

Safety recommendations for working with magnetic fluids

Hana Fejfarova*

*Faculty of Electrical Engineering, University of West Bohemia, Univerzitni 26, Pilsen, Czech Republic, e-mail:metis@rice.zcu.cz

Abstract The research described in this report is focused on the possible effect of magnetic fluids on the human organism and defining of the safety recommendations.

Keywords magnetic fluids; health risks; nanoparticles; safety recommendations

I. INTRODUCTION

Magnetic fluids were first studied in the nineteenth century. Liquids suitable for practical use were not discovered until the mid-twentieth century. Currently, magnetic fluids are used for many applications (e.g. loudspeakers or sealing) and they are still the subject of intensive research. Especially ferrofluids, which belong to nanomaterials, become more and more attractive for industry applications and scientific research.

In spite of the wide range of using magnetic fluids, there are not any official hygienic or safety recommendations for working with them - neither in the Czech Republic, nor in EU. Nevertheless, it is necessary to define appropriate recommendation, because magnetic fluids can have negative effect on the human organism.

II. POSSIBLE EFFECT OF MAGNETIC FLUIDS ON THE HUMAN ORGANISM

A. The influence of the chemical composition

Magnetic fluids consist of magnetic metal particles (Fe_2O_3 , Fe_3O_4), a carrier liquid and a little of surfactant [1]. Magnetic liquids are divided according to the metal particle size into ferrofluids (nanoparticles) and magnetorheological fluids (particle size in micrometers). The carrier fluid may be a mineral oil, water or a synthetic substance. Mineral oils contain mixtures of organic compounds derived from petroleum and coal tar, i.e. they contain mutagens and genotoxic components. It can be cause of massive allergies and irritations during contact with the skin [2]. Hydrocarbon-based fluids are generally fat soluble substances. If the fluid comes into contact with the skin, there will be a risk of penetration of hydrocarbon into the skin and also into the lymphatic and blood circulation. [2]

B. The influence of nanoparticles

Nanoparticles due to their small dimensions are able to penetrate into the body and pass through tissues and organs. The particles can travel throughout the body and accumulate in certain organs. Researches and experiments are indicative of possibility that nanoparticles can be deposited in the liver, heart, and kidneys. The deposited particles can be cause of cancer. In case that the particles settle in the blood vessels near the heart, the probability of myocardial infarction increases. [2 - 4]

III. SAFETY RECOMMENDATION

It is necessary to observe fundamental safety and hygiene recommendations. Firstly it is important to avoid skin contact with magnetic fluids. Protective gloves can guarantee the optimal protection. The series of stress tests were carried out in order to choose suitable type of protective gloves. During testing gloves filled with ferrofluid were stressed by magnetic field 140 mT for 48 hours. For reliable protection is advisable to use latex gloves. To protect the whole body is advisable to wear protective clothing.

If the magnetic fluid is exposed to high temperature during the experiments (or fire occurs), dangerous vapors and aerosols will be created. These fumes can seriously damage a human respiratory system [2]. In this case it is necessary to use respirator FFP3. The critical concentration of aerosols in the air is 5 mg per 1 m³. At normal temperatures vapors of the magnetic fluids are released very slowly – this fact was confirmed by experiment focused on the speed of vaporization. This phenomenon is not dangerous.

IV. CONCLUSION

Incorrect manipulation with magnetic fluids can endanger human health. It is necessary to define and observe safety recommendation. Protective clothing, latex gloves and respirator FFP3 guarantee optimal protection.

V. ACKNOWLEDGEMENTS

This work has been supported from SGS-2015-035.

VI. REFERENCES.

- [1] MAYER, D. Magnetic fluids and their application (1st Part). *Elektro*. 2007, vol. 17, nr. 3, p. 78-79.
- [2] FEJFAROVA, H. The influence of commercial magnetic liquids on the human body, Pilsen, 2014. Bachelor thesis (Bc.). University of West Bohemia in Pilsen, Faculty of Electrical Engineering.
- [3] GWINN, M., VALLYATHAN, V. Nanoparticles: Health Effect – Pros and Cons. *Environ Health Perspectives*. 2006, vol. 114, nr. 12, p. 1818 - 1825.
- [4] NOHAVICA, D. Risks of nanomaterials and nanotechnology to human health and the environment. *Ceskoslovensky casopis pro fyziku*. 2011, vol. 61, nr. 3 - 4, p. 220 - 227.