTION

Hertzberg [1] describes comfort as absence of discomfort. The term “seat comfort” is usually used to describe the temporary relief of the human body felt while sitting [2]. Discomfort is primarily related to biomechanical factors (such as joint angles, muscle contractions, and pressure distribution) that produce feelings of pain, soreness, numbness, stiffness and so on [3]. Discomfort could easily come from the bad structural biomechanical design of the seat. Table 1 shows some causes of seating discomfort, a person sitting might experience.

Physical comfort on automotive seats is dictated by a combination of static and dynamic factors. Static comfort can be evaluated using postural assessment, interface pressure and other standard ergonomic techniques. Dynamic comfort is usually assessed by making vibration measurement on the surface of passenger seats using method based on standards such as ISO2631, BS6841 etc., or through on-road trials [2]. In this paper the research is on the pressure distribution in static comfort with different angle of backrest.

Table 1 Causes of seating discomfort [4]

Human experience mode	Biomechanical		Seat/environment
	Physiological cause	Engineering causes	Source
Pain	Circulation occlusion	Pressure	Cushion stiffness
Pain	Ischemia	Pressure	Cushion stiffness
Pain	Nerve occlusion	Pressure	Seat contour
Discomfort	-	Vibration	Vehicle ride
Perspiration	Heat	Material	Vinyl upholstery
		Breathability	
Perception	Visual\auditory\tactile	Design/vibration	Vehicle cost

1.2 Pressure distribution

Among other factors, a driver's seating discomfort have been shown to be influenced by whether there is adequate support for preferred driving postures [5], even distribution of contact pressure [6]. Each of these should be provided by the driver's seat and can be described in terms of driver-seat interface pressure. The objective measures or indicators affecting driver's seating discomfort and related posture are needed to investigate. Each of these should be provided by the driver's seat and can be described in terms of driver-seat interface pressure. The objective measures or indicators affecting driver's seating discomfort and related posture are needed to be investigated [7].

Interface pressure measurement has demonstrated to be useful in the evaluation of seat comfort in its design process [8, 9]. Few direct exclusive and conclusive relationship pressure-discomfort is supported by literature findings [10]. Andreoni et al. [12] analyzed sitting posture and interaction of the driver body pressure with the cushion and the backrest. In this study, postures were measured by motion capture camera. Gyouhyung Kyung et al. [6] analyzed associations between subjective ratings and 36 measures of body pressure distribution in different seats and vehicles. These studies were performed in the static situation and used the body pressure distribution measured only at specific time. To investigate the pressure patterns, the body pressure distribution at specific times could provide enough information [13]. However if the body pressure distributions are analyzed serially, it might provide more valuable information. Lee et al. [11, 14] stated that the driver tends to move more frequently when he/she feels discomfort in order to adjust the posture and improve the discomfort situation. Seokhee Na et al. [10] used dynamic pressure distribution for evaluation of driver postural change in seat buck. However, they did not concern some important pressure variables such as load centers in the analysis.

In summary, the primary objective of this study was to investigate the associations between interface pressure and subjective ratings of seating discomfort and the relationships among the body pressure distribution and driver's postural changes and discomfort. The pressure distribution comfort; most important contribution of design of seat material (cushion) is to equalize and minimize peak pressure points [15]. Surface pressure can cause discomfort while sitting. People of different body weights and builds distribute their weight on a chair in similar patterns, but pressure intensity and areas of distribution vary from person to person. Good pressure distribution in a chair focuses peak pressure under the sitting bones in upright postures and in the lumbar and thoracic areas in reclined postures. Correct pressure distribution is critical to seated comfort. A high level of surface pressure can constrict blood vessels in underlying tissues, restricting blood flow, which the sitter experiences as discomfort [16]. To measure these small differences in pressure distribution and their relationship to chair comfort, researchers have experimented with a number of technologies. Most recently, thin, flexible, pressure sensitive mats connected to computers have been used to “map” the pressure-distribution properties of seating elements in office, automotive, and medical applications. These sensor-lined mats are draped over the chair’s seat pan and backrest; when a test subject sits in the chair, pressure gradients show up as different colors on the computer screen, mapping the peak pressure zones.

2 EXPERIMENTAL PART

The experiment is performed with Car seat (Skoda Fabia) with 50 randomly chosen people and seat position is adjusted at 90°, 100° and 110° for position 1, 2 and 3 respectively as shown in Figure 1. Pressure distribution is measured by X-sensor pressure measuring sheet for sitting and back rest region of car seat. The covered area of the car seat by the subject is calculated by the following formula:

$$\text{Covered area } [\%] = \frac{\text{area covered by the subject on the carseat}}{\text{total area of the carseat}} x100 \quad (1)$$

The total area of the back cushion of the car seat is found to be 3290 cm^2 and bottom part of the car seat as 3060 cm^2. The covered area can also be obtained from the X-sensor sheet which measures by following formula:

$$\text{Contact area by X sensor} = \frac{\text{number of contact cells by the subject}}{\text{total number of contact cells on the carseat}} x100 \quad (2)$$

The sheet is divided in to multiple contact cells and each cell is 1cm^2 in dimension.

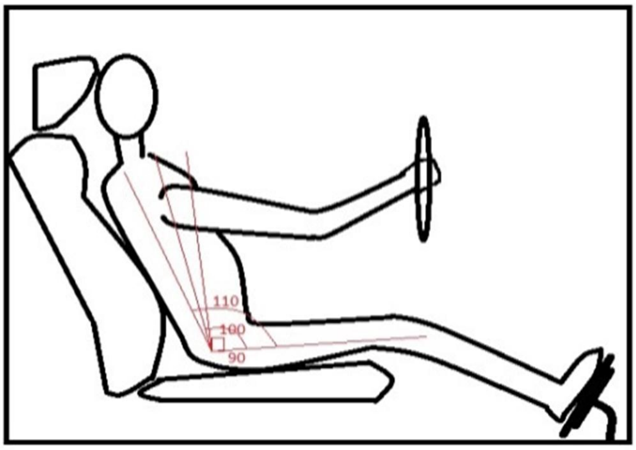

Figure 1 Sitting angle and position of car seat

3 RESULTS AND DISCUSSION

It is observed that there is no relationship between weights of person on cover area or peak points on car seat, it is mainly due to the volume and shape of human body is not always in relation to the weight of the person. Figures 2 and 3 show that the peak pressure is noted minimum for position 2 of car seat where angle is 100°. The graph is segmented it to 12 categories of 5 kg each ranging from 45 to 100 kg. The mean of each category is presented at columns of each section, categories and absolute frequency of each category is shown in Table 2.

Table 2 Number of subjects and weight categories

Category	Maximum weight of each category	Frequency of subjects
1	45	2
2	50	4
3	55	4
4	60	4
5	65	4
6	70	5
7	75	5
8	80	5
9	85	5
10	90	5
11	95	5
12	100	2

There is a significant difference in pressure at position 1 and 2 measured at 95% confidence interval.

It is due to the reason that the covered area by person is maximum for position 2; which distributes the pressure more evenly. The covered area by the subject at different positions can be seen in Figures 4 and 5, which show that the maximum covered area is for position 2. The small change in covered are at position 2 is also significant and causes decrease in the pressure points.

It is seen in Figure 6, 7 that even the minimum weight person can have extreme peak pressure point on the car seat, which eventually causes discomfort.

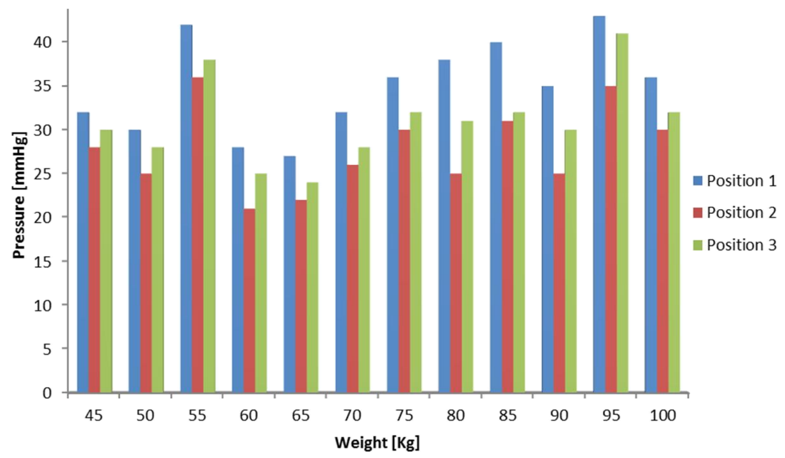

Figure 2 Maximum pressure peak at back cushion

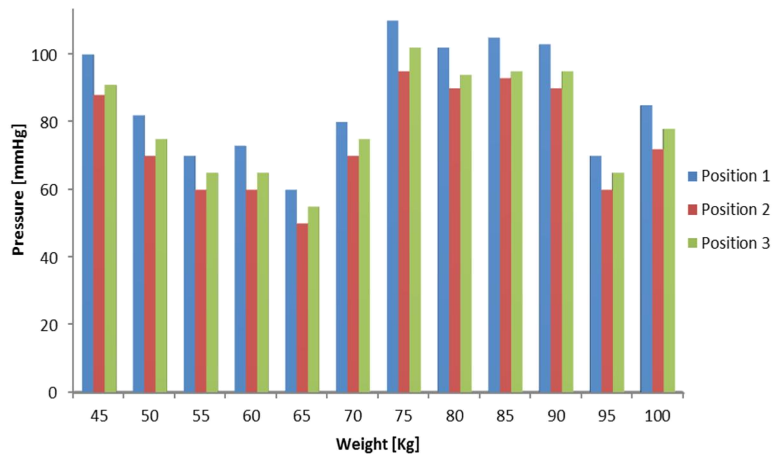

Figure 3 Maximum pressure peak at bottom cushion

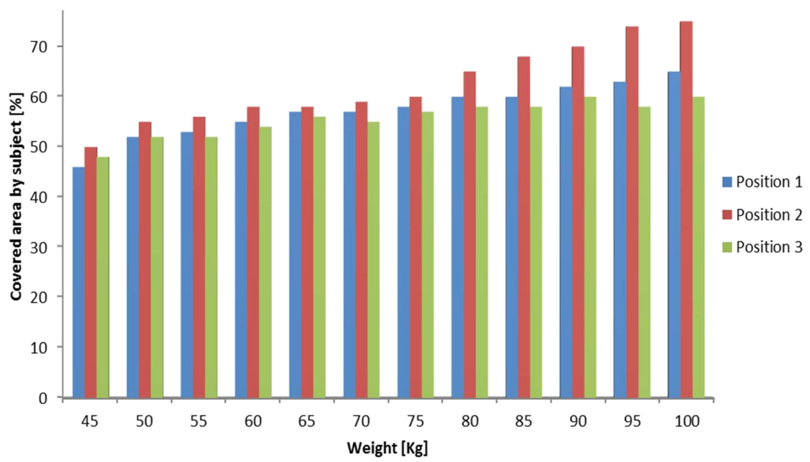

Figure 4 Covered area at car seat's back cushion

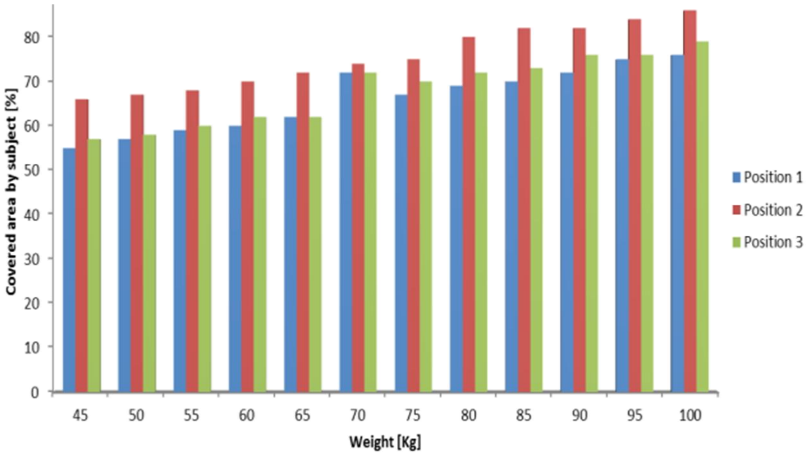

Figure 5 Covered area at car seat's down cushion

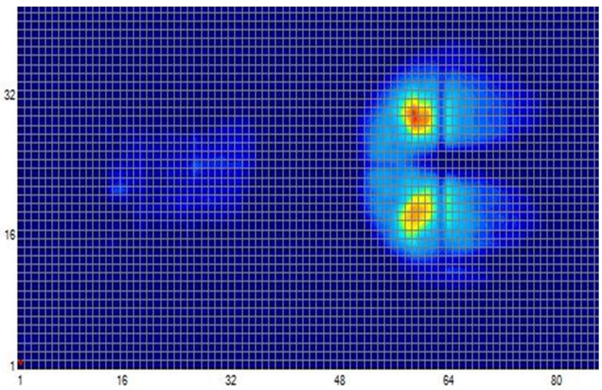

Figure 6 Pressure distribution (46 kg person)

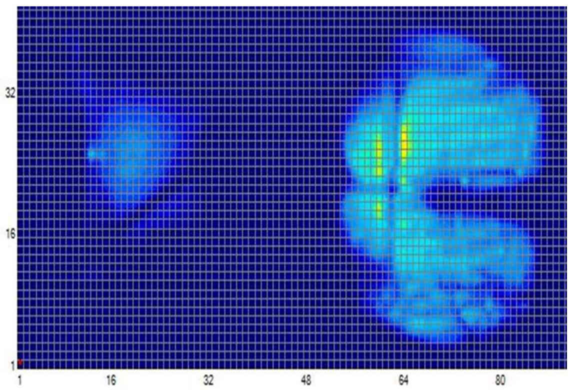

Figure 7 Pressure distribution (80 kg person)

Subjectively it is noted that 90% of the people felt the position 2 as the most comfortable.

The Body mass index (BMI) is useful value considering the weight and height of the person. The BMI of all persons are calculated by following formula to determine any relation with the maximum pressure on the car seat:

$$BMI = \frac{mass\ of\ person\ [kg]}{height^2\ [m]} \quad (3)$$

It is observed that there is no relationship between the BMI and the maximum pressure on the car seat. The scatter plot is shown in Figure 8.

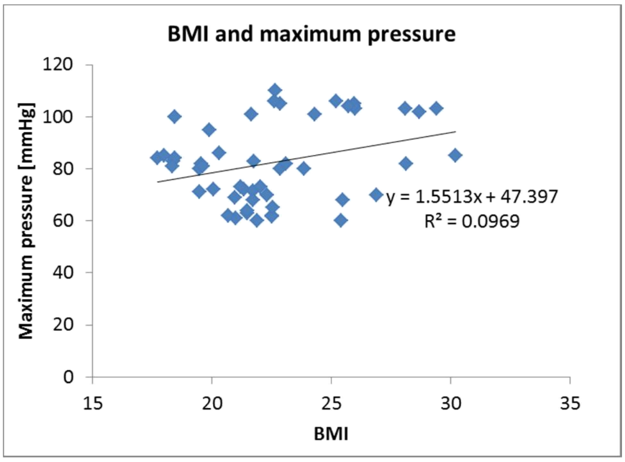

Figure 8 BMI and maximum pressure on seat by the subjects

4 CONCLUSIONS

It can conclude from our research that:

- There is no relationship between car seat peak pressure points with respect to weight of the person.
- The maximum pressure of 28-110 mmHg and maximum covered area of 45 to 86% was observed depending on the mass and height of the person.
- The position of car seat at 100° of angle showed the highest cover area and minimum pressure peaks.
- 90% of the subjects felt most comfortable at position 2. All other 10%, their height was observed less than 154 cm.

The pressure distribution chart, maximum pressure peak and covered area can be very useful for future research regarding the heat and mass transfer of car seat materials under different loads.

Acknowledgements: *The research work is supported by project SGS21044, Czech Republic.*

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ROZLOŽENÍ TLAKU U AUTOSEDAČKY PŘI RŮZNÝCH ÚHLECH OPĚRADLA

Translation of the article

Pressure distribution of car seat at different angle of backrest

Tento výzkum se zabývá komfortem řidiče při sezení, sleduje rozložení tlaku a maximální silu působící na sedadlo. Experiment byl prováděn s 50 náhodně vybranými lidmi, kteří mají různou váhu a výšku. Každý proband sedel na autosedačce při třech různých úhlech 90°, 100° a 110°. Výsledky jsou hodnoceny z pohledu vlivu lidských parametrů na uhel sezení a na rozložení tlaku při sezení. Bylo zjištěno, že hmotnost probanda nemá žádný vztah s dosaženým maximem (špičkami) v tlakových bodech, ale maximální oblast tlakové mapy a nízký počet tlakových špiček jsou pozorovány při 100° úhlu autosedačky. Dále bylo zjištěno, že maximální tlak 28-110 mmHg a maximální pokrytá oblast 45-86% je závislá na hmotnosti a výšce probanda.

MONITORING THERMOPHYSIOLOGICAL COMFORT IN THE INTERLAYER BETWEEN DRIVER AND THE CARSEAT

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Abstract: *The comfort of drivers in the car is strongly influenced by physiological properties of carseat which are dependent on heat and moisture between body of driver and seat. Purpose of this study is objective evaluation of carseat physiological comfort. Proposal deals with using network of sensors (for temperature and relative humidity) for investigation of thermal field and moisture field on the entire surface of carseat. Advantage of proposed method is evaluation of carseat (usually connection of upholstery and foam) comfort as a complex phenomenon. This is in contrast to standard methods of measuring physiological properties that are able to measure only top layer (upholstery) of carseat.*
Key words: *physiological comfort, carseats, objective evaluation, thermocouples, sensors of humidity.*

1 INTRODUCTION

A lot of researches have been occupied with research of comfort in automotive seating up to now [1, 2]. Comfort is a complex and subjective notion of sensory evaluation. This is related to good physical and psychological well-being of the interface between the driver and the seat. One of the most important factors influencing passenger convenience is thermophysiological comfort. Therefore, car manufacturers are paying a lot of attention to this aspect, as can be seen by an increased application of air conditioning in the car. This indicates whether the seat is able to support the thermoregulation of the body via heat and moisture transport. A rough approximation is that seat comfort involves the seat and the driver [3].

From the physiological point of view, seat comfort comprises of the following four parameters:

- The initial heat flow upon the first contact with the seat. In other words, the sensation of warmth or cold in the first few minutes or even seconds after entering the car.
- The dry heat flow on long journeys, i.e. the amount of body heat transferred to the seat.
- The ability, known as 'breathability', to transport any perspiration formed away from the body. In so-called 'normal' sitting situations, there is no perceptible perspiration, but, nevertheless, the human body constantly releases moisture (so-called 'insensible perspiration'), which has to be taken away from the body.
- In the event of heavy perspiration (a car in the summer heat, stressful traffic situations) the ability to absorb perspiration without the seat feeling damp.

A seat is built in three parts: a metal armature, foam injected in a matrix, and a dress which covers the foam and armature. Each component has its own features [3]. Thermal properties and the permeability of the components are important to investigate the car seat thermal comfort. Textiles materials at the top of the car seat are relatively better in permeability due to their lower thickness and the structure. On the other hand foams due to their thickness and pores, which sometimes are not connected to each other, provide only a limited sweat transport. Thus it needs to be improved for thermal comfort of the car seat [5]. The heat flux should be as low as possible; otherwise a car seat feels cold in the winter time or hot during summer; which means the lowest thermal conductivity. Similarly the insulation and protective materials are thick and consist of non-woven fiber structure or closed pore layer like polyurethane foam or polypropylene layers; the heat transfer through these compressible layers is always a critical issue and is difficult to be measured experimentally or theoretically. There are multiple devices in market which measure the heat and moisture transfer through the materials that are made of thin layer materials and secondly the load on the material always causes the change of the porosity inside the material and affects the final results.

The measurement of comfort is mostly subjective and depends on many personal feelings. Nevertheless there is testing equipment which measures the heat and mass flow through the car seat material and analyses the discomfort range. The measurements can be either made on testing machines like air permeability tester, SGHP sweating guarded hot plate and [4], thermal resistance of material tester like TCI and FOX for separate layers of the car seat. To analyse the car seat comfort in a real condition is a complicated measurement. In this research two methods are used to analyse the effect of the sitting person on the heat accumulated and dissipated by the car seat. The better flow of moisture and heat will always be comfortable for the sitting person and will not cause discomfort by accumulated sweat/moisture and excessive heat. Two methods used for the research are humidity and temperature sensor field of the car seat and infrared thermo-camera analysis of the car seat.

2 EXPERIMENTAL

The experimental part of this paper deals with the description of objective evaluation method of carseat physiological comfort. Both, sensor for humidity and temperature field measurement of the car seat and infrared thermo-camera analysis were used to investigate of physiological automotive seating comfort.

2.1 Evaluation of automotive seating by humidity and temperature sensor field

For measurement and imaging temperature and relative humidity fields in the interlayer between the person and seat surface for both, back part and sitting part, two sensor measurement layers were used. The measurement for back and sitting part of carseats were synchronized to compare change of humidity and temperature during usage of seat at the same time for both the above mentioned parts of carseat.

Each sheet contains 16 sensors of type SHT 21 to record full 2D areas of temperature (T) and relative humidity (RH). Sensors were arranged to grids (sensors distance is 100 mm) and fixed to special high permeable non-woven fabric (Figure 1).

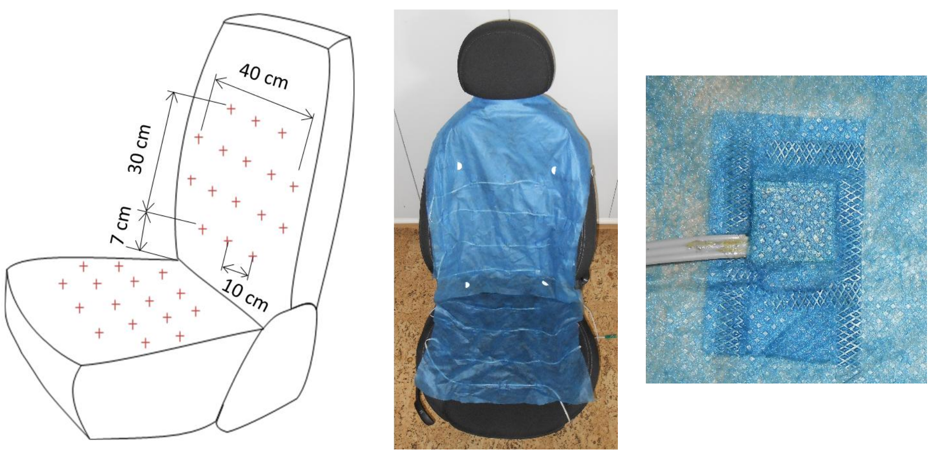

Figure 1 Illustration of measurement of thermal and humidity field by sensor sheet, detail of one sensor

Measuring area of sheet was 40x40 cm, distance of first sensor line from bottom edge (from the sitting part) was 7 cm (Figure 1). Technical parameters of sensors are: size 3x2 mm, measurement range of RH sensors is from 0% to 100% (accuracy ±2%), measurement range of T sensors is from -40 to 125°C (accuracy ±0.3°C).
The measurement was carried out in an air-conditioned room under constant conditions at a relative humidity of 65% and the temperature of 21°C.
The proband was dressed in T-shirt and trousers (jeans) during the test. Thermal insulation of the mentioned cloth system was ca. 0.45 clo.

2.2 Evaluation of automotive seating by thermography

Infrared thermography is a method, which detects infrared energy emitted from object, converts it to temperature, and displays image of temperature distribution. To compare results from sensors sheet two thermography systems (one for back part and second for sitting part) were used. Emissivity was set to 0.9 and this parameter was verified by sensor sheet measurement.

3 RESULTS AND DISCUSSION

The results from measured sheet can be obtained in form of:

- thermo-hydrographic images at a sampling interval of min 1 sec per image or
- "raw" source data for further analysis (for example into graph).
- Finally, the viewer receives live information about climate into the area between occupant and seat to understand feeling of driver.

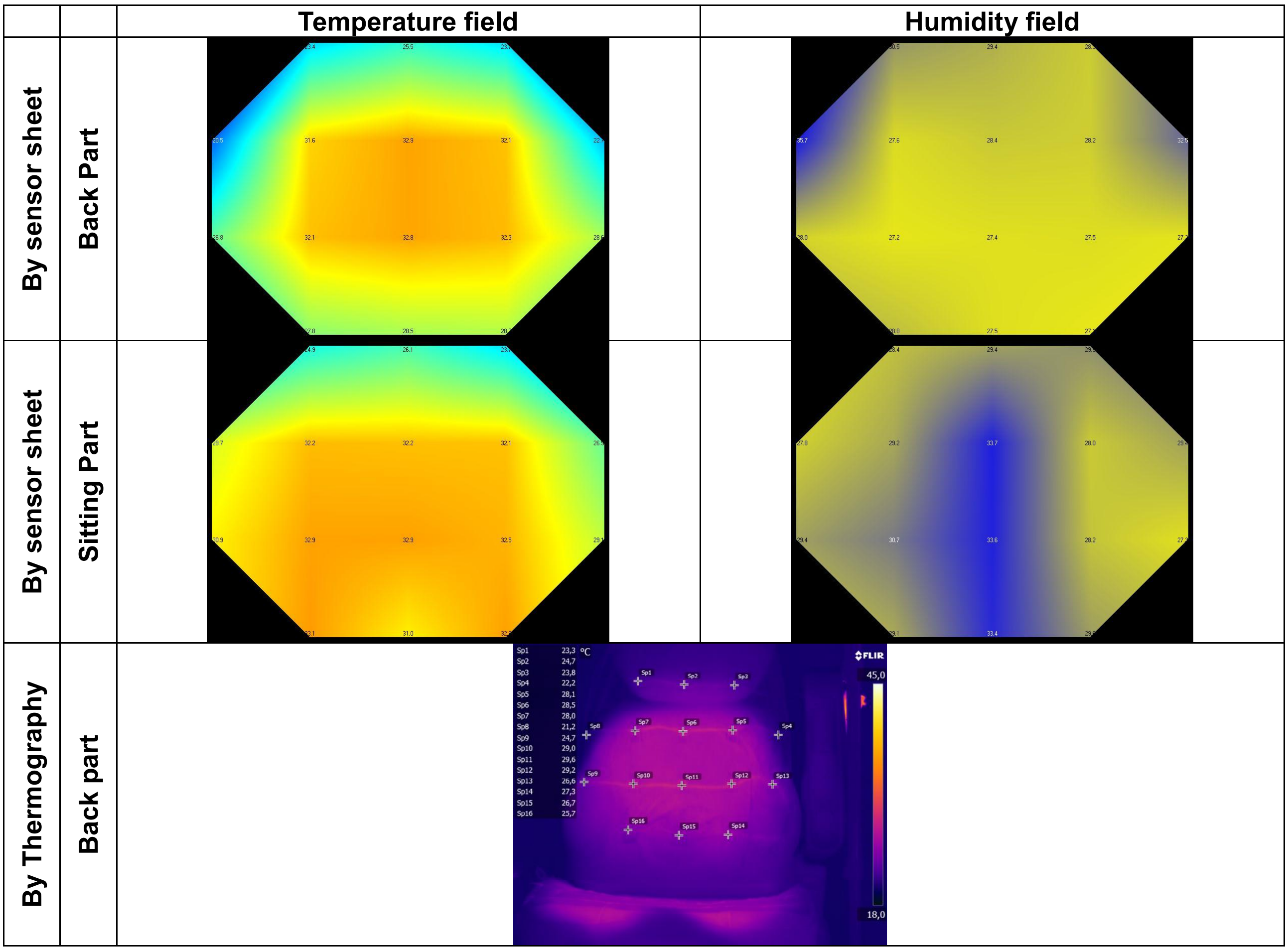

Figure 2 Imaging temperature and humidity field of carseats (after 32 min of measurement)

There are illustrations of temperature and relative humididy fields in the interlayer between the driver and carseat surface by means of proposed sensor sheet and by thermography in Figure 2. Above mentioned thermographs and hygrographs of carseats correspond to state after 32 minutes sitting of driver on carseats.

Figures 3-5 show illustrations of data evaluation from measurement sheet. There are time behaviour of temperature and relative humidity within 32 minutes of measurement for back parts of seat. T1-T16 represent sensors of temperature, H1-H16 are sensors of relative humidity.

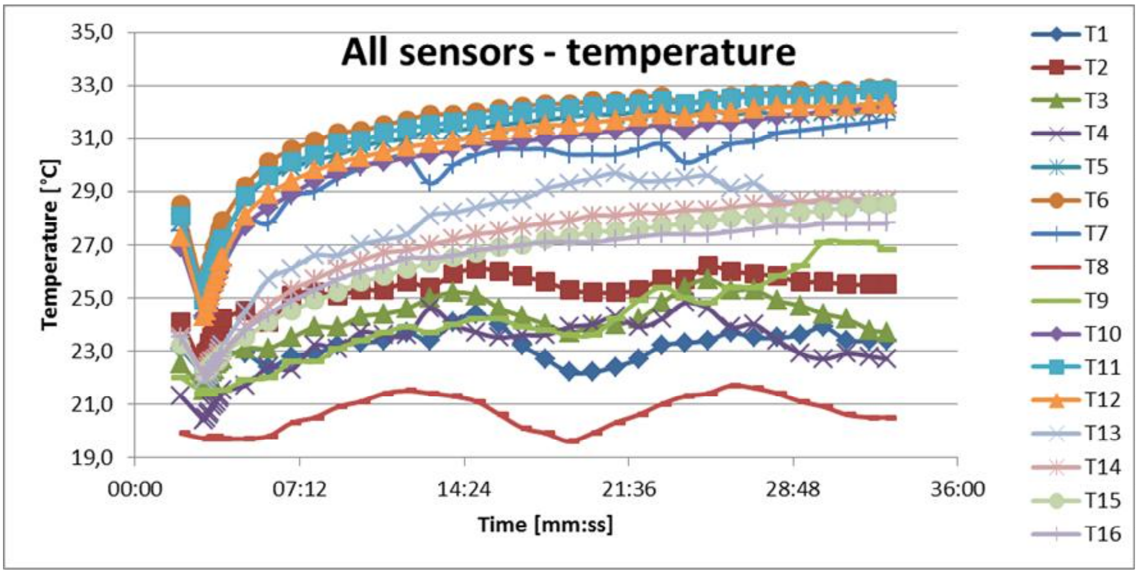

Figure 3 Temperature and time curve in 32 minutes for all sensors for back part

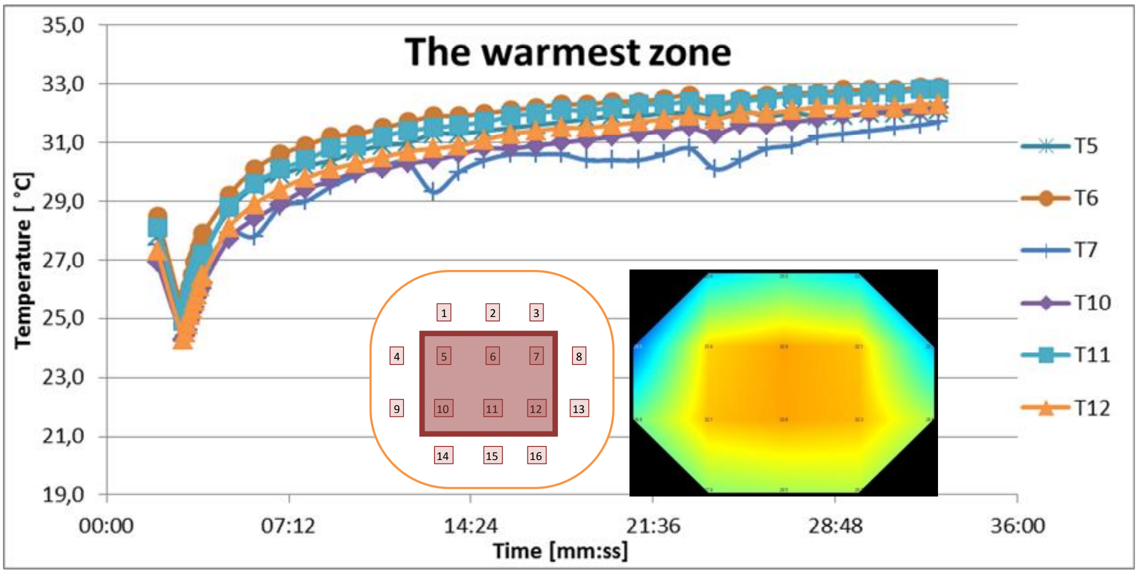

Figure 4 Temperature and time curve in 32 minutes for the warmest zone for back part

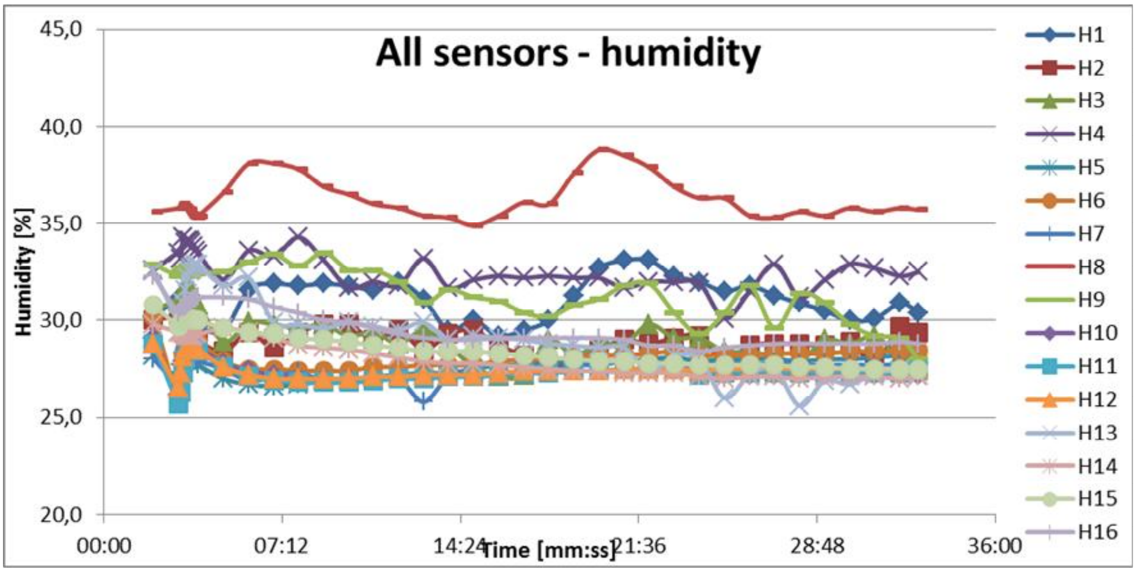

Figure 5 Relative humidity and time curve in 32 minutes for all sensors for back part

4 CONCLUSIONS

Thermophysiological seating comfort is very important aspect of the quality of seats, especially automotive. The improvement of comfort is the subject of many research works and invention of the Department of Clothing Technology at Technical University of Liberec (TUL) [6, 7]. Therefore sophisticated heating from point of view shape, location and intensity of heating for carseat was proposed by TUL [8]. Termophysiological comfort is not just pleasant feelings during the seating, but especially improvement of performance and concentration of drivers. The object of the research work described in this paper is an objective evaluation of thermal comfort when sitting. The tests are performed by measuring the heat and humidity fields in the interlayer between the surfaces of the seat and sitting person. Temperature and humidity curves were measured at a defined period of sitting, results were used to evaluate the seating comfort. The resulting values can be used to optimize the design of car seats. It is extraction, blowing of air, composition of car seat layers, heating etc. Additional research will focus on comparing the subjective sensations of subjects during the seating and feelings of subjects at the precise pressure distribution and should result into evaluation methodology including device for quick evaluation of moisture and temperature transport over the entire seat.

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MONITOROVÁNÍ FYZIOLOGICKÉHO KOMFORTU V MEZNÍ VRSTVĚ MEZI POTAHEM AUTOSEDAČKY A TĚLEM ŘIDIČE

Translation of the article

Monitoring thermophysiological comfort in the interlayer between driver and the carseat

Pohodlí řidiče v autě je silně ovlivňováno fyziologickými vlastnostmi autosedaček, které ovlivňují fyziologický komfort sezení daný zejména rozložením teploty a vlhkosti mezi tělem řidiče a sedačkou. Cílem této studie je návrh objektivního hodnocení fyziologického komfortu autosedaček jako celku. Předložený návrh se zabývá využitím sítě senzorů (pro měření teploty a relativní vlhkosti) pro šetření teplotního a vlhkostního pole v celém povrchu sedačky. Výhodou navržené metody je zhodnocení komfortu autosedaček jako komplexu zahrnujícího obvyklou konstrukci sedaček a to kombinaci čalounění (potahu) a pěny sedáku. Návrh je v kontrastu s běžnými postupy pro měření fyziologických vlastnosti textilních struktur, které jsou schopny měřit pouze horní vrstvu, tj. potah autosedaček bez zřetele na vliv masivu pěny.

MODIFIKOVANÉ POLYPROPYLÉNOVÉ VLÁKNA PRE SILIKÁTOVÉ KOMPOZITY

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Abstrakt: *Využitie vlákien v stavebnom priemysle sa stáva stále atraktívnejšie. Pre dobré mechanické vlastnosti, využiteľné aj pre výstuž betónov, sú polypropylénové (PP) vlákna najrozšírenejšie zo skupiny chemických vlákien. Nielen dobré mechanické vlastnosti, ale aj pomerne nízka cena či dlhá životnosť sú pozitívnym prínosom pri výbere PP vlákien pre využitie v stavebnom priemysle. Pri príprave modifikovaných PP vlákien bola použitá fyzikálna modifikácia pridaním anorganického nanoaditíva - kremičitého úletu. V práci sú sledované vlastnosti modifikovaných PP vlákien v závislosti od koncentrácie nanoaditíva ako aj od použitia rôznych dispergátorov.*
Kľúčové slová: *polypropylénové vlákna, modifikácia, kremičitý úlet.*

1 ÚVOD

Zo svetových trendov vo vývoji a produkcii chemických vlákien vyplýva skutočnosť, že absolútnu dominanciu v štandardných typoch vlákien dosiahli výrobcovia z Ázie, najmä Čína a India. Preto je tu výzva presadiť sa v náročnom konkurenčnom prostredí vývojom špeciálnych, modifikovaných, monofunkčne a multifunkčne aktívnych vlákien a textílií. Budúcnosťou sú špeciálne a technické vlákna, ktoré zahŕňajú environmentálne, zdravotné a ochranné aspekty použitých materiálov a technológii [1, 2].

Polypropylén (PP) je termoplastický polymér využívaný v mnohých odvetviach priemyslu. V širokom spektre technických aplikácií sa využíva práve PP pre uspokojenie dopytu spotrebiteľa. Pre jeho dobré mechanické vlastnosti sa výskum stále viac venuje využívaniu PP vlákien v stavebníctve ako výstuže betónov, ktoré sú najrozšírenejším konštrukčným materiálom. Betón ako konštrukčný materiál zaznamenal od 90. rokov minulého storočia výrazné kvalitatívne zmeny. Vývoj a výroba nových druhov cementov, využitie prísad a rôznych prímesí do betónu, podporované výsledkami rozsiahleho výskumu, dnes umožňujú vyrábať betóny vysokej kvality [3]. Zlepšenie určitých vlastností betónu je možné dosiahnuť práve vystužením rôznymi vláknami. Vo všeobecnosti betón charakterizujeme ako matricu silikátového kompozitu, ktorú vystužujú použité vlákna. PP vlákna v silikátových kompozitoch prispievajú k redukcii vzniku trhlín na povrchu v dôsledku zmrašťovania, k zvýšeniu pevnosti v ohybe, ako aj k odolnosti voči nárazu [4]. Avšak PP vlákna využívame aj pre ich dobrú chemickú odolnosť, čo znamená ekologickú prijateľnosť, či dobrú cenovú dostupnosť, čo by malo viesť k ekonomickému profitu. Existujú však určité nevýhody spojené s aplikáciou PP vlákien do silikátových kompozitov. Nízka afinita PP vlákien k cementovej matrici je v dôsledku nepolárneho, hydrofóbneho a fyzikálne či chemicky neaktívneho polyolefinického charakteru tohto polyméru [5]. A práve toto rozhranie medzi PP vláknom a silikátovou matricou je mierou úžitkových vlastností silikátových kompozitov vystužených PP vláknami. Preto je potrebné dosiahnuť efektívnejšie ukotvenie vlákien v silikátovej matrici. Pre dosiahnutie tohto cieľa je možné využiť metódy chemickej a fyzikálnej modifikácie. Modifikačný prejav je výsledkom premien chemického, fyzikálno-chemického a fyzikálneho charakteru [6]. Zmeny sa uskutočňujú na rôznych úrovniach štruktúry polyméru. Modifikácia vlákien umožňuje dosiahnuť významné zlepšenie úžitkových vlastností alebo poskytnutie nových vlastností. Faktory zohľadňujúce výber modifikačného postupu zahrňujú poznanie fyzikálnych a chemických zmien, ktoré modifikáciou nastanú, ako aj zhodnotenie prístrojovej náročnosti či náročnosti metodiky vyhodnocovania dosiahnutých výsledkov. Výber a aplikácia vhodného modifikačného postupu závisí predovšetkým od požiadaviek využitia modifikovaných PP vlákien [7]. Využitím fyzikálnej modifikácie s použitím anorganického mikro a nanoaditíva sa dosahujú zmeny vlastnosti modifikovaných vlákien, ktoré sa môžu sledovať v závislosti od množstva použitého aditíva ako aj od koncentrácie či typu použitého dispergátora. Pri príprave modifikovaného polyméru s aditívom je dôležité dosiahnuť homogenitu zmesi, resp. čo najlepšiu dispergáciu častíc aditíva. Čím menšie sú častice daného aditíva, tým lepšie vlastnosti je možné získať u modifikovaného polyméru. Avšak veľmi jemné častice aditíva - nanočastice majú tendenciu vytvárať pevné, ťažko dispergovateľné agregáty, resp. aglomeráty. Na získanie rovnomernej distribúcie častíc anorganického aditíva, pri príprave vlákna, je potrebné použiť dispergátory. Prídavkom dispergačných činidiel, ktoré zabraňujú agregácii dispergovaných častíc aditíva, je možné dosiahnuť stabilnú a rovnomernú výrobu modifikovaných vlákien. Využívané dispergátory sú zo škály od vyšších mastných kyselín až po organické väzbové prostriedky, predovšetkým silány [8].

Výber použitého anorganického nanoaditíva kremičitého úletu na modifikáciu PP vlákien súvisel s dôležitosťou týchto častíc pri príprave betónov. Za najdôležitejšiu aktívnu prímes do betónov sa považuje kremičitý úlet, vďaka puzolánovej aktivite častíc [3]. Puzolánovou aktivitou sa rozumie schopnosť častíc reagovať s hydroxidom vápenatým $Ca(OH)_2$:

$$Ca(OH)_2 + H_4SiO_4 \rightarrow Ca^{2+} + H_2SiO_4^{2-} + \\ + 2\,H_2O \rightarrow CaH_2SiO_4 \cdot 2\,H_2O$$

alebo v skrátenom zápise cementovej chémie:

$$CH + SH \rightarrow C\text{-}S\text{-}H$$

Puzolánovú aktivitu majú napr. materiály obsahujúce reaktívny oxid kremičitý SiO_2, niektoré puzolány sa vyskytujú v prírode – vulkanické sklá, popoly, kremelina a bridlice, no existujú aj umelé puzolány, medzi ktoré zaraďujeme najmä lietajúce popolčeky a kremičité úlety [9]. Minerálne prímesi, ako sú kremičitý úlet, či popolček (so svojimi puzolánovými, resp. latentne hydraulickými vlastnosťami), vytvárajú podmienky na vznik nových pevnejších väzieb na úrovni mikroštruktúry cementovej matrice. Pozitívny vplyv účinku nano-SiO_2 na vlastnosti silikátového kompozitu možno zhrnúť do troch základných bodov [10, 11]:

1) nanočastice SiO_2 pôsobia ako centrá kryštalizácie pri hydratácii cementu, čím sa urýchľuje proces hydratácie s preferenciou tvorby kryštálov malých rozmerov,

2) nano-SiO_2 je súčasťou puzolánových reakcií, čo prispieva k spotrebe nespojivovej zložky $Ca(OH)_2$ a zároveň tvorbe ďalšieho C-S-H gélu, čo zabezpečuje skvalitnenie štruktúry kontaktnej zóny medzi kamenivom a cementovou pastou,

3) nanočastice SiO_2 vypĺňajú priestor v štruktúre C-S-H gélu, čím prispievajú k spevneniu väzby medzi časticami C-S-H gélu, čoho výsledkom je nižšia priepustnosť, znížené vylúhovanie vápnika z cementovej pasty a zvýšenie trvanlivosti kompozitu

Z hľadiska vyššie spomenutých významných zlepšení vlastností betónu sú tieto prímesi aj potenciálnymi aditívami pre modifikáciu PP vlákien s aplikáciou do betónu.

Špeciálne typy betónov sú betóny, ktoré sa vyrábajú len pre zvláštne použitie. Pripravujú sa špecifickou kombináciou vybraných zložiek, alebo použitím netradičných zložiek. Do tejto skupiny zaraďujeme aj vláknobetón.

Vláknobetón je špeciálny betón, ktorý obsahuje okrem bežných zložiek navyše aj vlákna s cieľom zvýšiť jeho úžitkové vlastnosti. Do betónov sa môžu pridávať rôzne vlákna, ako oceľové, sklené, polypropylénové, azbestové, uhlíkové, či dokonca rastlinné [12]. Široké spektrum vlákien ale vždy nespĺňa očakávané účinky pri hodnotení vlastnosti zatvrdnutého betónu [9, 12-15]. Hlavným sledovaným faktorom pri vláknobetónoch je zabránenie vzniku a vývoju zmrašťovacích mikrotrhlín v začiatočnom štádiu hydratácie. Avšak pridaním vláknitej výstuže do betónu sa zlepšia aj niektoré vlastnosti dosahujúce nepriaznivé výsledky betónu v zatvrdnutom stave. Všeobecne sa zvyšuje pevnosť betónu v ťahu, jeho húževnatosť a odolnosť proti nárazu, odolnosť proti teplotným zmenám, či lepšia odolnosť voči únave [16]. Napriek zlepšeniu uvedených vlastností treba brať do úvahy, že ide len o sekundárnu výstuž, ktorá má pomôcť zlepšiť niektoré vlastnosti zatvrdnutého betónu a nejde o hlavnú nosnú výstuž. Polypropylénové vlákna s nemodifikovanou matricou sa štandardne aplikujú do silikátových kompozitov. PP vlákna používané ako rozptýlená výstuž do silikátových kompozitov prispievajú k redukcii vzniku trhlín, zvyšujú ťahovú a ohybovú pevnosť, zlepšujú rázovú odolnosť a majú dobrú chemickú odolnosť a nízku senzitivitu voči vlhkosti [4, 14, 17].

Nakoľko nedochádza k chemickým ani fyzikálnym medzimolekulovým väzbám medzi cementovou matricou a PP vláknom, znižuje sa schopnosť absorpcie deformačnej energie pri namáhaní silikátového kompozitu v ťahu a v ohybe, zvyšuje sa možnosť uvoľnenia vlákna z kompozitu, namiesto deformácie vlákien ako súčasti kompozitu [5, 18]. Preto je snaha modifikovať PP vlákna nanočasticami anorganických nanoaditív s cieľom zintenzívniť interakcie medzi vláknom a cementovou matricou. Tieto interakcie môžu viesť k zvýšeniu adhézie až k vzniku chemickej väzby. Doterajší výskum v oblasti aplikácie PP vlákien v betónových kompozitoch, modifikovaných nano-SiO_2 časticami, prezentuje fyzikálny a chemický efekt nanočastíc na zníženie vodného filmu v okolí PP vlákien, ako aj zlepšenie mechanických vlastnosti, odolnosti voči oderu, mrazuvzdornosti a chemickým látkam, vláknami vystuženého kompozitu [11, 16].

2 EXPERIMENTÁLNA ČASŤ

2.1 Použité materiály

Na prípravu vlákien boli použité tieto materiály:

- izotaktický polypropylén TATREN HT2511 (PP), MFR=25 g/10 min., Slovnaft, SR,
- kremičitý úlet ako nanoaditívum

a dispergátory:

- Tegopren 6875 (TEG), organicky modifikovaný siloxan, Evonik Industries
- Slovacid 44P (S44P), ester kyseliny stearovej a polypropylénglykolu, Sasol Co.

2.2 Príprava vlákien

Najprv boli pripravené koncentráty PP s obsahom nanoaditíva 5%hm. Koncentráty boli pred zvlákňovaním pretavené na dvojzávitovke, aby častice kremičitého úletu boli čo najrovnomernejšie rozdispergované vo vzorke. Pripravilo sa päť koncentrátov buď bez dispergátora alebo s rôznou koncentráciou dvoch dispergátorov (S44P, TEG). Z koncentrátov boli na laboratórnej zvlákňovacej linke pripravené nedĺžené modifikované PP vlákna s obsahom nanoaditíva 1, 3 a 5%hm. vo vlákne, bez dispergátora a s dispergátormi (TEG, S44P), ako aj referenčná vzorka čistého polypropylénu. Podmienky zvlákňovania: rýchlosť odťahu galety 150 m/min., teplota zvlákňovania 240°C, počet otvorov hubice 13. Po zvláknení boli tieto nedĺžené PP vlákna vydĺžené na maximálny dĺžiaci pomer (λ_{max}) a na rovnaký dĺžiaci pomer λ=3. Na hodnotenie vlastnosti PP vlákien boli použité dlžené PP vlákna s obidvoma dĺžiacimi pomermi.

2.3 Metódy hodnotenia

Mechanické vlastnosti

Mechanické vlastnosti (pevnosť a ťažnosť pri pretrhnutí, Youngov modul) PP a modifikovaných PP vlákien boli merané prístrojom Instron 3343 a vyhodnotené pomocou príslušného softvéru. Mechanické vlastnosti vlákien boli stanovené v súlade s STN EN ISO 139, STN EN ISO 2060, STN EN ISO 2062 and PND 129-129-06. Nastavené parametre počas merania boli:

upínacia dĺžka 125 mm a rýchlosť posunu čeľusti 200 mm/min.

Faktor priemernej orientácie vlákna

Faktor priemernej orientácie vlákna (f_α) je počítaný z nameraných hodnôt rýchlosti zvuku v orientovaných vláknach, pomocou nasledujúcej rovnice:

$$f_\alpha = 1 - \frac{c_n^2}{c^2} \quad (1)$$

kde: f_α - faktor priemernej orientácie vlákna
c_n - rýchlosť zvuku v úplne neorientovanom vlákne [km.s^{-1}] (c_{pp}= 1.6 km.s^{-1}),
c - rýchlosť zvuku v skúmanom vlákne [km.s^{-1}].

Rýchlosť zvuku v PP a modifikovaných PP vláknach bola meraná prístrojom Dynamic Modulus Tester PPM-SR v súlade so štandardmi PND 129-126-06.

Sorpcia vzdušnej vlhkosti

Chemické vlákna prijímajú z okolitého prostredia rôzne množstvo vodných pár, ktoré závisí od typu vlákna, od teploty prostredia a relatívnej vlhkosti. Z vlákien sa pripravili náviny s hmotnosťou 0,4-0,6 g, ktoré boli predsušené v sušiarni pri teplote 80°C/1 hod. Vzorky boli následne vložené do exikátora s nasýteným roztokom NH_4NO_3, kde sa ustálila relatívna vlhkosť vzduchu 65%. Po 96 hod. bola stanovená hmotnosť vlákna *m* s rovnovážnym obsahom vlhkosti. Po opätovnom sušení v sušiarni počas 3 hod a teplote 105°C bola stanovená hmotnosť m_0 suchého vlákna. Množstvo vody prijatej vláknom zo vzdušnej vlhkosti sa počíta z nasledovnej rovnice:

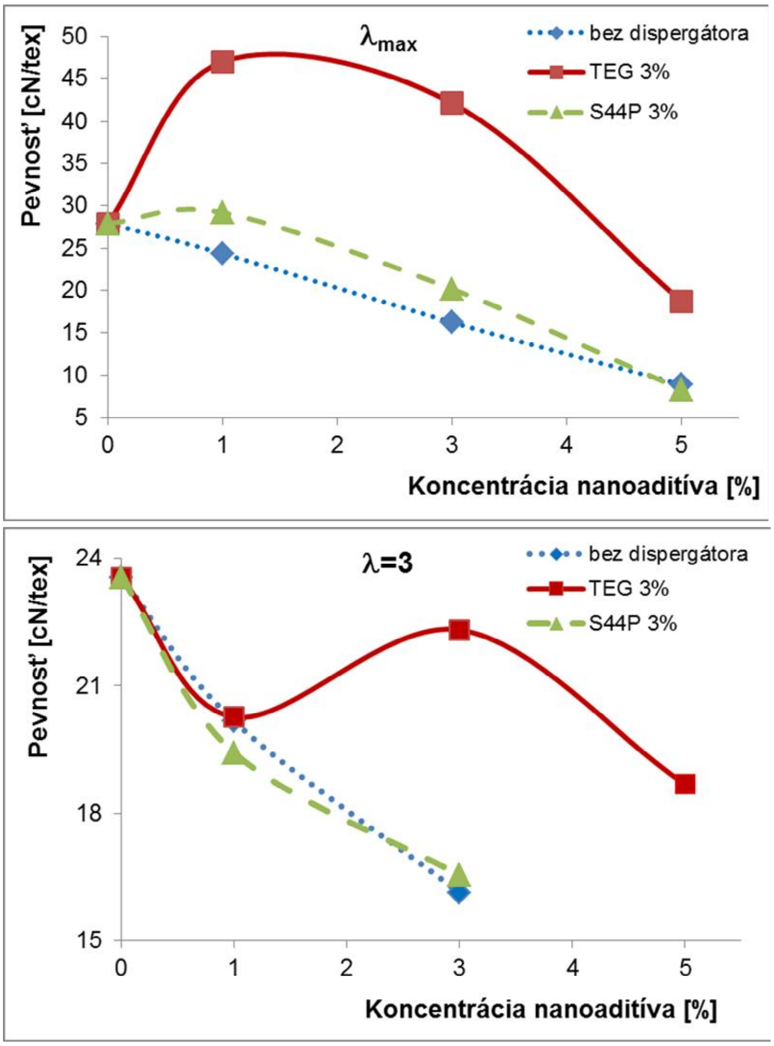
$$C_{wv} = \frac{m - m_0}{m_0}.100\% \quad (2)$$

3 VÝSLEDKY A DISKUSIA

Pre lepšiu dispergáciu anorganických plnív pri príprave modifikovaných PP vlákien sa používajú rôzne dispergátory. Preto sme sa v prvej časti práce zamerali na stanovenie vplyvu použitých dispergátorov na mechanicko-fyzikálne vlastnosti pripravených PP vlákien. Boli sledované dva dispergátory – Tegoprén 6875 a Slovacid 44P. Získané výsledky sú znázornené v Obr. 1.

Z grafu je možné konštatovať, že pri maximálnom dĺžiacom pomere dosahujú vlákna s dispergátorom TEG výrazne vyššie pevnosti pri všetkých použitých koncentráciách nanoaditíva v porovnaní s čistým PP vláknom (Obr. 1a). Pri rovnakom dĺžiacom pomere, nižšom ako maximálny, je rozdiel menej výrazný, ale je tiež možné hovoriť o vyššej pevnosti pri modifikovaných PP vláknach s použitým dispergátorom TEG, ako bez dispergátora, či použitím dispergátora S44P (Obr. 1b). Mechanické vlastnosti ukázali, že použitie dispergátora TEG, sa ukazuje ako výhodné z hľadiska zlepšenia vlastnosti modifikovaného PP vlákna.

Meraním rýchlosti zvuku a následným výpočtom faktora priemernej orientácie vlákien sme získali výsledky, ktoré potvrdzujú, že použitie kremičitého úletu spolu s dispergátorom TEG v PP vláknach zlepšujú orientáciu vlákien v porovnaní s PP vláknami s dispergátorom S44P ako i čistým PP vláknom (Obr. 2). Lepšia orientácia makromolekúl v PP vláknach s vyšším dĺžiacim pomerom bola potvrdená vyššou pevnosťou týchto vlákien a vyšším faktorom priemernej orientácie (Obr. 1, 2).

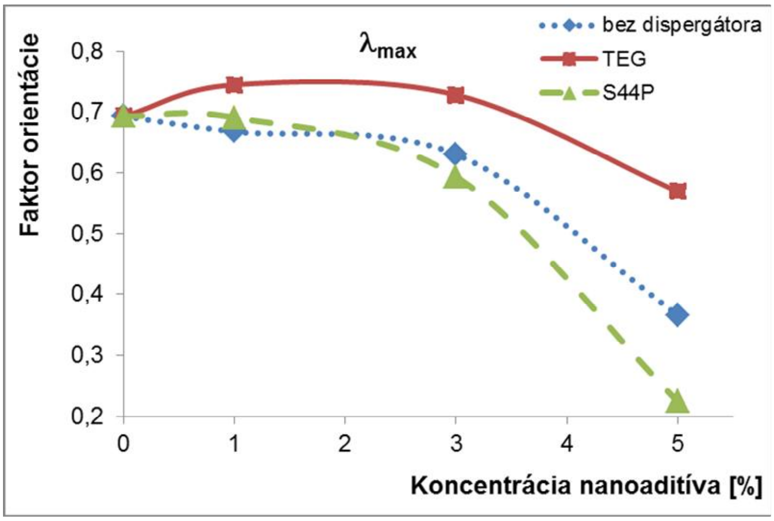


Obrázok 1 Závislosť pevnosti modifikovaných PP vlákien s a bez dispergátorov od koncentrácie nanoaditíva pre vlákna s dĺžiacim pomerom a) λ_{max} a b) λ=3

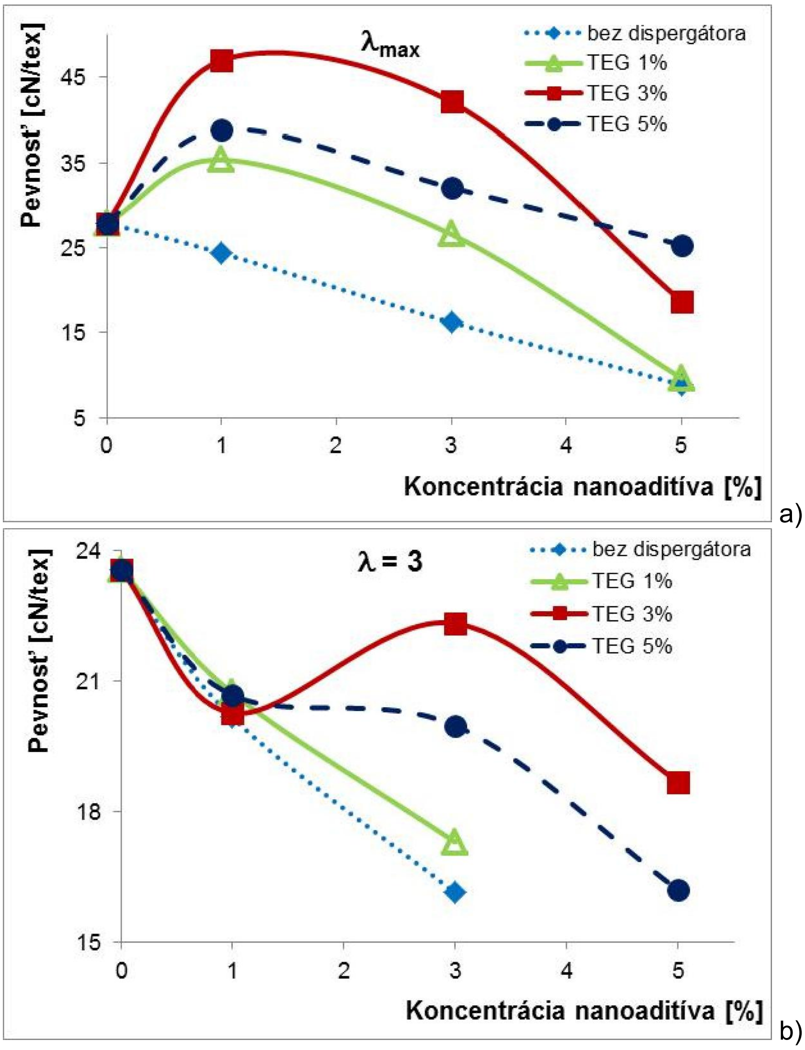
Na základe týchto nameraných výsledkov sme sa rozhodli doplniť sériu meraní modifikovaných PP vlákien s rovnakým množstvom aditíva, ale s ďalšími koncentráciami dispergátora TEG.

Z výsledkov meraní mechanických vlastnosti modifikovaných vlákien aditívom kremičitého úletu s koncentráciou 1, 3, 5% a rôznou koncentráciou dispergátora 0-5% (bez/s dispergátorom) vyplýva, že pevnosť modifikovaných vlákien s použitím dispergátora TEG s koncentráciou 3% je výrazne vyššia hlavne pri koncentráciách 1 a 3% použitého nanoaditíva oproti iným koncentráciám použitého dispergátora (Obr. 3a). Pri spoločnom dĺžiacom pomere dochádza k poklesu pevnosti vlákien oproti λ_{max}, medzi jednotlivými koncentráciami TEG, už nie sú také výrazne rozdiely pevnosti modifikovaných vlákien, ale stále môžeme vidieť, že použitie tegoprenu v množstve 3%, vykazuje zvýšenie pevnosti pri vyšších koncentráciách nanoaditíva (3 a 5% kremičitého úletu), (Obr. 3b).

Z predchádzajúceho konštatovania vyplýva, že existuje určitá optimálna koncentrácia dispergátora, ktorá vedie k zlepšeniu mechanických vlastnosti. Ďalším zvyšovaním koncentrácie dispergátora nedosahujeme zlepšenie mechanických vlastnosti.



Obrázok 2 Závislosť faktoru priemernej orientácie modifikovaných PP vlákien s a bez dispergátorov od koncentrácie nanoaditíva pre vlákna s dĺžiacim pomerom λ_{max}



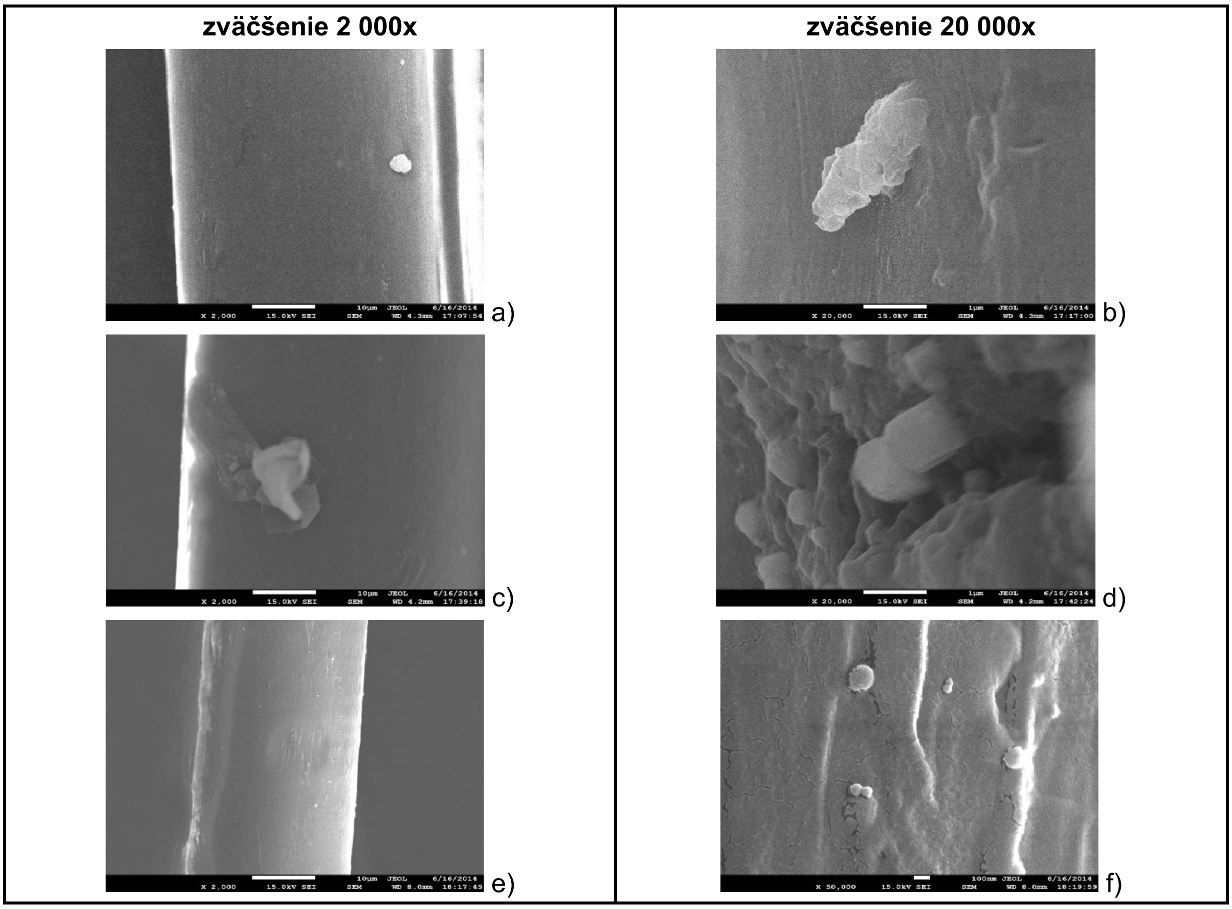
Obrázok 3 Závislosť pevnosti pri pretrhnutí modifikovaných PP vlákien bez dispergátora/s rôznou koncentráciou dispergátora Tegopren od koncentrácie nanoaditíva pre vlákna s dĺžiacim pomerom a) λ_{max} a b) λ=3

Pridaním anorganického plniva do PP vlákien sa sorpcia vodných pár zvyšuje v porovnaní s nemodifikovaným PP vláknom (Tab. 1).

Tabuľka 1 Sorpcia vodných pár modifikovaných PP vlákien

Vzorka	Dispergátor	Aditívum [%]	Sorpcia H_2O [%]	
			λ=3	λ_{max}
1	-	-	0,26	0,23
2	-	1	0,37	0,34
3	-	3	0,56	0,36
4	-	5	-	0,46
5		1	0,54	0,46
6	TEG	3	0,52	0,43
7		5	0,44	0,44
8		1	0,66	0,36
9	S44P	3	0,52	0,37
10		5	-	0,37

Sorpcia vodných pár je vyššia u nemodifikovaných i modifikovaných PP vlákien pri nižšom dĺžiacom pomere λ=3 ako pri maximálnom dĺžiacom pomere λ_{max}. To môže súvisieť s vyšším podielom amorfnej fázy (neusporiadanou štruktúrou) v pripravených vláknach s nižším dĺžiacim pomerom. Je známe, že sorpcia látok všeobecne prebieha ľahšie do oblasti s nižšou orientáciou ako do oblasti s vyššou orientáciou. Zvýšením obsahu koncentrácie nanoaditíva sa zvyšuje aj sorpcia vody, najmä pri modifikácii nanoaditívom bez dispergátora. Sorpcia vody vo vláknach je vo väčšine nižšia ako pol percenta, preto nedochádza k zmene hydrofóbneho charakteru PP vlákna.



Obrázok 4 REM snímky povrchov PP vlákien modifikovaných kremičitým úletom s obsahom nanoaditíva 5%
a), b) bez dispergátora
c), d) s dispergátorom TEG
e), f) s dispergátorom S44P

Pre zlepšenie adhézie medzi modifikovaným PP vláknom a matricou silikátových kompozitov by bolo výhodné, keby častice anorganického plniva boli uložené najmä v povrchovej vrstve vlákna. Preto sme na sledovanie prítomnosti aditíva na povrchu modifikovaného PP vlákna využili mikroskopickú metódu. Získané REM snímky dokazujú prítomnosť kremičitého úletu na povrchu modifikovaných vlákien (Obr. 4). Najvýraznejšie povrchové zdrsnenie môžeme sledovať pri modifikácii PP vlákna kremičitým úletom s použitím dispergátora TEG (Obr. 4c, 4d).

4 ZÁVER

V experimentálnej práci boli pripravené modifikované PP vlákna s rôznym pomerom zloženia polyméru, aditíva a dispergátora. U modifikovaných PP vlákien boli hodnotené vybrané vlastnosti. Z vyhodnotenia získaných výsledkov je možné konštatovať, že modifikované PP vlákna majú lepšiu pevnosť a priemernú orientáciu najmä u vlákien s maximálnym dĺžiacim pomerom pri použití dispergátora TEG. Z výsledkov vyplýva, že existuje optimálny pomer polymér/kremičitý úlet/TEG, nakoľko zvyšovanie koncentrácie dispergátora TEG neviedlo k ďalšiemu zlepšovaniu sledovaných vlastnosti.

Poďakovanie: *Týmto sa chcem poďakovať spoločnosti Evonik Industries a Sasol Co. za dodanie dispergátorov pre náš výskum.*

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MODIFIED POLYPROPYLENE FIBRES FOR SILICATE COMPOSITES

Translation of the article
Modifikované polypropylénové vlákna pre silikátové kompozity

Using of fibres in the construction industry is becoming more attractive. For good mechanical properties, usable for reinforcing concrete, PP fibres are the most widely used fibres. PP fibres are used in the construction industry not just for good mechanical properties but also for the relatively low cost and high durability. During preparation of the modified PP fibre was used physical modification of the inorganic nanoadditive - silica fume. The aim of our paper is the presentation of properties of modified PP fibre in dependence on the concentration of nanoadditive and the use of various dispersants.

"TRADITION AND HIGH-TECH DEVELOPMENT – KEYS TO THE TEXTILE MARKET"

24th IFATCC World Congress, June 13-16 2016, PARDUBICE (Czech Republic)

At the end of the nineteenth century the first attempts of textile chemists and colorists to join and work hand in hand in the fast growing textile industry of northeast Bohemia region began. These efforts were crowned with the foundation of the first Continental Textile Chemists and Colorists Society in 1908. In the same area production of dyestuffs has started and several small producers of textile auxiliary agents supported the tremendous development of the textile manufacturing.
The textile chemistry and coloration nowadays are becoming a new dimension – not only as the key to the fashion and comfort but also as a tool of the textile industry sustainability and last but not least as an extension of the new textile materials and fabrics into the new technical applications. Environmentally friendly, cost effective and energy efficient flexible technologies joining the tradition of chemistry with high-technologies, and boosted by new emerging disciplines, such as, to name a few biotech and nanotech, need to be communicated. Due to the significance of modern textile sector the forthcoming congress has obtained patronage of the Prime Minister of the Czech Republic.
Let´s come and acquaint ourselves with these trends, let´s unite with the business partners and friends from our branch and enjoy the hospitality of Pardubice region, the center of chemistry, horse racing and gingerbread. A kind invitation of the modern campus of the Pardubice University shall provide us with a good opportunity to engage youth to follow the tradition and to get together with the industrial representatives – breathing in the most recent innovation impulses of researchers.
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- Nano-based materials and technologies
- Textile surface treatment
- Digital printing/digital jet processing
- Advanced dyes and dyeing methods
- Advanced fibers
- Ecology and environment/green textile technologies
- Testing, physical and chemical analysis of textiles and textile processes
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Deadline: Abstract Submission (oral/poster presentation) 30.11.2015

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Jan Marek
IFATCC/STCHK President

František Janak
Congress Organizing Committee Chairman

The 24th IFATCC World Congress
13.-16.6.2016 in Pardubice – Czech Republic

At the end of the nineteenth century the first attempts of textile chemists and colorists to join and work hand in hand in the fast growing textile industry of northeast Bohemia region began. These efforts were crowned with the foundation of the first Continental Textile Chemists and Colorists Society in 1908. In the same area production of dyestuffs has started and several small producers of textile auxiliary agents supported the tremendous development of the textile manufacturing.

The textile chemistry and coloration nowadays are becoming a new dimension - not only as the key to the fashion and comfort but also as a tool of the textile industry sustainability and last but not least as an extension of the new textile materials and fabrics into the new technical applications. Environmentally friendly, cost effective and energy efficient flexible technologies joining the tradition of chemistry with high-technologies, and boosted by new emerging disciplines, such as, to name a few biotech and nanotech, need to be communicated.

Let's come and acquaint with these trends, let's unite with the business partners and friends from our branch and enjoy the hospitality of Pardubice region, the center of chemistry, horse racing and gingerbread. A kind invitation of the modem campus of the Pardubice University shall provide us with a good opportunity to engage youth to follow the tradition and to get together with the industrial representatives - breathing in the most recent innovation impulses of researchers.

Let's make the 24th International IFATCC Congress a three-day living space for multidisciplinary professional communication and multinational partnering event. Call for papers is now open to get a wide space for your innovative presentations from both - research and industrial innovation spheres. See more about highlighted program topics and deadlines at http://ifatcc2016-pardubice.upce.cz

STCHK (Czech Society of Textile Chemists and Colorists) as the main Congress organizer is pleased to welcome your organization to sign a sponsor agreement for XXIV IFATCC International Congress, Pardubice (CZ). This is a great opportunity for your organization to highlight your association with the centennial reputation of IFATCC as a global brand representing tradition and unfailing care about the transfer of innovations as key instruments of textile sustainability and the multidisciplinary approach encouragement.
The 24th IFATCC Congress is organized under the patronage of Czech Prime Minister Mr. Bohuslav Sobotka.

Jan Marek
IFATCC/STCHK President
on behalf of the Scientific and Organizing committees

INSTRUCTIONS FOR AUTHORS

The journal „**Vlákna a textil**" (Fibres and Textiles) is the scientific and professional journal with a view to technology of fibres and textiles, with emphasis to chemical and natural fibres, processes of fibre spinning, finishing and dyeing, to fibrous and textile engineering and oriented polymer films. The original contributions and works of background researches, new physical-analytical methods and papers concerning the development of fibres, textiles and the marketing of these materials as well as review papers are published in the journal.

Manuscript

The text should be in ***single-column format***.

The original research papers are required to be written in English language with summary. Main results and conclusion of contribution from Slovak and Czech Republic should be in Slovak or Czech language as well.

The other parts of the journal will be published in Slovak language; the advertisements will be published in a language according to the mutual agreement.

The first page of the manuscript has to contain:

The title of the article (16 pt bold, capital letters, centred)

The initials of the **first name** (s) and also **surnames** of all authors (12 pt, normal, centred)

The complete address of the working place of the authors, e-mail of first author (12 pt, italic, centred)

Abstract (10 pt, italic)

Key words (10 pt, italic)

The manuscript has to be written in A4 standard form, in **Arial, 12 pt**. Page margins: up and down 2.5 cm; left 1.4 cm, right 1.9 cm.

Do not number the pages and do not use footnotes. Do not use business letterhead.

Figures, tables, schemes and photos (centered) should be numbered by Arabic numerals and titled over the table and under the figure or picture. The total number of figures and tables should not be more than 10.

Photos and schemes have to be sufficiently contrastive and insert in text as pictures.

Mathematical formulae should be centred on line and numbered consecutively on the right margin.

Physical and technical properties have to be quantified in SI units, names and abbreviations of the chemical materials have to be stated according to the IUPAC standards.

References in the text have to be in square brackets and literature cited at the end of the text. References have to contain names of all authors.

1. Surname N., Surname N.: Name of paper or Chapter, In *Name of Book (in Italics)*, Publisher, Place of Publication, pp. xxx-yyy, YYYY
2. Surname N., Surname N.: Name of paper, *Name of Journal (in Italics)* Vol. (No.), pp. xxx-yyy, YYYY
3. Surname N., Surname, N.: Title of conference paper, *Proceedings of xxx xxx*, conference location, Month and Year, Publisher, City, Surname N. (Ed.), pp. xxx-yyy, YYYY
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