

EXPERIMENTAL TESTING AND DATA ANALYSIS BETWEEN ACOUSTIC PROPERTIES AND CURRENT FREQUENCY OF FERRITE

Chuantao Li

School of Science, China University of Geosciences, Beijing 100083, P. R. China

Abstract

In this paper, the experimental test between ferrite vocal characteristics and current frequency is mainly carried out, and the experimental data are statistically analyzed.

Keywords: ferrite, acoustic properties, current frequency, data analysis.

1. Introduction

Ferrite is a ferromagnetic complex oxide composed of iron and one or more other metals [1], [2]. Ferrite has excellent properties, it can undergo magnetostriction in alternating magnetic fields, and can also have high

*Corresponding author.

E-mail address: lct78@cugb.edu.cn (Chuantao Li).

Copyright © 2025 Scientific Advances Publishers

2020 Mathematics Subject Classification: 05C78.

Submitted by Jianqiang Gao.

Received November 10, 2025

This work is licensed under the Creative Commons Attribution International License (CC BY 3.0).

http://creativecommons.org/licenses/by/3.0/deed.en_US

permeability, high resistivity, and low loss at high frequencies, all of which are current research hotspots. It is well known that we can change the strength and frequency of the magnetic field by changing the output voltage, current, and number of turns of the energized solenoid. For infinitely long-carrying copper coils, the magnitude of their internal magnetic field can be known by Biot-Savart's law

$$B = B_0 \sin(\omega t + \varphi) = \mu_0 n l_0 \sin(\omega t + \varphi), \quad (1)$$

where B is the magnetic field strength inside the copper coil; B_0 is the initial magnetic induction strength; ω is the angular velocity of the current change; φ is the initial phase of the current variation; μ_0 is the vacuum permeability; n is the number of turns of the coil; l_0 is the initial strength of the AC current in the copper coil; t is the time.

According to (1), an alternating magnetic field will be generated in a copper coil with alternating current, and the magnetic field frequency is the same as the current frequency. Changing the number of turns and output voltage of the coil can change the magnetic induction strength in the copper coil.

In this paper, the experiments between the sound characteristics and current frequency of ferrite materials are mainly carried out, and the experimental data are analyzed, and the effect of applied current frequency on the sound loudness of ferrite is mainly discussed.

2. Experimental Results and Data Analysis

In order to obtain the correlation factors of ferrite vocal characteristics at different output voltages, we can construct a correlation analysis model between ferrite loudness and current frequency according to different ferrite types by control variable method (1).

In the experimental process, the other factors affecting the soundness of manganese-zinc ferrite ferrite and nickel-zinc ferrite are controlled unchanged, and only the current frequency is changed, and the changes in the soundness of the two types of ferrite under different current frequencies can be obtained.

Combined with the experimental data, the relationship between the sound loudness and current frequency of the two types of ferrite is obtained respectively, as shown in Table 1, and the corresponding visualization results are shown in Figure 1 and Figure 2.

Combined with the statistical analysis of experimental data, Figure 1 shows the change trend of the vocal loudness of manganese-zinc ferrite with the increase of current frequency. Figure 2 shows that the sound loudness of nickel-zinc ferrite increases with the increase of current frequency, which is consistent with the calculation results of the correlation coefficient in Table 1.

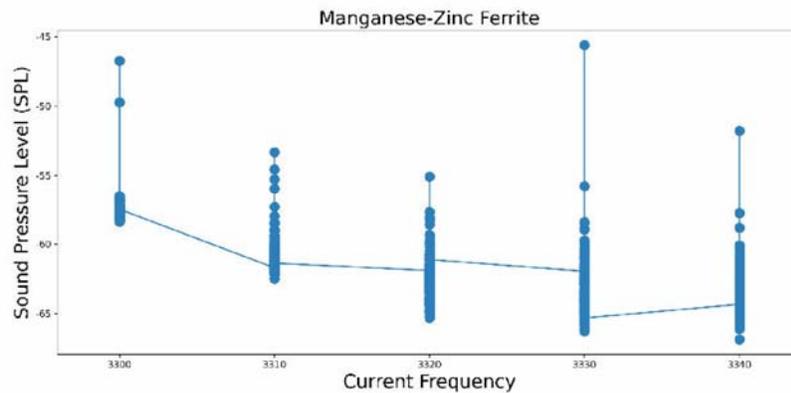


Figure 1. Relationship between current frequency and sound pressure level of Mg-Zn ferrite.

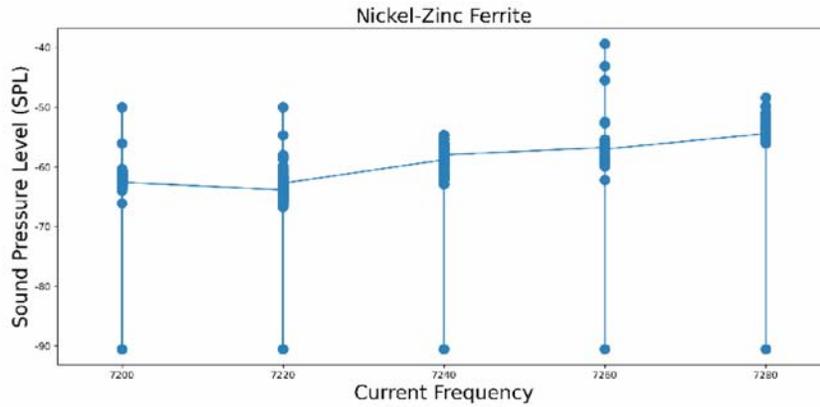


Figure 2. Relationship between current frequency and sound pressure level of Ni-Zn ferrite.

Furthermore, combined with statistical knowledge, it can be seen from Table 1 that the correlation coefficient between the current frequency and the sound frequency of manganese-zinc ferrite is -0.7072 , and its corresponding p value is far less than 0.05 , which indicates that the calculation result is significant, and the sound loudness of manganese-zinc ferrite shows a significant negative correlation with current frequency. The correlation coefficient between the sound loudness and current frequency of nickel-zinc ferrite is 0.7136 , which corresponds p value is much less than 0.05 , rejecting the null hypothesis, which proves that there is a significant positive correlation between the sound loudness and the current frequency of nickel-zinc ferrite.

Table 1. Correlation analysis results between current frequency and vocal loudness

Two Materials	Correlation Coefficient r	p -value
Manganese-Zinc Ferrite	-0.7072	3.978×10^{-135}
Nickel-Zinc Ferrite	0.7136	3.593×10^{-157}

Acknowledgements

This work is supported by 2025 Special Projects for Graduate Education and Tea China Reform from China University of Geosciences, Beijing (Grant No. JG2025031).

References

- [1] Z. J. Chen, Z. Y. Fu, H. Wang et al., Research progress in ferrite materials, *Ceramics Science and Art* 37(3) (2003), 31-35.
- [2] M. B. Tian, *Magnetic Materials*, Beijing: Tsinghua University Press, 2001.

