Accurate Absorber Modeling

Electromagnetic wave measurements involving very low signal levels are commonly performed in laboratory facilities that provide isolation from external electromagnetic environment.

A shielded enclosure with the entire inner surface covered with wave absorber materials to create a non-reflecting environment equivalent to free space is known as anechoic chamber. Different types of absorber elements are widely used: pyramidal absorbers, wedge absorbers, hollow pyramidal absorbers, ferrite tiles, hybrid absorbers, layered block absorbers, flat sheet absorbers, rubber absorbers and etc.

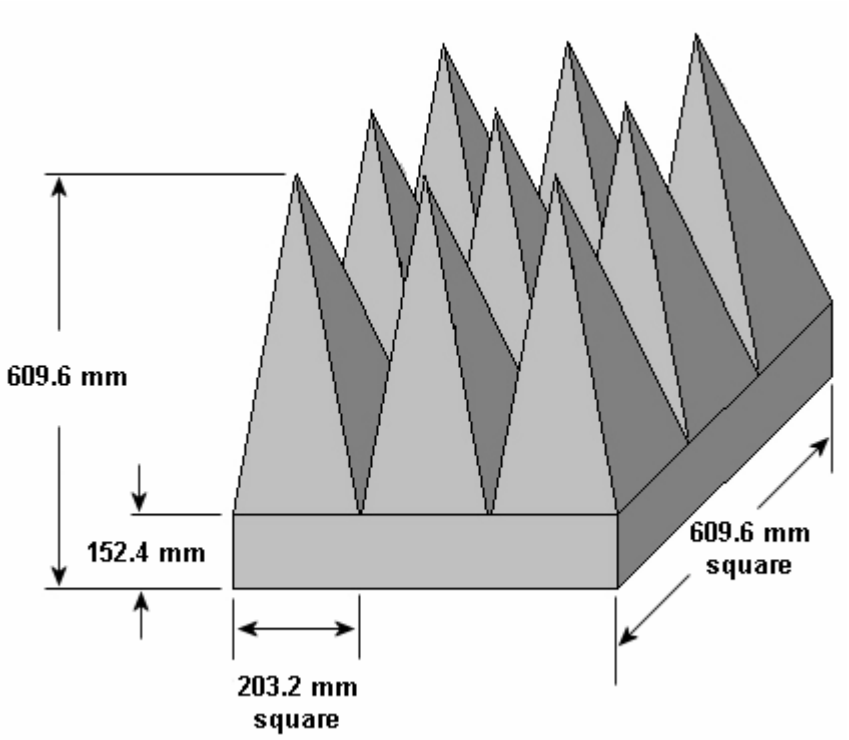

Fig. 1. Pyramidal absorber model

Calculations of the interference field in an anechoic chamber are often inaccurate due to the lack of a proper model to characterize the scattering from the absorber element. Manufacturers usually specify only the reflectivity at normal incident due to measurement limitations, while in actual fact the reflectivity of the absorber may deteriorate with incident angle change. The

accurate analysis of the absorber performances can be done using Method of Moments model, where different materials and absorber shapes can be analyzed.

Problem definition

Model of the absorber array with dimensions 4.27 m x 4.27 m x 0.6 m is considered. Dimensions of absorber elements are shown in Fig. 1

At high frequencies (400MHz - 1000MHz) the attenuation characteristics of urethane absorber are examined. For calculation of the absorber attenuation parameters two horn antennas are used. The computational model and positioning of antennas in case of normal and oblique angles of incident field are shown below.

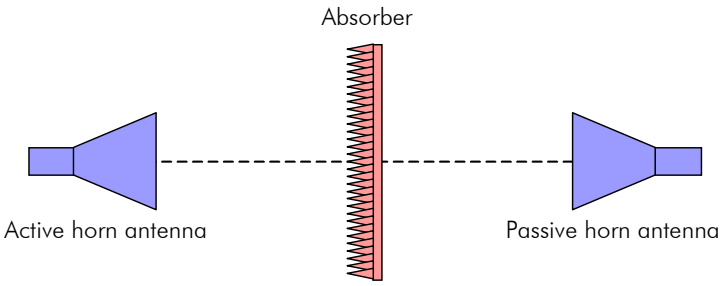

Fig. 2. Normal angle of incident field

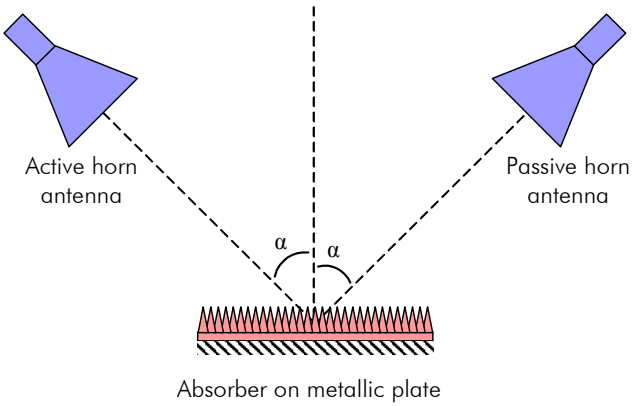

Fig. 3. Oblique angle of incident field

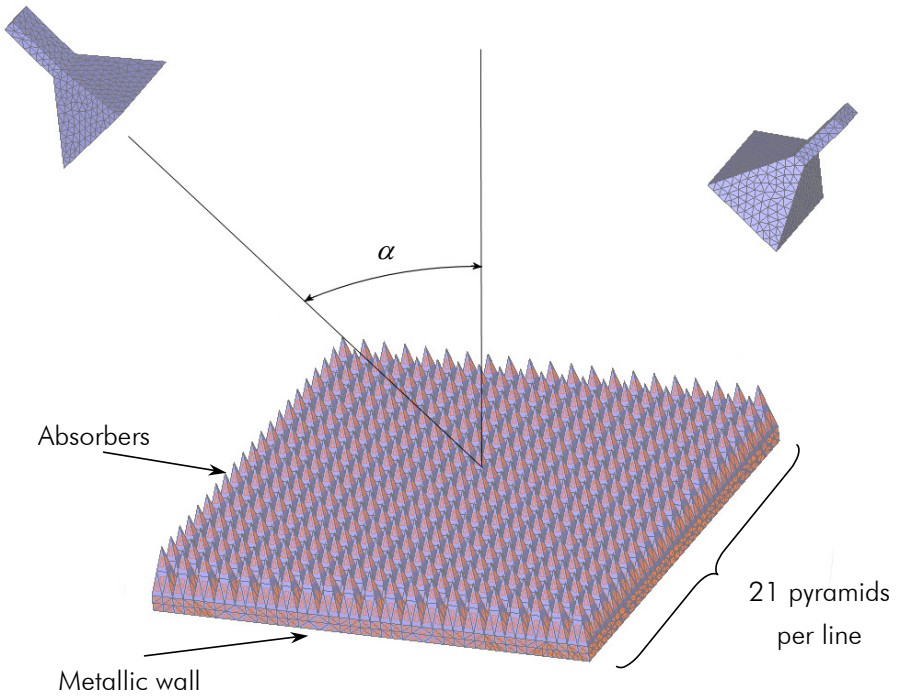

Fig. 4. 3D view of computational model

Absorbers are modeled using Surface Integral approach ('Dielectric' element in GUI). Urethane material is used for analysis. Parameters of current material are obtained from [1].

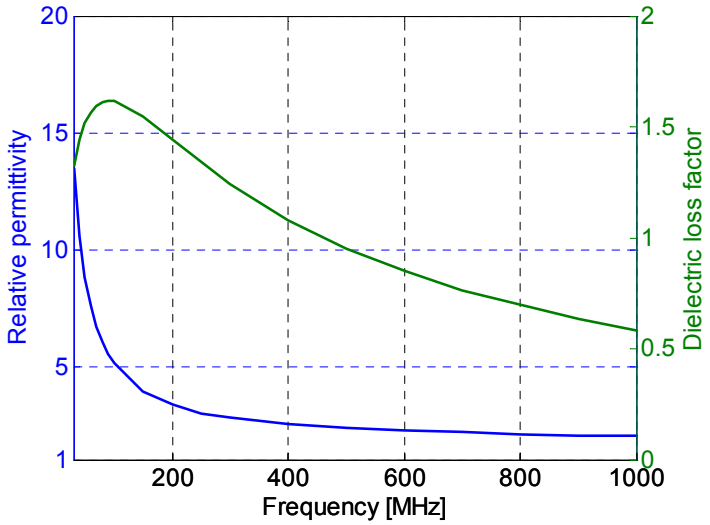

Fig. 5. Urethane material parameters

The signal reflected from absorbed wall was estimated. The comparison of the signals received by passive antenna with and without absorber is performed. Four incident field angles are considered: 0°, 30°, 45° and 60°.

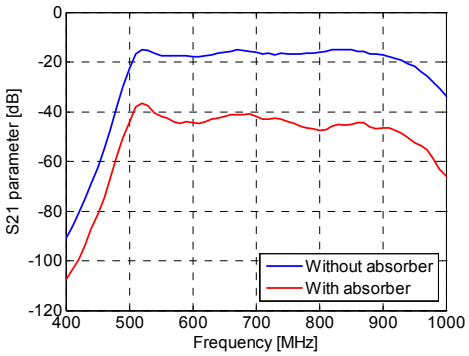

Fig. 6. Incident field at $\alpha = 0°$

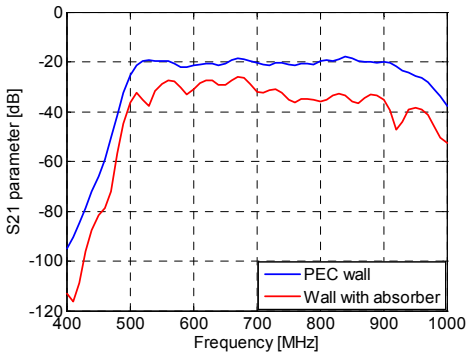

Fig. 7. Incident field at $\alpha = 30°$

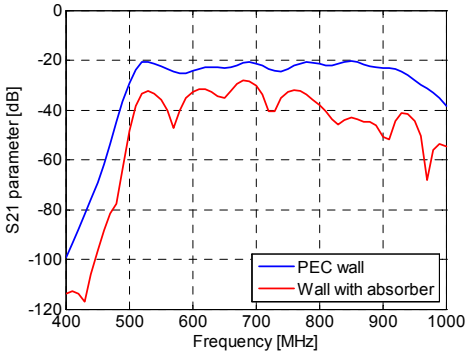

Fig. 8. Incident field at $\alpha = 45°$

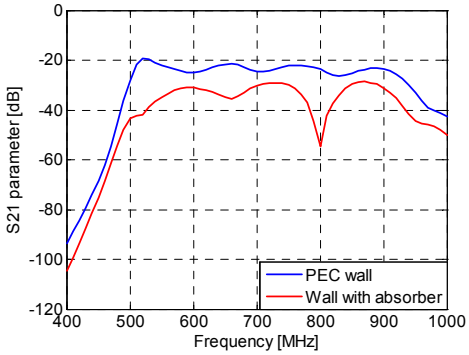

Fig. 9. Incident field at $\alpha = 60°$

Fields reflected from absorbing and perfectly conducting walls are compared for frequency 700MHz.

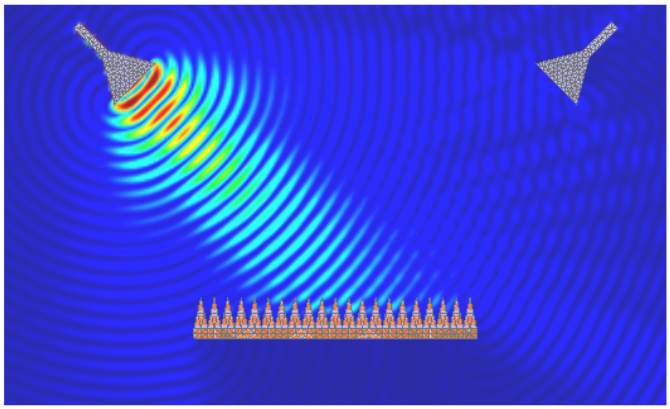

Fig. 10. Electric field reflected from absorber wall (45 degree incident field)

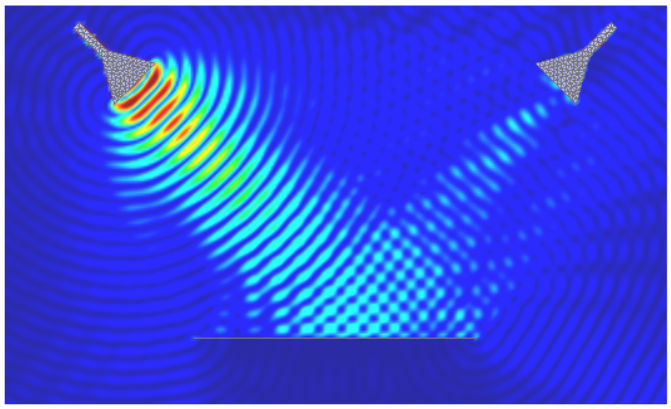

Fig. 11. Electric field reflected from perfectly conducting wall (45 degree incident field)

Using obtained data attenuation factor of the urethane absorbers was calculated by following formula.

$$Attenuation[dB] = S_{21}^{without\ absorber}[dB] - S_{21}^{with\ absorber}[dB]$$

Obtained attenuation characteristics are shown below.

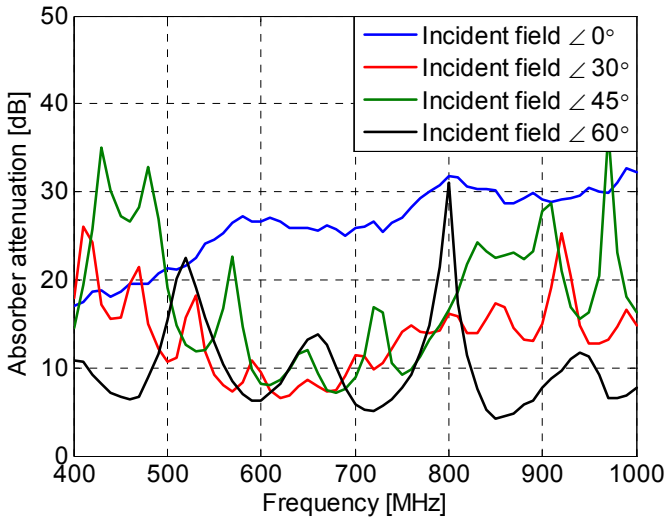

Fig. 12. Absorber attenuation

From figures it can be seen that attenuation of absorber elements highly depends on incident field angle.

Conclusions

The high frequency characteristics of the absorber can be easily analyzed within EMC Studio.

References

[1] Christopher L. Holloway, Robert F. German, Paul McKenna, Motohisa Kanda 'Comparison of Electromagnetic Absorber Used in Anechoic and Semi-Anechoic Chambers for Emissions and Immunity Testing of Digital Devices', IEEE TRANSACTIONS ON ELECTROMAGNETIC COMPATIBILITY, VOL. 39, NO. 1, FEBRUARY 1997