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(54) **BABY MATTRESS**

(57) The invention relates to a baby mattress which reduces all of the risk factors associated with the sudden death of nursing infants and, more specifically, reduces the thermal stress of the baby and reduces the carbon dioxide accumulation rate below the toxic threshold of 5%. The mattress is characterised in that it comprises a

core produced from a polyether open cell foam and a 3D polyester cover. The core has a density between 30-35 kb/m³, a compressive strength determined by ISO 3386 standard between 4-5 K Pa a cell size between 2.5-3.5 mm and the the cover has a weight between 180-250 grams

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DescriptionTechnical Field of the Invention

5 **[0001]** The present invention describes a baby mattress which reduces all risk factors associated with sudden infant death. The mattress is characterized in that it comprises a core produced from an open-cell polyether foam and a 3D polyester cover.

Background of the Invention

10 **[0002]** Sudden infant death syndrome (SIDS) is the most common cause of death among babies in the post-natal period (between the second and the sixth month of life) and causes about 2,400 deaths a year in Europe alone. Experts describe SIDS as a multifactorial syndrome relating to overheating and thermal stress, with carbon dioxide re-inhalation, respiratory tract obstruction and inhalation of toxic substances.

15 **[0003]** There is a need for mattresses which reduce the risk factors associated with sudden infant death.

[0004] The risk factor associated with inhalation of toxic substances is reduced by means of using certified materials, such as OEKO-TEX® certified Class 1 material, for example.

[0005] The risk factor associated with respiratory tract obstruction can be reduced by avoiding cores having a soft firmness because they can generate folds and enclose the respiratory tracts. According to published studies, the risk of sudden death increases between 2.36-5 fold when mattresses having a soft firmness are used.

20 **[0006]** The risk associated with carbon dioxide re-inhalation can be reduced by using mattresses and fibers which allow air circulation, but the carbon dioxide accumulation rate depends on the type of mattress (material of the core, material of the covers, cell size). The World Health Organization has established that carbon dioxide accumulation rates in exhaled air of over 5% are toxic.

25 **[0007]** The risk associated with thermal stress could be reduced by means of using mattresses that remove heat.

[0008] In addition, the mattress must provide horizontal firmness preventing the backbone from adopting hyperkyphosis postures which are detrimental to musculoskeletal development.

[0009] The state of the art describes different mattresses formed by cores of open-cell plastic material such as polyester, polyether, polyurethane, polyethylene, allowing air recirculation in the mattress, but these documents do not describe if the carbon dioxide accumulation rate is below the toxic threshold of 5%.

30 **[0010]** DE20200513361U describes different air permeable fibers produced from polyesters suitable for being incorporated in mattresses.

[0011] US 4357725 describes a mattress formed by an open-cell plastic core with polyether foam covered by a layer of closed-cell plastic material. The plastic cover produces thermal stress in infants and plastic is not gas permeable.

35 **[0012]** The document closest to the invention, WO2008/067834, describes a mattress intended for preventing sudden infant death made from polyethylene foam made up of three layers and a cover produced from cotton or cotton made from mesh with polyesters. The structure of the mattress allows air circulation. However, this document does not provide in detail the carbon dioxide accumulation rate.

40 **[0013]** Finally, according to the data published by Bar-Yishay E, Gaides M, Goren A, Szeinberg A. Aeration properties of a new sleeping surface for babies. *Pediatr Pulmonol.* 2011 Feb; 46(2):193-8, mattresses on the market today show carbon dioxide accumulation rates of over 4.5%

[0014] In summary, the state of the art discloses mattresses made from open-cell plastic foams and 3D polyester fibers allowing air recirculation, but it does not describe or suggest mattresses having a carbon dioxide accumulation rate of less than 4%.

45 **[0015]** With respect to the risk factor associated with thermal stress, the state of the art does not show any solution to the problem.

Object of the Invention

50 **[0016]** The problem solved by the invention is to provide a mattress which reduces all the associated risk factors of sudden infant death syndrome.

[0017] The solution provided according to the claims is a mattress comprising an open-cell polyether foam core and a 3D polyester fabric cover.

[0018] The described mattress:

- 55
- shows a carbon dioxide accumulation rate in exhaled air of less than 4%,
 - shows a thermal resistance of less than $3.2^{\circ}\text{Cm}^2/\text{W}$, which prevents overheating of the mattress, hyperthermia and improves thermal comfort,

- prevents choking due to asphyxia,
- prevents inhalation of toxic materials,
- shows optimal ergonomic characteristics, preventing the backbone from adopting hyperkyphosis postures which are detrimental to musculoskeletal development.

Detailed Description of the Invention

[0019] The mattress is structured on the basis of an open-cell polyether foam core included in a housing provided by a cover comprising an upper sheath and a lower sheath, both made of 3D polyester fabric with side borders made of 3D polyester fabric, having finishing parts made of the same fabric in the four corners.

[0020] Optionally, a cotton edging with polyester cord reinforcement is linked by sewing between the upper sheath and the border and the lower sheath and the border. The lower sheath includes a longitudinal zipper for linking the sides whereby the inside of the cover can be accessed for removing the core in order to subject it to aeration and/or washing operations, when necessary.

[0021] The core is made from polyether foam with a density between 30-35 kg/m³, a compressive strength determined by the ISO 3386 standard between 4-5 KPa and a cell size between 2.5-3.5 mm. The thickness of the mattress can range between 3 cm and 10 cm.

[0022] The cover is made from 3D polyester and preferably from non-quilted 3D polyester with a weight between 180 and 250 grams. Non-quilted polyester prevents the risk of choking and furthermore reduces hyperthermia or thermal stress in babies.

[0023] The core and the cover comply with the OEKO-TEX® class 1 test, therefore the mattress is non-toxic.

Carbon dioxide accumulation tests

[0024] Tests were performed to confirm the potential carbon dioxide re-inhalation reduction level with a baby mannequin, the simulation mechanism of which consisted of a leak-tight cube having sides measuring 15*15 cm and a height of 10 cm, open on a single side located on the mattress. The cube was connected to a gas container filled with air with a 5% carbon dioxide concentration. Two 60 mL one-way valves simulating the baby's breathing at a rate of 30 openings per minute were installed in the connection circuit. A carbon dioxide analyzer was connected for analyzing the concentration inside the cube, for analyzing the maximum carbon dioxide concentration according to the method described by Bar-Yishay E, Gaides M, Goren A, Szeinberg A. Aeration properties of a new sleeping surface for babies. *Pediatr Pulmonol.* 2011 Feb; 46(2):193-8. The carbon dioxide concentrations were then continuously collected (20 Hz).

[0025] The results obtained were:

Sample	Maximum carbon dioxide (%)
Mattress having a 100% thermally bonded fiber core with removable 3D fabric cover	4.36 ± 0.11
Open-cell polyether foam core with 3D polyester fabric cover	3.35 ± 0.14

[0026] The results described by Bar-Yishay E, Gaides M, Goren A, Szeinberg A. Aeration properties of a new sleeping surface for babies. *Pediatr Pulmonol.* 2011 Feb; 46(2):193-8 for the different mattresses on the market were:

Sample	Maximum carbon dioxide (%)
Pang® mattress	5.20 ± 0.04
Shilav® mattress	4.51 ± 0.10
Polygon® mattress	4.56 ± .04
AeroSleep® mattress	6.25 ± 0.28
Aminach Air® mattress	5.15 ± 0.19

where:

the Pang® mattress is a standard polyurethane foam mattress covered with a layer of polyester,
the Shilav® mattress is a standard polyurethane foam mattress with a 3-layer polyester covering,
the Polygon® mattress is a polyurethane mattress covered with a 3D fabric that improves air flow,

the AeroSleep® mattress is a 5 mm paneled surface located on a standard mattress that improves air flow, the Aminach Air® mattress is a polyurethane mattress with a 5 mm upper paneled polyester surface that improves air flow.

[0027] The preceding results show that only the mattress formed by an open-cell polyether foam core with a 3D polyester fabric cover has a carbon dioxide accumulation rate of less than 4%.

[0028] The AeroSleep® and Aminach Air® mattresses, which improve air flow according to the manufacturer, show carbon dioxide accumulation rates greater than the toxic threshold of 5%.

Thermal stress tests

[0029] The tests were performed with an ST-2 thermal mannequin which allows simulating the heat flow produced by babies. The thermal flow for the study was 6 W/m² for 3 hours. Before the start of the test, the mattresses were acclimatized for 24 hours at the control temperature. The temperature between the surface of the mattress and the mannequin was recorded. The thermal resistance, which is a parameter characterizing thermal comfort, because the lower the thermal resistance obtained the greater the thermal comfort, could therefore be measured by controlling the temperature and thermal flow.

[0030] The results obtained were:

Sample	Thermal resistance (°Cm ² /W)
Quilted spring mattress	3.20
Mattress having 100% thermally bonded fiber core with removable 3D fabric cover	3.34
Mattress having a low-density polyurethane core (20 kg/m ³) with impermeable PVC cover	3.20
Low-density polyurethane core (20 kg/m ³)	3.17
Open-cell polyether foam core	3.10
Open-cell polyether foam core with quilted polyester cover	3.20
Open-cell polyether foam core with 3D polyester cover	3.19

Sample	Mean temperature for the last 30 minutes (°C)
Quilted spring mattress	38.4
Mattress having 100% thermally bonded fiber core with removable 3D fabric cover	40.1
Mattress having a low-density polyurethane core (20 kg/m ³) with impermeable PVC cover	38.4
Low-density polyurethane core (20 kg/m ³)	38.1
Open-cell polyether foam core	37.2
Open-cell polyether foam core with quilted polyester cover	38.5
Open-cell polyether foam core with non-quilted 3D polyester cover	38.3

[0031] The results show that the cores made with crosslinked polyester foam, i.e., open-cell foam, improve thermal comfort and prevent hyperthermia in babies.

[0032] It is observed that the mattress formed by an open-cell polyether foam core and non-quilted 3D polyester cover has improved thermal properties compared to an open-cell polyether foam core with a quilted polyester cover. Furthermore, by eliminating quilting, the risk of asphyxia is prevented.

[0033] The detailed claims below are part of the description. The embodiments resulting from the dependencies of the claims are included in the description by reference.

Claims

1. A non-toxic mattress comprising:

- a core formed by a open-cell polyether foam and
- a 3D polyester fabric cover.

2. The mattress according to claim 1, wherein the cover is a non-quilted 3D polyester fabric cover.

3. The mattress according to the preceding claims, **characterized in that** the thermal resistance of the mattress is less than $3.20\text{ }^{\circ}\text{Cm}^2/\text{W}$ and the carbon dioxide accumulation rate is less than 4%.

4. The mattress according to the preceding claims, **characterized in that**,

- the core has a density between $30\text{-}35\text{ kg/m}^3$, a compressive strength determined by the ISO 3386 standard between 4-5 KPa and a cell size between 2.5-3.5 mm,
- the cover has a weight between 180-250 grams.

5. Use of an open-cell polyether core with cell size between 2.5-3.5 mm, a density $30\text{-}35\text{ kg/m}^2$ and a compressive strength between 4-5 Kpa for producing a mattress which reduces thermal stress of the baby.

6. Use of a 3D polyester fabric with a weight of 180-250 grams for producing a mattress which reduces thermal stress of the baby.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2014/000146

A. CLASSIFICATION OF SUBJECT MATTER

A47C27/14 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A47C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, INVENES

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	US 4357725 A (AHL M LARS G W) 09/11/1982, column 2, line 53 - column 3, line 27; figures.	1-3, 6
Y	WO 2008068734 A2 (GABBAI MOSHE ET AL.) 12/06/2008, pages 3 - 4; figures.	1-3, 6
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Y	WO 9639904 A1 (HARGEST THOMAS S ET AL.) 19/12/1996, page 30, line 21 - page 31, line 24; page 35, line 24 - page 36, line 2; figures.	1-3, 6
A	JP 2004097540 A (DELTA TOOLING CO LTD ET AL.) 02/04/2004, figures & Abstract from base of WPI. Retrieved from EPOQUE; AN 2004-394215	1-6

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Date of the actual completion of the international search
12/12/2014Date of mailing of the international search report
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International application No.

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C (continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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A	US 4520517 A (AHLM LARS) 04/06/1985, abstract; table	1-6
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