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Title: Validation of EMF shielding of silver infused weighted blankets

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Products:

- SleepGift EMF Shielding Everyday Blanket
- SleepGift EMF Shielding Weighted Blanket

AIM OF REPORT

This report focuses on the validation of the shielding effectives of SleepGift blankets, which are manufactured with nano-sized silver mineral infusion. They are manufactured to reduce the electromagnetic field (EMF) exposure by individuals in their daily lives.

By conducting thorough testing and analysis, the project aims to provide valuable insights into the extent to which these blankets can shield individuals from EMF radiation by means of their shielding effectiveness (SE).

MAKE OF THE SLEEPGIFT SHIELDING BLANKETS

The shielding comes from the silver content present in the fabric. As seen in the Scanning Electron Microscopy (SEM) images of the cross-section of the fabric, the silver coating on the threads is extremely thin (approximately 0.1 microns), and does not seem to be present in all of the fibers. The coating is not visible in the light microscope, except when the fiber cross section is almost horizontal.

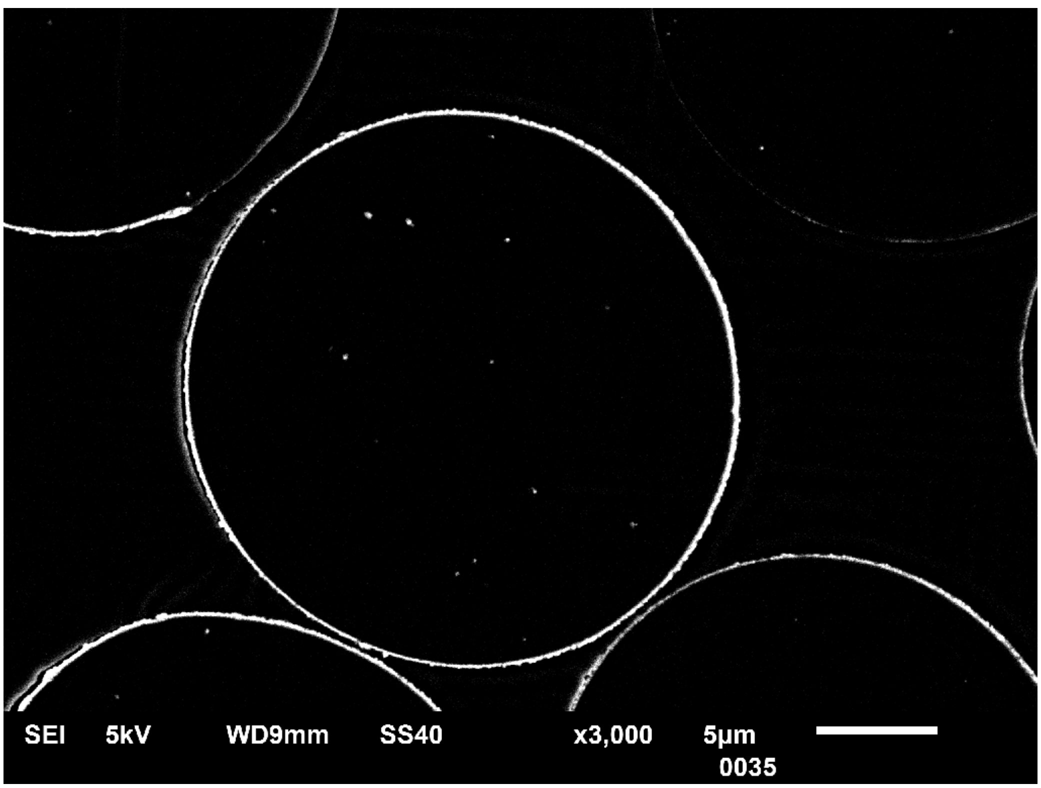

Fig1: SEM image of cross section of fabric

Result Type	Weight %			
Spectrum Label	Silver Layer 1	Silver Layer 2	Silver Layer 3	Resin
N	4.68	6.01	3.99	11.85
O	13.00	9.56	7.94	72.58
Si	0.14	0.35	0.35	0.18
S	0.16	0.82	0.16	0.22
Cl	1.82	0.74	0.62	10.99
Ag	80.20	82.52	86.94	4.17
Total	100.00	100.00	100.00	100.00

Table 1: EDS Quant Results

Note: The interaction volume for EDS (approximately 1 to 3 microns[3]) exceeds the thickness of the silver resulting in the resin being detected. The microtoming will cause low level contamination of the resin and cotton surfaces with silver and vice versa.

Thickness of Silver Layer (microns)	0.102
	0.1
	0.102
	0.104
	0.1
	0.103
	0.102
	0.1
	0.1
	0.101
Average	0.1014
St. Dev.	0.00143

Table 2: Thickness of silver layer in microns, with average and standard deviation

EXPERIMENTAL SETUP

MIL-STD-285 is a standardized test method used to evaluate the shielding effectiveness of materials for electromagnetic radiation.

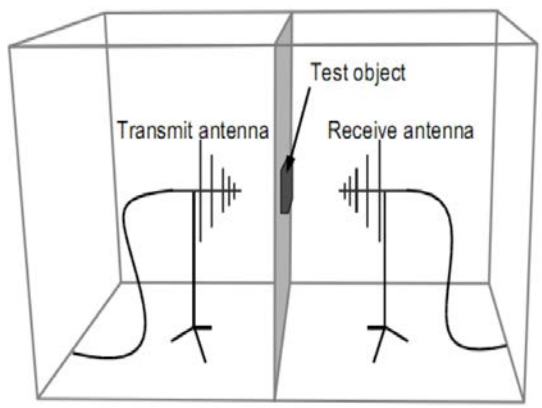

Fig 2: Shielding Effectiveness measurement according to MIL-STD-285

The Shielding effectiveness from this method can be calculated via:

Shielding Effectiveness formula

$$P(Watt) = \frac{P_1}{P_2} = \frac{No\ Shield\ Measurement\ (Watt)}{Shield\ Measurement (Watt)} \quad \textbf{(Equation 1)}$$

where $P_1 = Power\ generated\ by\ interference\ source$

and $P_2 = Power\ passing\ through\ the\ shielding\ material$

$$Shielding\ \ Effectiveness = 10 * Log_{10}(P) = 10 * Log_{10}\left(\frac{P_1}{P_2}\right) \quad \textbf{(Equation 2)}$$

$$Shielding\ \ Effectiveness\ \ Percentage = \left(100 - 10^{\left(-\frac{SE}{10}\right)}\right) \quad \textbf{(Equation 3)}$$

In this experiment, we utilized two antennas to generate and capture signals. One antenna served as the transmitter, while the other acted as the receiver. The antennas were placed inside a faraday box as seen in figure 3.

Inside the Faraday box, the antennas were positioned with the transmitter starting at a distance of 40 cm from the box's center, which is shown in figure 4. The receiver was placed perpendicular to the shield, while maintaining a fixed distance of 0 cm from the shield. We conducted the experiment by moving the transmitting antenna closer to the shield. The experiment was repeated multiple times, with the transmitter power level set at a constant 10 dBm and gradually decreasing from 10 decibel milliwatts (dBm) to -50 dBm. The dBm unit is defined as the amount of power that an antenna is able to produce or how much signal is present at a site.

To create a repeating signal for the experiment, the transmitter antenna generated a sweep alternate signal spanning from 100 MHz to 6 GHz which are the frequency range used by most of the telecommunication devices.

The experiment measures the transmitted signal in the presence and absence of a shield placed between the antennas. To facilitate this analysis, we employ Equation 1 to convert the signals from Watts (W) to decibels (dB). Additionally, Equation 2 enables us to calculate the shielding effectiveness of the shield, while Equation 3 allows for the determination of the shielding effectiveness percentage of the material being tested.

Fig 3: Outside of Faraday box

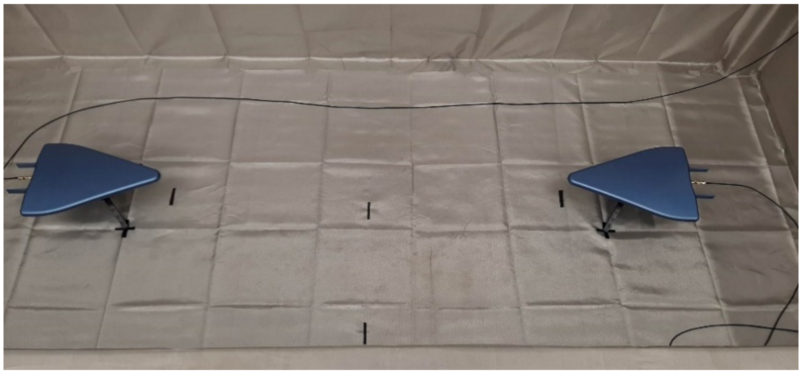

Fig 4: Receiver and transmitter antenna at 40 cm from center

In Figure 5, we can observe the experimental setup for the light blanket. Figure 6 showcases the testing of the weighted blanket. The experiments commence with the transmitter positioned 40 cm away from the shield. As the experiment progresses, we gradually move the transmitter closer to the shield being tested.

Fig 5: Light Blanket

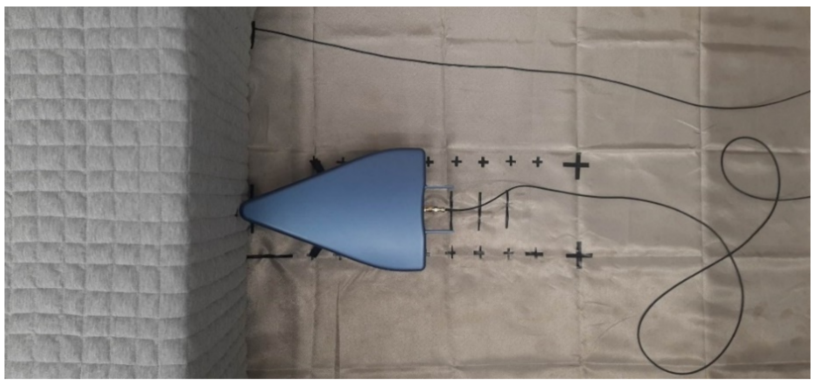

Fig 6: Weighted Blanket

This report covers three main experiments:

- Shielding effectiveness percentage vs frequency with the transmitter the same distance from the shield but different transmitter power levels
- Shielding effectiveness percentage vs frequency with the transmitter at different distances from the shield but the same transmitter power level
- Shielding effectiveness percentage vs frequency with the transmitter at different distances from the shield but the same Transmitter power level, and at different measurement placement on the shield

RESULTS

Different distance, same Transmitter Power

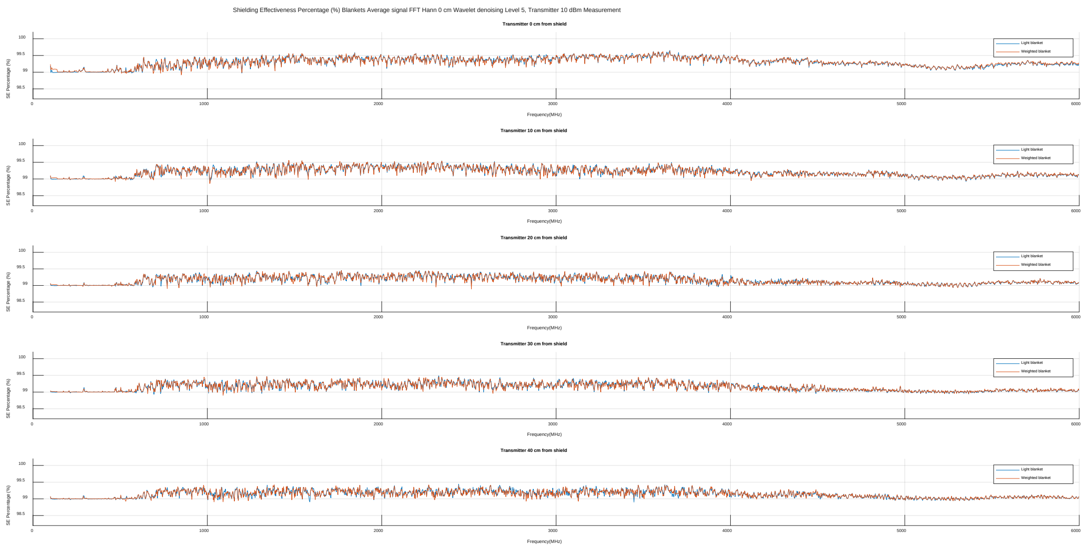

Fig 7: Shielding effectiveness of blankets, Transmitter at different distances from shield, Power 10 dBm

In Figure 7, the combined graphs display the shielding effectiveness percentage based on the initial experiment. The graphs illustrate that across the entire spectrum, at 0 cm distance and with a 10 dBm Transmitter power, both the light and weighted blankets exhibit a shielding effectiveness percentage exceeding 99%. As we progress to subsequent graphs, the shielding effectiveness percentage for both blankets decrease as the distance between the transmitter and shield increases. However, it consistently maintains close to the 99% mark. Both blankets demonstrate remarkably high shielding effectiveness and exhibit nearly identical responses. These observations lead us to conclude that both blankets perform similarly in terms of shielding effectiveness percentage at varying distances from the shield, while keeping the transmitter power constant. Hence, as the distance decreases, the signal weakens, but the shielding effectiveness remains consistently high.

Same distance, different Transmitter dBm

In Figure 8, the combined graphs display the shielding effectiveness of the blankets when the transmitter is 0 cm from the shield, while changing the transmitter power level from 10 dBm to -30 dBm. At 10 dBm, the highest signal is created from the transmitter, and the highest SE percentage is observed. As the transmitter power level is decreased, the signal weakens, and so does the shielding effectiveness percentage. Nonetheless, the percentage does not go below 99% for the whole frequency spectrum being tested. Once again, both blankets demonstrate a high percentage of shielding effectiveness at multiple transmitter power levels.

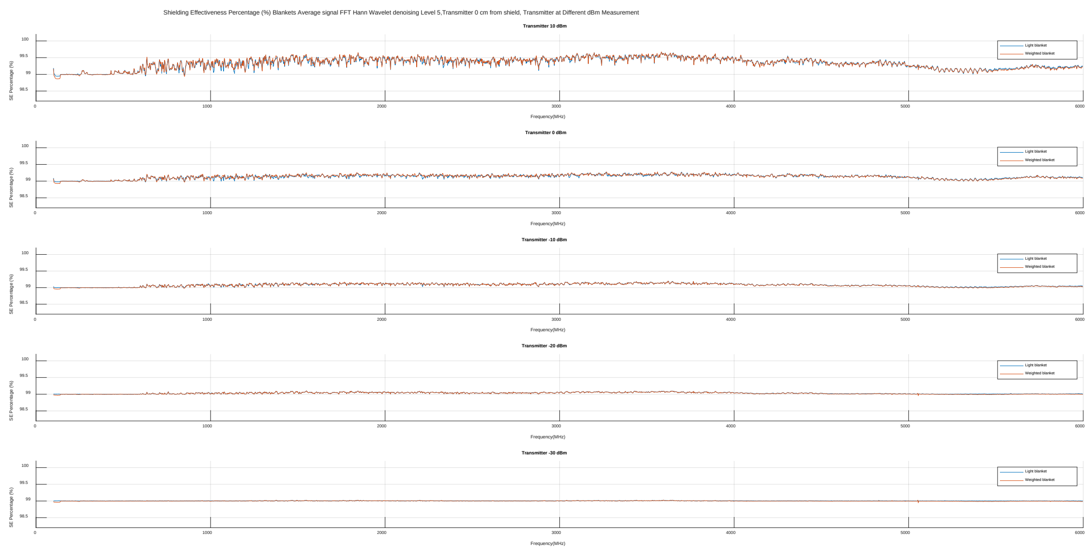

Fig 8: Shielding effectiveness of blankets, Transmitter at 0 cm from shield, Power 10 dBm

Shielding Effectiveness of Blankets at different spots

For the last experiment, a different position of the blankets was tested. This spot was 15 cm away from the original point. The experiment conducted involved starting the transmitter at 0 cm from the shield, and after each measurement, it would be placed further from the shield. The experiment went from 0 cm away from the shield, up to 40 cm, with measurements taken every 10 cm.

Similarly, to the other experiments, both blankets exhibit high shielding effectiveness percentages. The results from this experiment are very similar to the previous experiment at the original testing spot in the blankets. From this it can concluded that the blankets have high percentage of shielding effectiveness regardless of the specific point tested within the blankets.

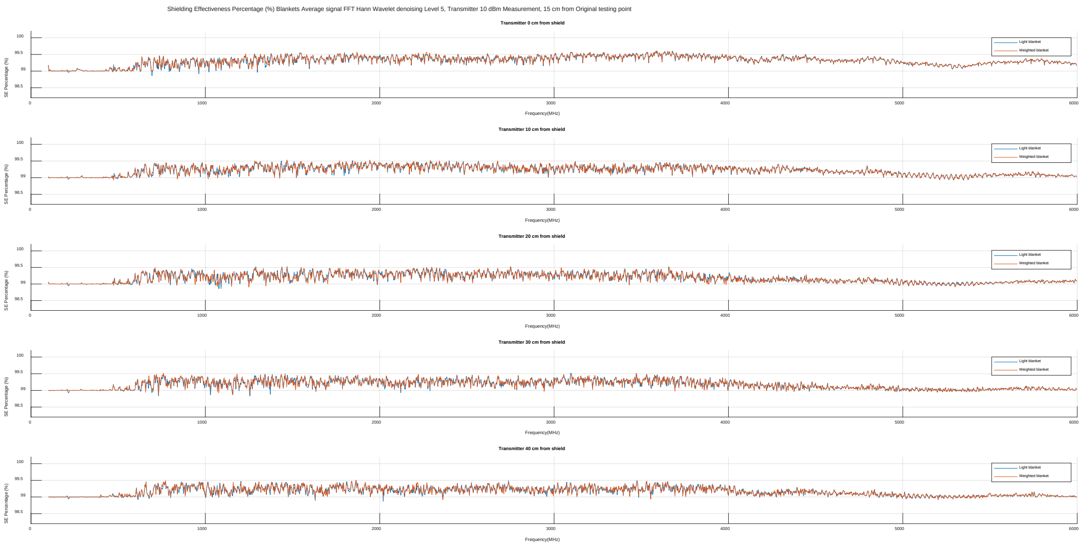

Fig 9: Shielding Effectiveness of Blankets at different distances from shield, at a spot 15 cm away from last measurement

CONCLUSION

The purpose of the study aimed at validating the shielding effectiveness of silver infused blankets manufactured by SleepGift. The use of electronic devices in our daily lives has increased exposure to electromagnetic fields (EMF). By assessing the shielding effectiveness of the blankets, this study intends to offer a non-intrusive solution to reduce EMF exposure.

As seen in Figure 7, both blankets show a shielding effectiveness percentage exceeding 99% across the entire tested frequency spectrum which is 100MHz to 6GHz. As the power of the transmitter decreases, both signal strength and shielding effectiveness percentage decrease. Nevertheless, the percentage remains above 99% for the tested frequency spectrum.

In figure 8, as the power of the transmitter decreases, both signal strength and shielding effectiveness percentage decrease. Nevertheless, the percentage remains above 99% for the tested frequency spectrum.

In figure 9, the measured results show that both blankets continue to exhibit high shielding effectiveness percentages, which in turn are similar to those observed in the original testing spot as seen in figure 7. This suggests that the blankets maintain their shielding capabilities regardless of the specific point tested within the blankets.

By conducting thorough testing and analysis, the study finds that the blankets are able to mitigate a high percentage of EMF signals over a large frequency spectrum at different distances away from the shield itself, and at different transmitter power levels. All while keeping a shielding effectiveness around 99%.