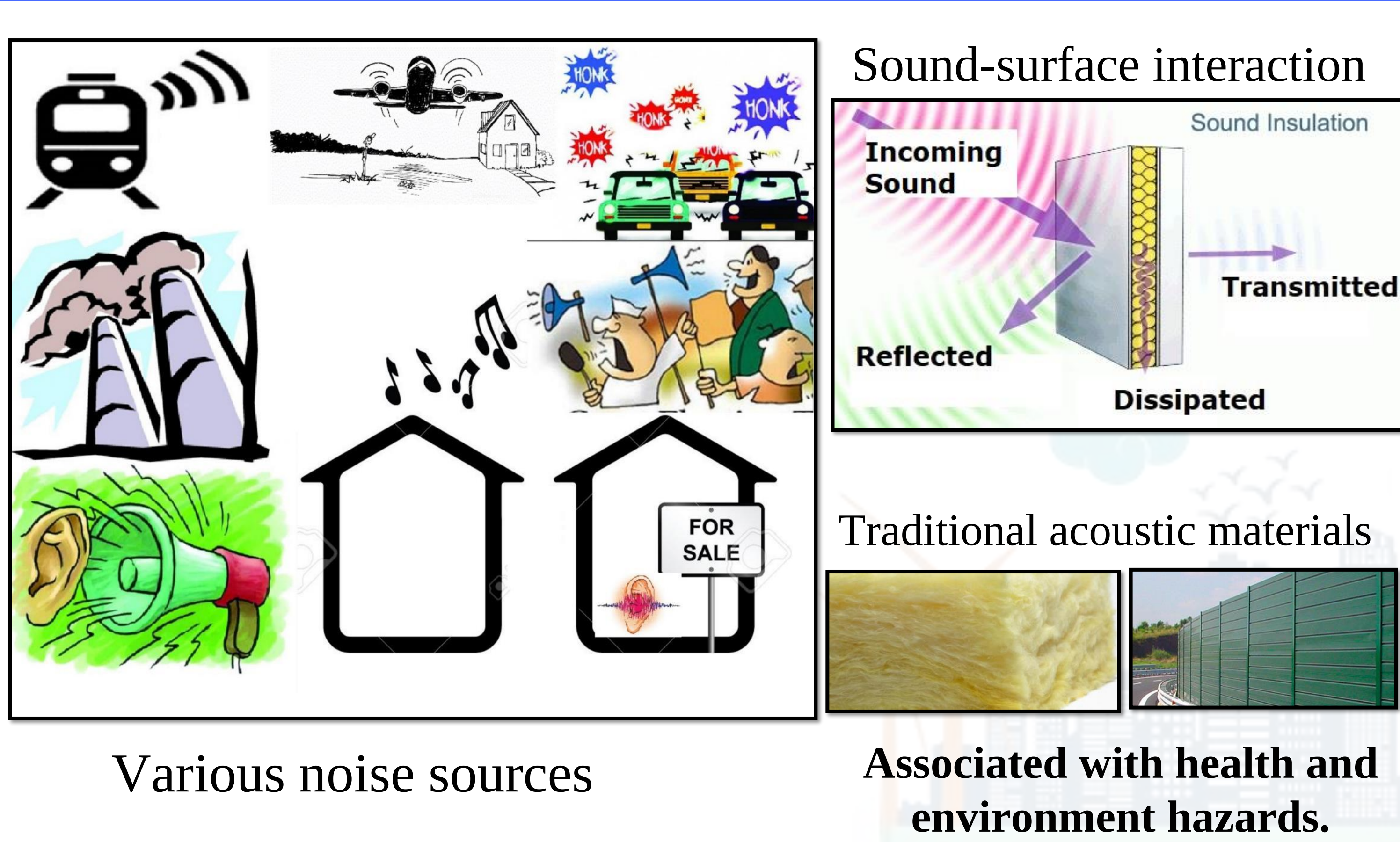


Sustainable Environment Friendly Materials for Noise Control Application

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1. Motivation



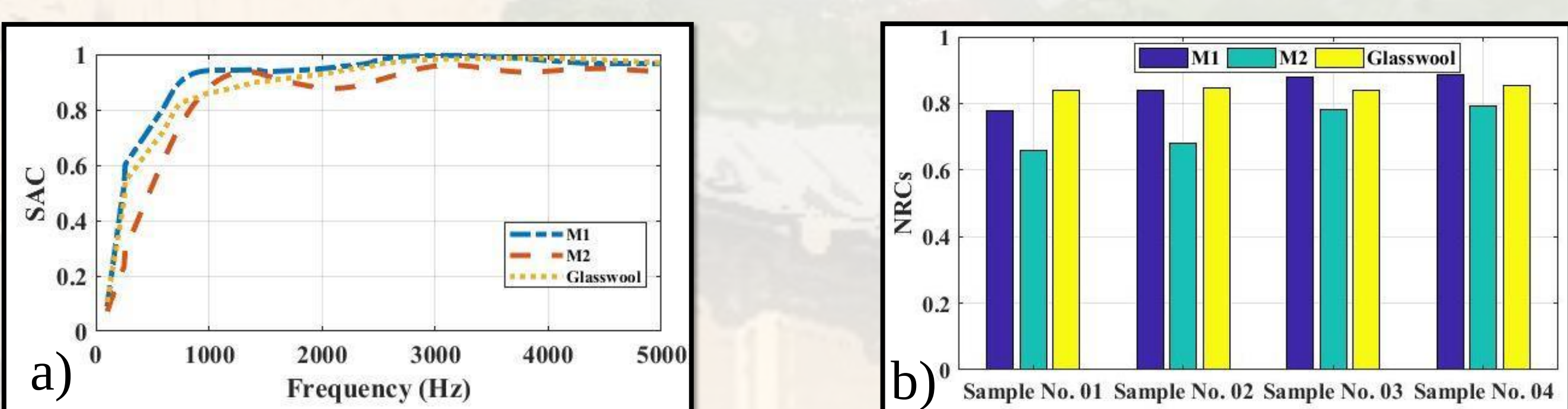
2. Task statement

To reduce the carbon foot print of synthetic acoustic materials by exploring nature materials for their acoustical behaviour.

3. Some materials tested in literature:



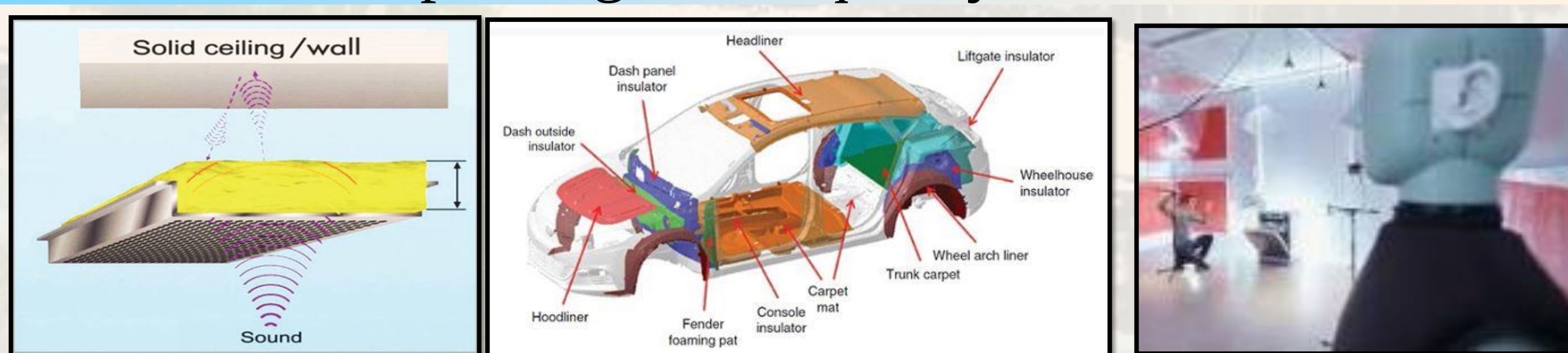
8. Results obtained



Comparison of natural materials with commercial glasswool.
a) Sound absorption spectrum b) Noise reduction coefficients

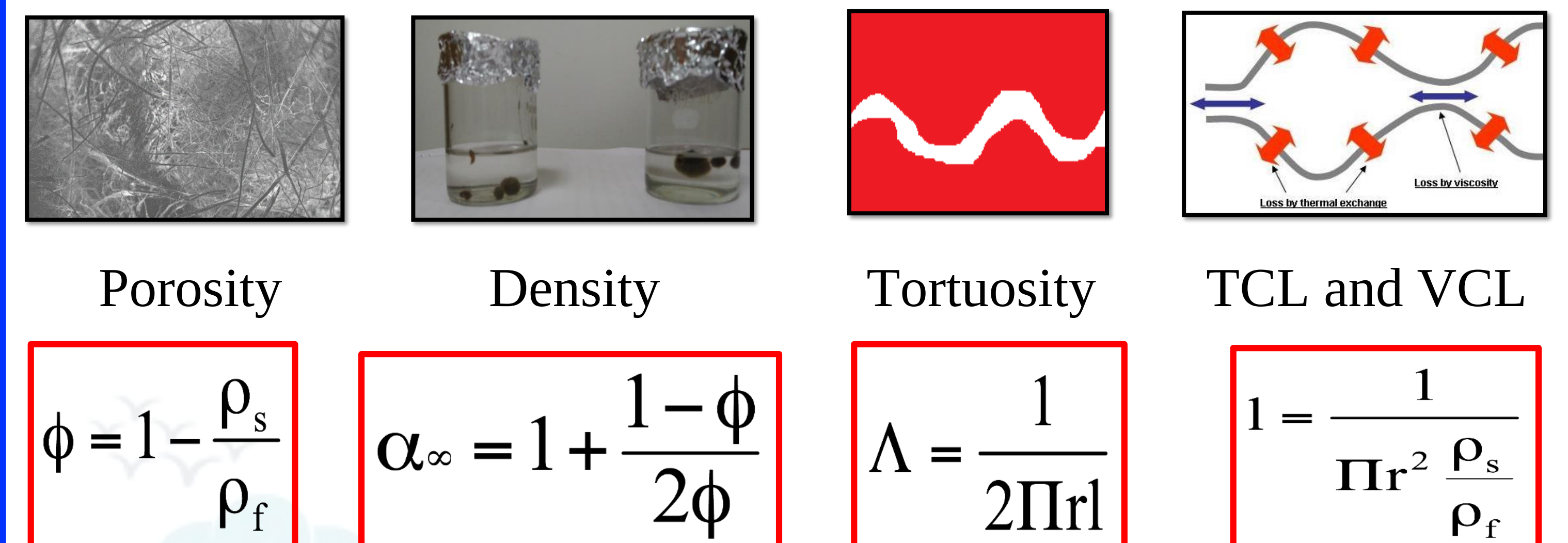
9. Industrial significance

- Suitable for applications in automotive noise control, use in buildings as sound absorbers.
- Suitable for improving sound quality.



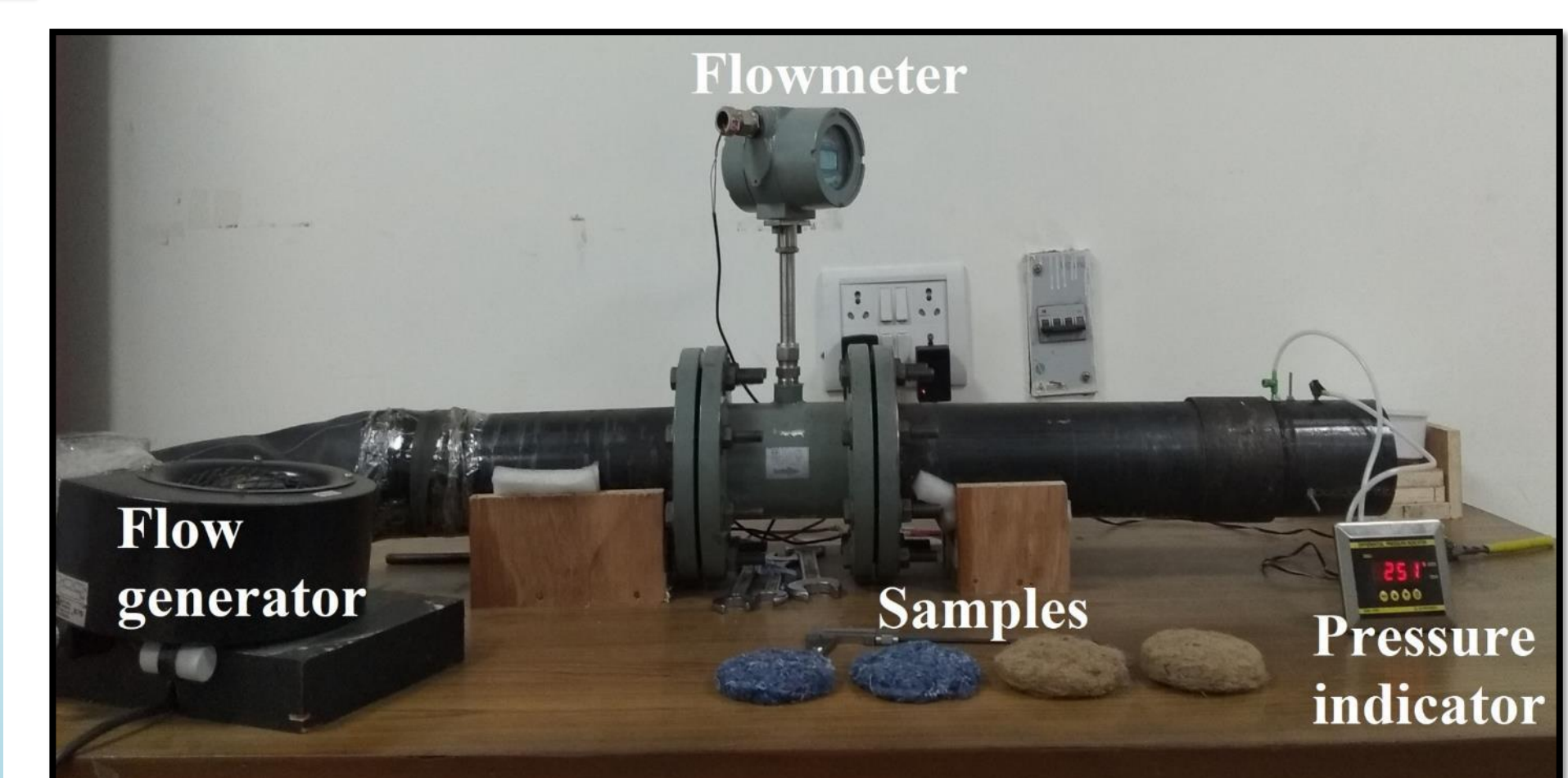
Technology Readiness Level: Ready at laboratory level.

4. Acoustical characterization



5. Airflow Resistivity

- Used to predict the acoustical performance by using mathematical models.
- Ratio of the static pressure difference (P) to the product of the velocity (V) and the thickness (t) of the porous sample.



Airflow resistivity setup

$$\sigma = \frac{\Delta P A}{Q_v d}$$

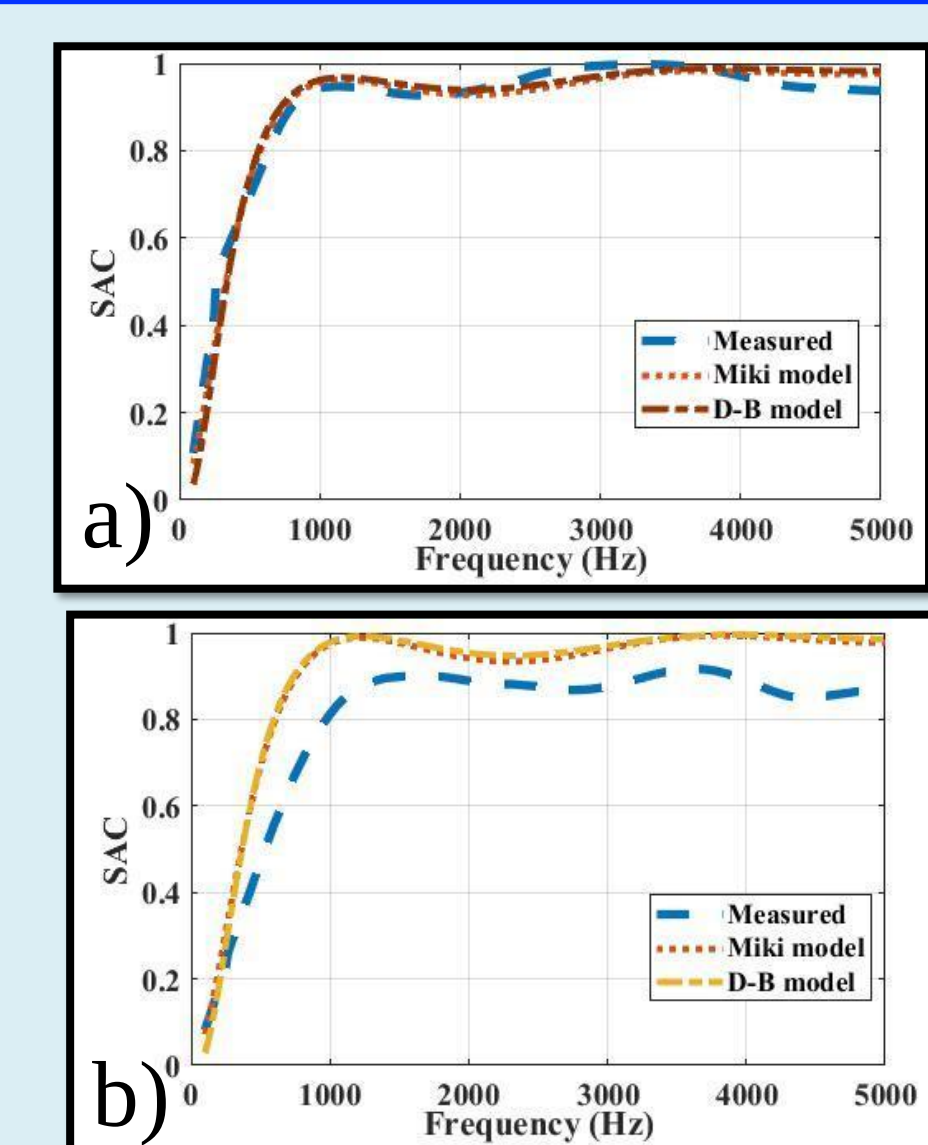
6. Mathematical Models

$$Z_c = Z_0 \left\{ 1 + a \left(\frac{f}{\sigma} \right)^b - j c \left(\frac{f}{\sigma} \right)^d \right\}$$

$$\gamma = \frac{2\pi f}{C_0} \left\{ e \left(\frac{f}{\sigma} \right)^g + j \left(1 + i \left(\frac{f}{\sigma} \right)^k \right) \right\}$$

$$Z_s = Z_c \coth(\gamma l)$$

$$\alpha = 1 - \left| \frac{Z_s - \rho_0 C_0}{Z_s + \rho_0 C_0} \right|^2$$



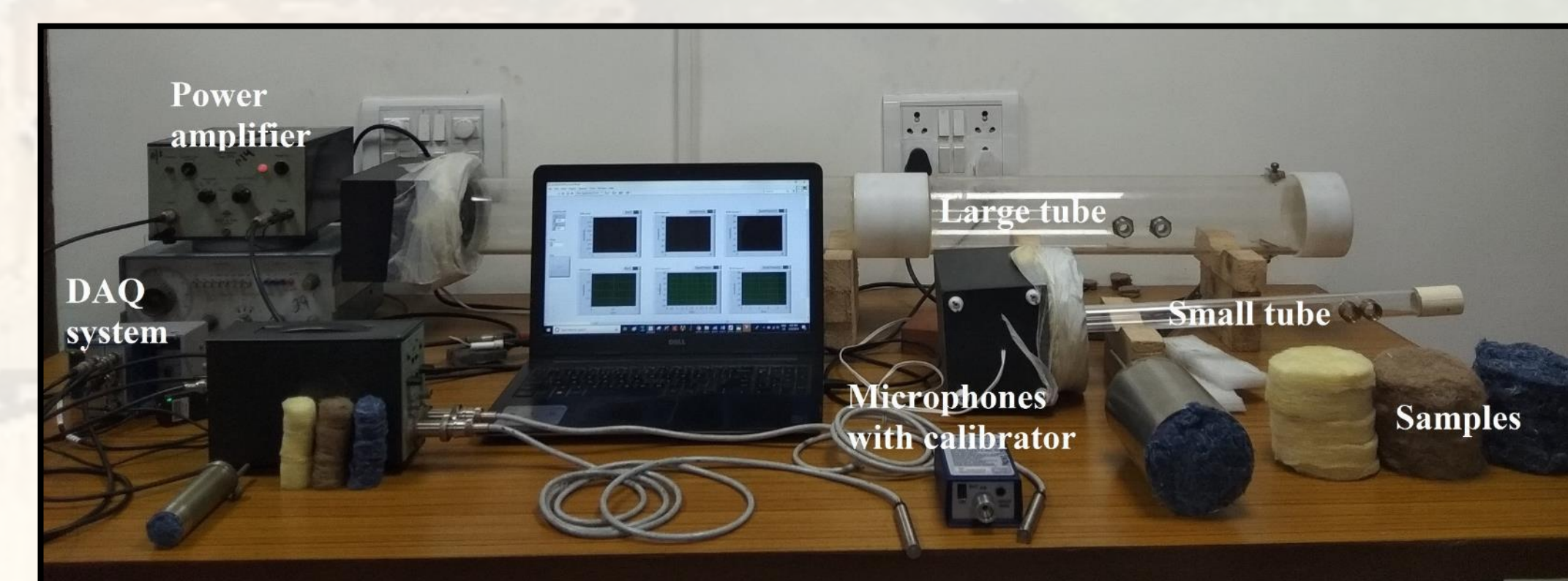
Comparison of measured results with predicted results.

7. Measurement of Sound absorption

An impedance tube measures the sound absorption as per ASTM E-1050, by measuring the transfer function.

$$R = \frac{H - e^{-jks}}{e^{jks} - H} e^{j2k(l+s)}$$

$$\alpha = 1 - R^2$$



References

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- M. Raj, S. Fatima, N. Tandon, "Acoustical properties of recycled material", 48th International Congress and Exhibition on Noise Control Engineering held at Madrid (Spain), 16-19 June 2019.
- M. Raj, S. Fatima, N. Tandon, "Development of an economical set up to measure sound absorption coefficient of materials", 13th Western Pacific Conference on Acoustics (WESPAC-2018) held at CSIR-NPL, New Delhi, India from 11 - 15 November 2018.

Acknowledgement:

