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Study of thermal properties, toxicity emissions and rebreathing avoidance as exogenous stressors of Sudden Infant Dead Syndrome in baby mattresses. Design recommendations.

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Introduction

Sudden Infant Death Syndrome is the highest cause of death in the post-neonatal period. According to the Triple Risk Model (Kinney et al, 2009), SIDS results when three factors simultaneously influence the infant: (a) an underlying vulnerability in the infant, (b) a critical developmental period, and (c) an exogenous stressor.

Considering exogenous stressor evidences, the objectives were:

- to determine the thermal behavior of current baby mattresses
- to test improvements reached by new materials, to confirm the viability to design harmfulness mattresses according to Oeko-tex
- to confirm that rebreathing of exhaled air is above the safety threshold concluding with a design criteria including the properties mentioned above.

Figure 1

Thermal test

It was used a thermal mannequin ST-2 made by Measurement Technology Northwest *(fig. 2 & 3)*.

Figure 2

Test specimens were:

1. Spring mat.-foam-textile cover sewed
2. Fiber mat.-foam 3D textile
3. PU mat. core low density PU-PVC cover
4. PU Mat. core with low density PU
5. Babykeeper® mat. core
6. Babykeeper® mat. core-3D foam textile
7. Babykeeper® mat. core-Smart textile *(fig. 1)*

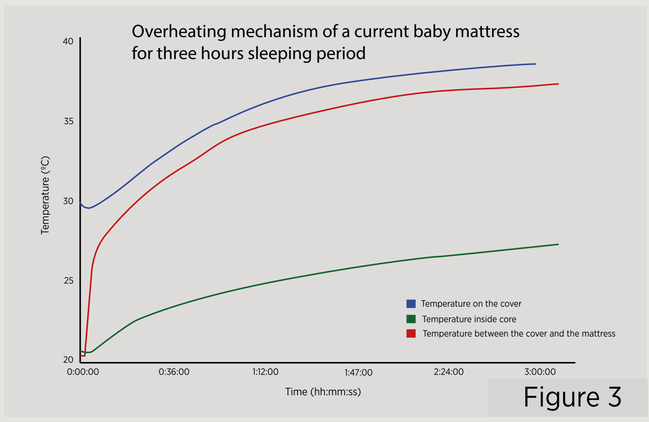

Figure 3

Toxicity and Rebreathing test

Oekotex test was performed by AITEX following label standards. To study rebreathing avoidance an infant mannequin was simulated as a head box which was placed with its open face on the mattress and connected with tubing to a gas reservoir filled with 5% CO2. Also it was used 50 cc syringe with two one-way valves which simulates infant breathing. Finally a CO2 analyzer was placed in the head box (tested by Bar-Yishay Phd). Both tests were executed to confirm liability of new materials: spec. 2 and 7.

Results

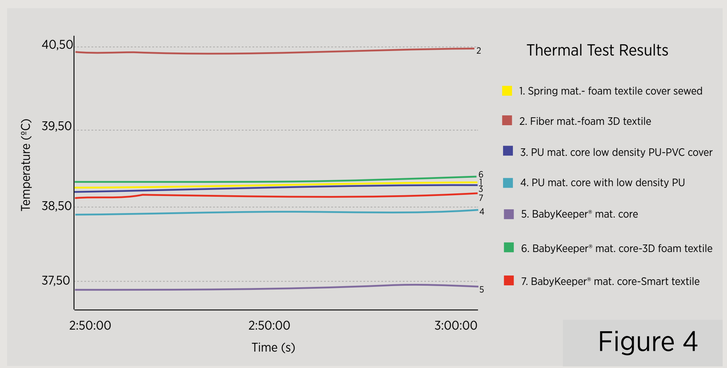

Figure 4

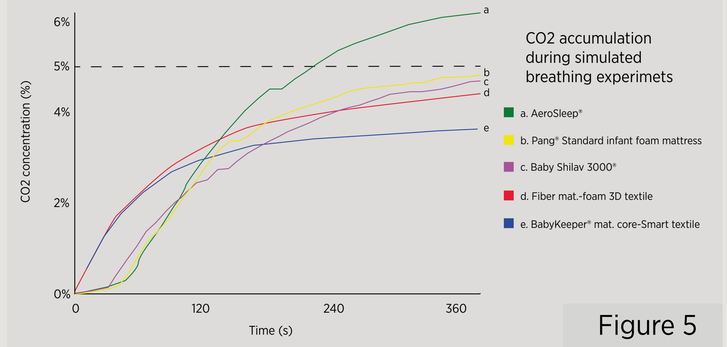

Figure 5

Thermal Test Results (Test Specimen (Temperature average last 30min, Thermal Resistance Rt (C.m^2/W)) *(fig. 4)*

- Spring mat.-foam-textile cover sewed (38.4ºC, 3.2)
- Fiber mat.-foam 3D textile (40.1ºC, 3.34)
- PU mat. core low density PU-PVC cover (38.4ºC, 3.2)
- PU Mat. core with low density PU (38.1ºC, 3.17)
- Babykeeper® mat. core (37.2ºC, 3.1)
- Babykeeper® mat. core-3D foam textile (38.5ºC, 3.20)
- Babykeeper® mat. core-Smart textile (38.3ºC, 3.19)

Oekotex: Not toxic class1.

Rebreathing results (specimen (Max CO2(%),Time to reach plateau (sec)) *(fig. 5)*:

2. Fiber mat.-foam 3D textile (4.36±0.11, 324±1.4)
7. Babykeeper® mat. core-Smart textile. (3.35±0.14, 298±19)

* According to state of the art (Bar-Yishay et al., 2011), 3 current mattresses test results are (including Aerosleep which is a product that adverts better airflow properties): Pang® (5.20±0.04) BabyShilav 3000® (4.51±0.1), AeroSleep®(6.25±0.28).

In this sense both systems had a significantly faster rate of CO2 elimination (4-5 minutes) compared to 15 min to 18.7 min. for other mattresses and **max CO2<5% (toxic limit)** (Bar-Yishay et al, 2011).

Conclusion

As a conclusion design recommendation for baby matresses:

- Thermal resistance (RT) < 3.2 ºCm^2/W
- Oekotex label class 1 for product and components
- Rebreathing test simulation (fixing CO2: concentration at 5%): CO2< 4%(steady state situation non-toxic) and CO2 elimination rate <400 sec. (Bar-Yishay et al, 2011)

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