Development of Paint-type and Spray-type Electromagnetic Wave Absorbers

Jae-Man Song[1] · Dong-Il Kim[2] · Jeung-Hyun Choi[2] · Jae-Hyun Jeung[2] · Ki-Man Kim[2]

Abstract

Sometimes, it is more convenient to use paint-type and spray-type EM wave absorbers than bulk-type or sheet-type. Thus, in this paper, we prepared paint-type and spry-type EM wave absorbers. The proportion of ferrites to paints, particle size of magnetic material, and kinds of paint should be considered to prepare a superior paint-type EM wave absorber. There is no big gap between spray-type and paint-type in EM wave absorption of EM wave absorbers prepared with same composition.

Key words : Paint-type EM Wave Absorber, Spray-type EM Wave Absorber, Reflectivity, Enamel Paint, Epoxy Paint, Urethane Paint, Wet Paint.

Ⅰ. Introduction

EM(Electromagnetic) wave absorbers are used to protect EM machines, such as personal communication and wireless LAN systems, from unwanted EM wave radiation.

A lot of researchers have designed EM wave absorbers to get superior EM wave absorption. When we design EM wave absorbers, the type of EM wave absorbers have to be considered, because their type could decide uses. Already, we prepared bulk-type and sheet-type EM wave absorbers and reported their EM wave absorption[1]~[4]. Generally, bulk-type EM wave absorbers are used in large band-width, but their thickness is very thicker than paint-type and spray-type EM wave absorbers.

Sometimes, it is more convenient to use paint-type and spray-type EM wave absorbers than bulk-type or sheet-type. However, research efforts on paint-type and spray-type EM wave absorbers have not been enough. Thus, it is worthwhile to study paint-type and spray-type EM wave absorbers. In this paper, we prepared paint-type and spray-type EM wave absorbers, and report their EM wave absorption. It is a technical report to show EM wave absorption of paint-type and spray-type EM wave absorbers.

Ⅱ. Sample Preparation and Measurements

We used Mn-Zn, Ba, Sr ferrites, and sendusts as magnetic materials, and enamel, epoxy, urethane, wet paints as binders. To prepare paint-type EM wave absorbers, we pulverized the magnetic materials with a vibration and mixed the pulverized powders in binders with a hand mixer. To prepare spray-type EM wave absorbers, we compressed the paint-type EM wave absorbers in a tank with a compressor. Thinner was added to increase dispersion.

For the investigation of the EM wave absorption properties, the prepared paint-type and spray-type EM wave absorbers were punched into a toroidal shape with an inner diameter of 3.05 mm and an outer diameter of 6.95 mm. The absorption properties of the samples were investigated with a HP-8753D network analyzer. Fig. 1 and 2 are diagrams of the measurement system used for the reflection coefficient and the sample holder, respectively.

Ⅲ. Results and Discussion

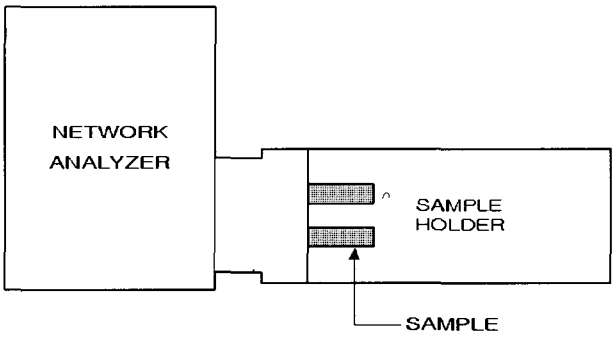

Fig. 1. Measurement system for the reflectivity.

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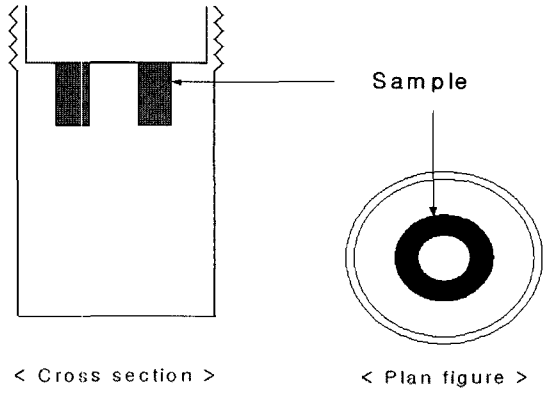

Fig. 2. Sample holder.

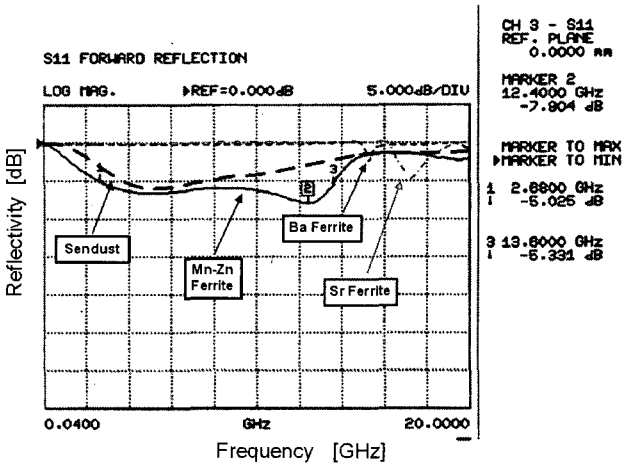

Fig. 3. Reflectivity as a function of frequency for EM wave absorbers with 2 mm thickness prepared with various magnets.

Mn-Zn, Ba, and Sr ferrites are useful materials as EM wave absorbers because of their high magnetic loss which contributes to the EM wave absorption[1]~[6]. A sendust is a useful material as EM wave absorbers, which is suggested by our previous research, and its EM wave absorption in sheet-type was investigated[7].

We prepared paint-type EM wave absorbers to mix Mn-Zn, Ba, Sr ferrites, and sendusts with enamel paints, and show their EM wave absorption as a function of frequency in Fig. 3. Ba and Sr ferrite EM wave absorbers do not show absorption in the examined frequency. Sugimoto et. al. reported that the natural resonance of Ba decreased from 48 GHz to 8 GHz with increasing TiMn[5]. They found the absorption peak at 6 GHz in a sheet-type Ba ferrite EM wave absorber composed with $BaFe_{7.5}(Ti_{0.5}Mn_{0.5})_{4.5}O_{19}$. This means that Ba ferrites without any additives show their absorption peak in very high frequency. Our result consists with their result. In Fig. 3, paint-type EM wave absorbers prepared with sendusts and Mn-Zn ferrites show their EM wave absorption in frequency 2~13 GHz, which almost consist with one of sheet-type EM wave absorbers[4],[7]. From the above results, we can conclude that there is no big gap in EM wave absorption between sheet-type and paint-type EM wave absorbers.

In Fig. 3, a Mn-Zn ferrite EM wave absorber show better absorption than the others. Thus, we investigated more carefully about Mn-Zn ferrite EM wave absorbers. Fig. 4 shows reflectivity as a function of frequency for EM wave absorbers prepares with various proportion of Mn-Zn ferrites to enamel paints. In Fig. 4, the absorption peak in a central frequency and the central frequency increase with increasing enamel paint content. This means that we have to consider proportion of ferrites to paints to get a superior paint-type EM wave absorber.

Generally, wet paint is used for inside wall of room

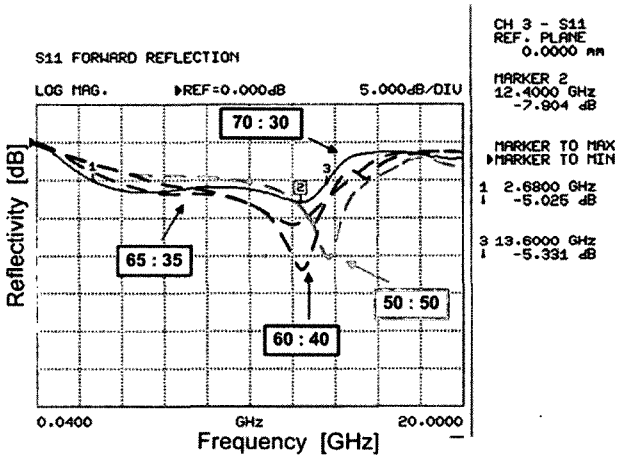

Fig. 4. Reflectivity as a function of frequency for Mn-Zn ferrite EM wave absorbers with 2 mm thickness prepared with different enamel paint contents.

because of environmentally friendly products. Urethane, epoxy, and enamel paints are painted on steel and woods. Thus, when we prepare an EM wave absorber, a paint has to be selected to be fit for the purpose.

EM wave absorption of Mn-Zn ferrite EM wave absorbers prepared with various paints was investigated, and is shown in Fig. 5. From Fig. 5, we could conclude that an appropriate paint should be chosen to prepare a superior paint-type EM wave absorber.

To prepare a paint-type EM wave absorber, we pulverized bulk-type magnet. At this time, we control pulverization time to get different average particle size of magnet powders. Fig. 6 shows the reflectivity as a function of frequency for Mn-Zn ferrite EM wave absorbers with various particle size. As we show in Fig. 6,

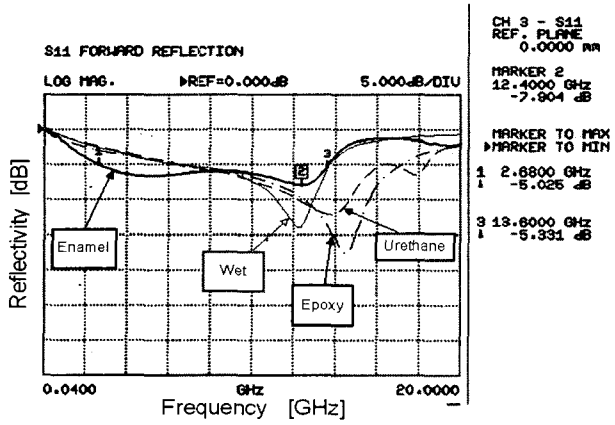

Fig. 5. Reflectivity as a function of frequency for Mn-Zn ferrite EM wave absorbers with 2 mm thickness prepared with various pains.

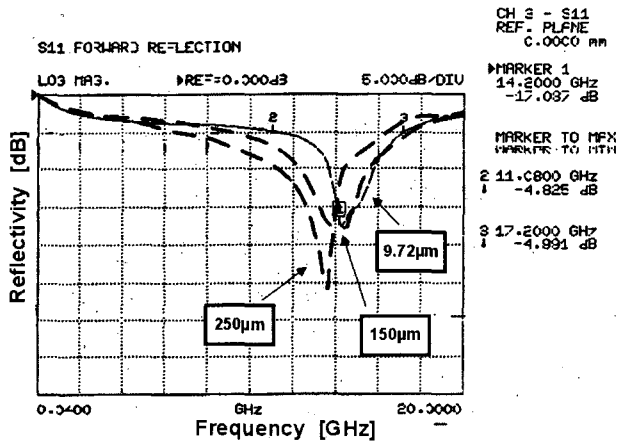

Fig. 6. Reflectivity as a function of frequency for Mn-Zn ferrite EM wave absorbers with various particle size.

the reflectivity depends on the ferrite particle size. In our previous research[1], we reported that central frequency shifts toward lower frequency with increasing average particle size in sheet-type Mn-Zn ferrite EM wave absorbers, which consists with the result of paint-type EM wave absorbers. And it consists with the report of Rusan et al. for Ba ferrites[8]. We explained why the central frequency shifts with average particle size in the pervious research[1]. From the above results, we could control the central frequency by varying particle size of magnet powders. Thus, we have to consider particle size of magnets to prepare superior paint-type EM wave absorbers.

For the convenience, sometimes we need spray-type EM wave absorbers. Thus we prepared spray-type EM wave absorbers and compared EM wave absorption with a paint-type. From Fig. 7, we can confirm that there is

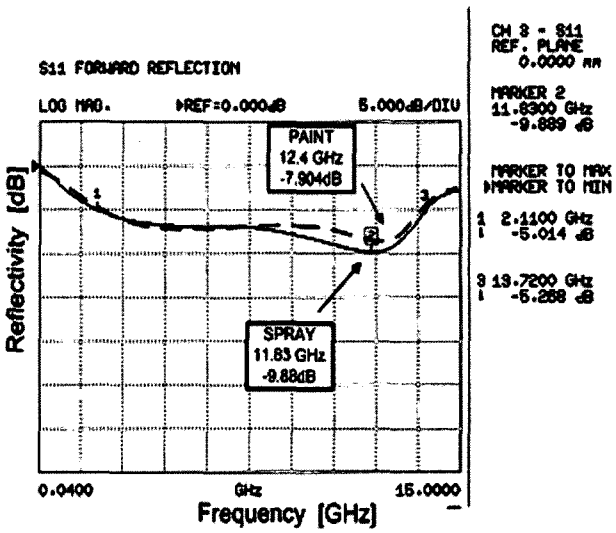

Fig. 7. Comparison of reflectivity between paint-type and spray-type for Mn-Zn ferrite EM wave absorbers with 2 mm thickness.

no big gap between paint-type and spray-type in reflectivity. Thus, we concluded that we can use both-type for convenience.

Ⅳ. Conclusions

We prepared pain-type and spray-type EM wave absorbers. EM wave absorption of paint-type EM wave absorbers prepared with several magnetic materials and paints were investigated.

Mn-Zn ferrite EM wave absorbers show better absorption than the others. The proportion of ferrites to paints, particle size of magnetic material, and kinds of paint should be considered to prepare a superior paint-type EM wave absorber. There is no big gap between spray-type and paint-type in EM wave absorp- tion of EM wave absorbers prepared with same composition.

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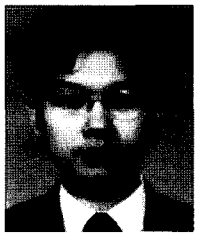

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