

# **DIELECTRIC CHARACTERISTICS POLYMER WITH METAL POWDER**

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## **ABSTRACT**

This work deals with the dielectric and electric characteristics of the composites. It analyses the permittivity and loss factor in dependence of the frequency and filling factor, and inner resistivity in dependence of the filling factor of the Ni powder. The analysed system is of type: copolymer ethylen-vinylacetat – Ni.

## **1 INTRODUCTION**

Composite material with metal filler in polymeric matrix constitutes two or multicomponent system, whose characteristics are impressed with how characteristic feature polymeric matrix, so and feature metal filler and mutual interaction on interface filler-polymer. Type polymeric matrix work largely tensile properties, as are fort, figurability etc ..; concentration substitution metal filler work largely electrical characteristics compound word. Like matrix generally used elastomer, thermoplastic and reaktoplast and filler used to be soot, plumbago, ferrite and metals in practice powder.

Purposes sight work is find out choice dielectric characteristics constitution system elastomer - nickel powder. Surveyed dielectric characteristics - absolute permittivity and loss factor in frequency divide 100 Hz - 10 GHz, inner resistivity , and influence content nickel filler in conducting compound word on presentation dielectric characteristics. Single parts experiment was and inquest pertinent influence particle size metal filler on dielectric characteristics.

## 2 EXPERIMENTAL PART

For purposes metering were ready for gardens exhibits, which contain like matrix copolymer ethylene-vinyl acetate with 45 % wt. substitution vinyl acetate with trade name LEVAPREN 450, product firm Bayer AG. Filler were nickel powder firm Högenas in three faction with next mark:

- 1320 – with particle size 45-125  $\mu\text{m}$ ,
- 1020 – with particle size 20-106  $\mu\text{m}$ ,
- 1120 – with particle size 20-71  $\mu\text{m}$ .

All presentation faction contain, according to catalogue 95,77 % Ni, 2,4 % Si, 1,4 % B, 0,4 % Fe a 0,03 % C.

Matrix Levapren 450 was delivery teacher's desk plastic and rubber CHTF STU Bratislava and nickel powder firm Wempo s.r.o .

## 3 PREPARATION SPECIMEN

Samplpes filling elastomer were ready for on teacher's desk plastic and rubber CHTF STU Bratislava, which has fit technological arrangement. Voluminous substitution nickel in matrix was election on the basis tuition on mentioned workplace [1], with consideration with supposed conductivity characteristics and quantity gained powder.

Were ready for next elastomer composite, which contain:

- nickel powder with mark 1320, 1120 a 1020:
  - with 15 % voluminous substitution Ni in matrix,
  - with 18 % voluminous substitution Ni in matrix,
  - with 20 % voluminous substitution Ni in matrix,
  - with 22 % voluminous substitution Ni in matrix,
  - with 25 % voluminous substitution Ni in matrix,
  - with 30 % voluminous substitution Ni in matrix,
  - with 34 % voluminous substitution Ni in matrix.
- nickel powder with mark 1120:
  - with 42 % voluminous substitution Ni in matrix,
  - with 50 % voluminous substitution Ni in matrix,
  - with 55 % voluminous substitution Ni in matrix,
  - with 60 % voluminous substitution Ni in matrix,
  - with 75 % voluminous substitution Ni in matrix.

Nickel powder were first exsiccation in seat power control oven KCW-100 at temperature 150 °C for a period of 30 mine behind occasional shuffle, with the view of minimization defect at generation exhibits.

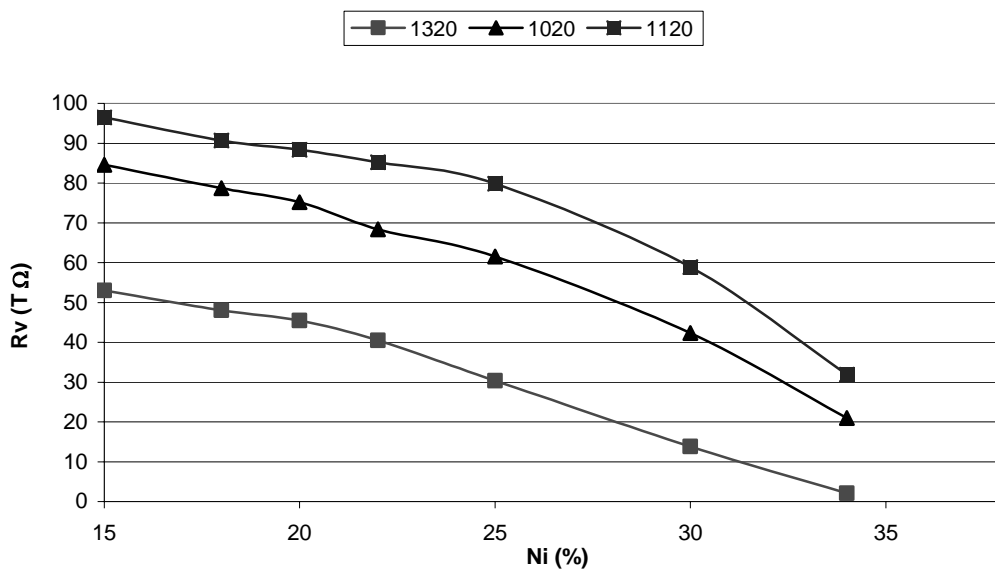
Specific lots nickel were weighing on full content agitator box. For mixture exhibits was using machine PLASTI-CORDER-BRABENDER, used in rubber for disposition specimen, with content agitator box 70 cm<sup>3</sup>. Ready specific substitution matrix and filler was step by step homogenize. Homogenizing proceed double regime - regime dosage and regime mixture. In regime dosage proceed homogenizing at 50 speed/mine and temperature 150 °C; for regime meddley speed heighten on 70 revolutions per minute/mine for a period of perhaps

15 mine. After homogenizing was mixture translocation to the steel frame about proportion 150x150x2 mm and interpolation to the press GRT-20 on time 10 mine at temperature 150 °C and pressure 20 MPa. Frame was further will transposition to the press GTR-20 on time 8 mine at ambient temperature and pressure 20 MPa.

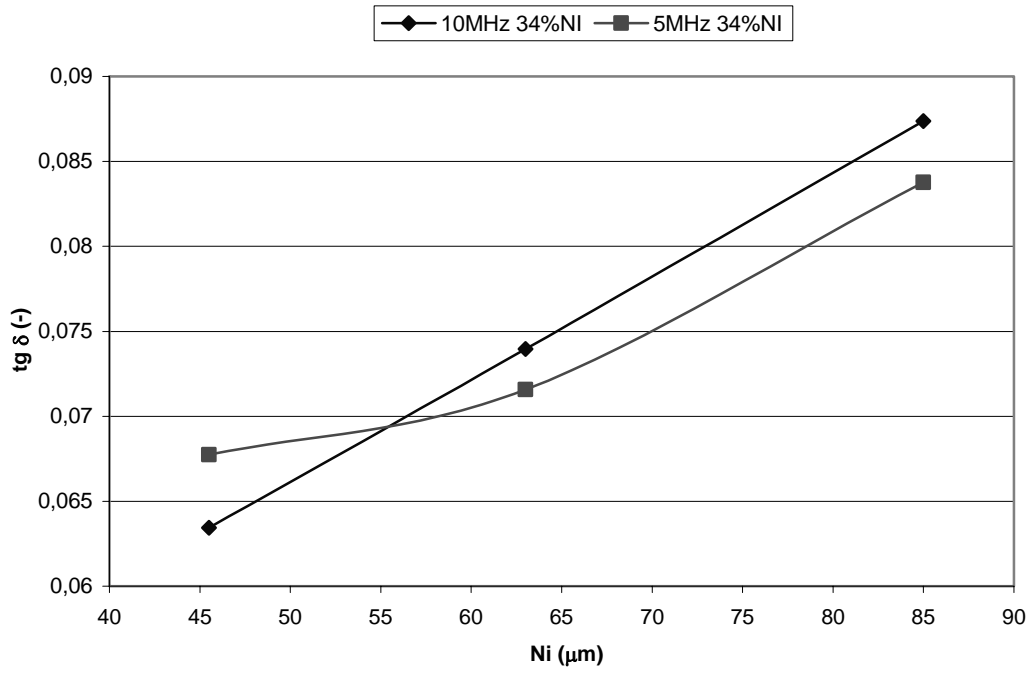
For purposes metering were from appropriate sheeting made two exhibits from anyone specific substitution and matrix shaped circle about proportion  $\phi$  55 mm and h=2 mm and two exhibits from anyone specific substitution and matrix shaped circle about proportion  $\phi$  50 mm and h=2 mm.

#### 4 RESULT OF MEASUREMENT

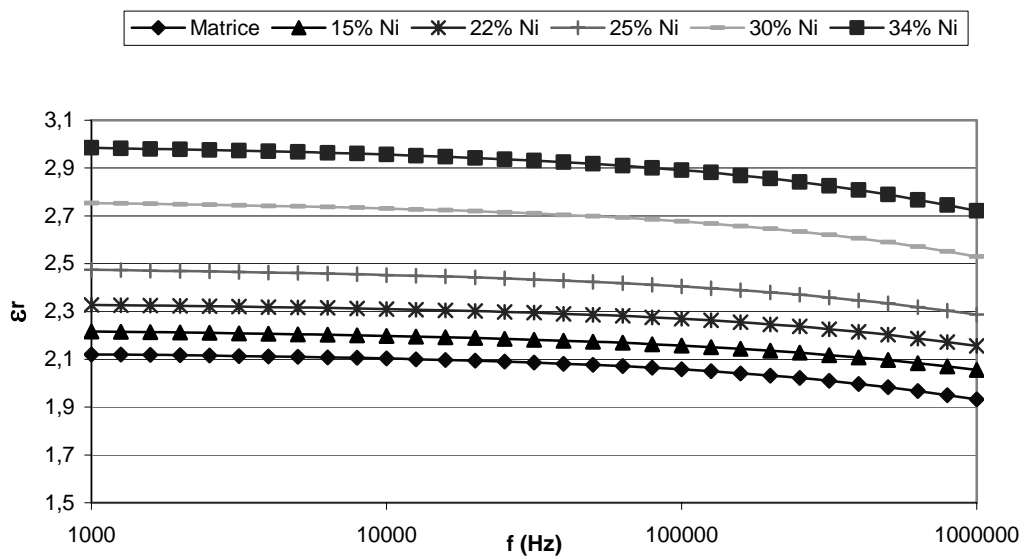
Result of measurement inner resistivity come out on fig. 1, metering relative absolute permittivity and loss factor come out on fig. 2–4.



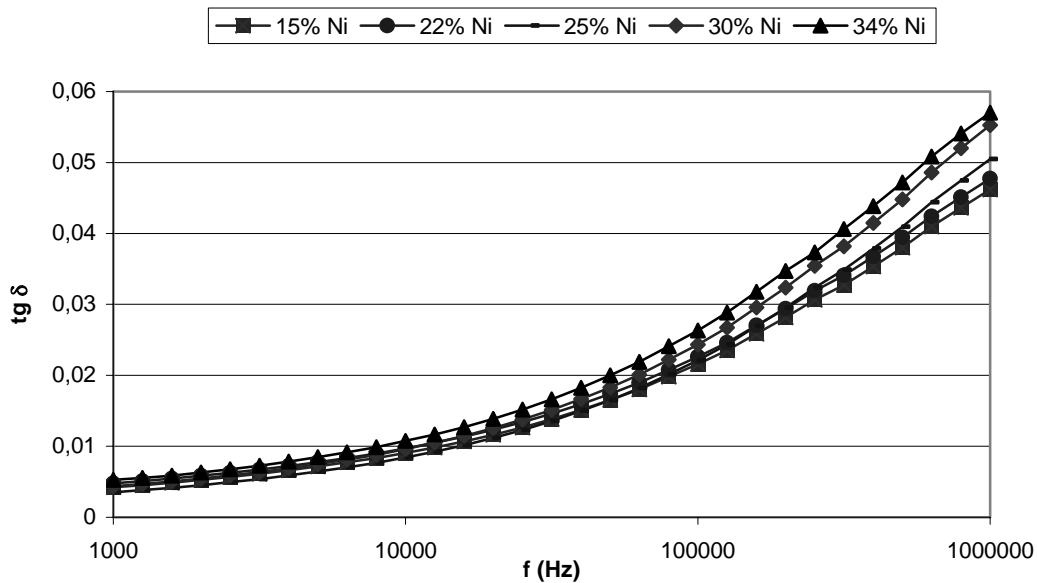
**Fig. 1:** *Dependence inner resistivity on specific substitution Ni in matrix for metal filler type 1320, 1020 a 1120*



**Fig. 2:** *Dependence loss factor on sizes Ni grains in matrix at frequency 5 and 10 MHz*



**Fig. 3:** *Dependence permittivity on frequency for metal filler type 1320*



**Fig. 4:** *Dependence loss factor on frequency for metal filler type 1320*

## 5 CONCLUSION

Levapren 450 and out of him pedigree conducting composite can be account polar matters. Z measured record resulting next matter:

- By increasing the specific substitution nickel in matrix shoot up duly how specific inductive capacity, so and loss factor.
- By increasing the specific substitution nickel decreases inner resistivity.
- Size nickel grains in matrix influence dielectric characteristics, in investigation influence grain size continues.

## REFERENCES

- [1] Holcman, V.: Dielektrické a magnetické vlastnosti pryže s ferimagnetickým plnivem, [bachelor thesis], FEI VUT Brno, 1999
- [2] HP 4284A Precision LCR meter – Operation manual, Hewlett – Packard LTD Yokogawa 1989
- [3] Kováčiková, S., Vicen, R., Hudec, I.: Kompozitné materiály na báze polymernej matrice a magnetického plniva, Elektroizolačná a káblová technika, 53, 2000, p. 43