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Research area:
Paper, paperboard and board // Technical specialty papers

Keywords:
Electromagnetic shielding, dispersing, coating, barium hexaferrite powder

Title:

Development of an optimised method for preparing special pigment slurries and subsequent coating of paper to provide electromagnetic shielding in the high-frequency range.

Background/Problem area

High-frequency electromagnetic fields in the microwave range always exist at different intensities and frequencies in our environment as a consequence of necessary communication technology, measurement techniques and the unavoidable radiation of microwave technologies. All biological systems are exposed to these fields. Furthermore, the wide use of electronics for the efficient operation of industrial processes, medical technology, office technology, motor vehicles and even household appliances has increased significantly. Electronic circuits consist of components whose electromagnetic compatibility increases greatly with increasing performance and miniaturisation and which themselves radiate high-frequency power as a result of high data transfer and/or switching frequencies. Suitable shielding materials are necessary to limit the immissions of high-frequency electromagnetic fields onto biological systems on the one hand and to guarantee a reliable functionality of the electronic circuits on the other hand. Available shielding materials include wire mesh, metal pigmented varnishes, conductive adhesive tapes, noble metal coated foils and metallic coated shielding wallpapers and others. But the electromagnetic fields continue to exist even if these shielding materials are used. New reflections and interferences are even created as the shielding generally consists of electrically conductive materials and is thus based on attenuation of reflection. Furthermore, the electrical conductive shielding materials must always be earthed when used to line rooms, plants and devices for safety purposes due to potential equalisation and/or to offer contact protection.

Objective/Research results

The objective of this research project is to develop an optimised procedure for producing a specialty paper which is able to attenuate high-frequency electromagnetic radiation, primarily in the range from 1 GHz to 10 GHz. TU Ilmenau developed different modified and doped nanoscaled barium hexaferrite (BHF) powder. First they focused on improving the deagglomeration behaviour during (in-situ: replacing B_2O_3 by SiO_2) and after (ex-situ: hybridisation with SiO_2) pigment synthesis to prevent the primary particles from agglomerating. Further on TU Ilmenau developed CoTi-doped BHF powder to enhance the electromagnetic absorption properties. These steps were escorted by measuring the electromagnetic properties of the developed BHF particles. At TU Ilmenau further developments of doped BHF powders are carried out using other doping material combinations like MnTi, ZnTi, ZnRu. At PTS several dispersants, dispersers and dispersing processes were studied to optimise the deagglomeration/separation of the BHF particle. The best deagglomeration results were achieved using a cationic starch as dispersant and a ball mill as disperser. The produced dispersions were examined (viscosity, sedimentation behaviour) then applied on a base paper with regard to optimised coating process parameters. Pictures of the paper surface were taken by means of SEM to evaluate the separation of the BHF particle. Coated paper sample have been produced for the firsts tests to measure the absorption rate of the paper sample for high-frequency electromagnetic radiation. At present these absorption tests are carried out.

Application/Economic benefits

In contrast to the technical realisation of the past, it will be possible to provide electromagnetic shielding in the high-freuquency range (>1GHz) by absorption. Hence, this will reduce the intensity of the immission of electromagnetic radiation on human beings, other biological systems and on electronic components. Furthermore, it is expected that multipath effects will not occur in rooms, plants and devices which are fitted with such papers. This will result in better and safer WLAN transmission. Surfaces fitted with this material do not have to be earthed anymore. The innovative approach is also that the research project makes it possible to produce specialty papers and a new material as a coating pigment using van-der-Waals and magnetic attraction. The use of this innovative, highly effective ferrite material will be economical in large quantities due to established coating methods. This responds to the real demand for materials that are required for working and living areas as well as for the area of shielding devices and components.

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Remarks

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