

# INJECTION MOLDED COMPOSITES WITH IRON OXIDE ADDITION

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## Introduction

Magnetite particles ( $\text{Fe}_3\text{O}_4$ ) due to their physico-chemical properties currently belong to the most interesting materials considered for applications in medicine and biotechnology. The magnetic particles possess very low toxicity on the living cells [1]. They are used, among others, to enhance contrast in magnetic resonance imaging (MRI) or in bone regeneration [2]. Magnetite can also be used to modify polymer matrix of implantation materials [3]. Implants with reproducible shapes and low cost can be manufactured by injection method. Polymer modifying with magnetite have new properties which can be use in magnetic resonance imaging. Furthermore, the addition of magnetite improves the regeneration of bone tissue. This work demonstrates an assessment of thermal properties and also magnetic resonance imaging was tested.

## Materials and Methods

Polymer with magnetite was use for injection. Samples were made in the shape of the tensile flat specimen with different concentrations of magnetite: 0,05wt%, 0,10wt%, 0,25wt% and 0,5wt%. The laboratory injection molding machine V-4-S15N Multiplast was use. Obtained materials were investigated by the MRI technique. The different pulse sequences were tested with the aim to find the optimal sequence for imaging of such materials. Each of the specimens was tested in three mutually perpendicular dimensions. The influence of added magnetite particles on polymer matrix were also studied with differential scanning calorimetry (DSC).

## Results and Discussion

MRI visualizations allowed to obtain images of the composite samples modified with magnetite. Analysis of the images showed that increasing the concentration of magnetite causes more distorted images. For all samples, the best images were obtained with the spin-echo  $T_2$ -weighted sequence. Images of the highest quality were obtained for the materials with the smallest amount of modifier (0.01wt%).

Thermal analysis confirmed that there were not significant differences between properties composites modified with magnetite and pure polymer. We noticed slight decrease glass transition temperature.

## Conclusions

The performed analysis have shown that there is a direct connection between the amount of magnetic modifier in the composite and the quality of MRI images. It was stated in this research that the critical amount of the modifier is 0,5wt%. Addition of such quantity of the modifier made the images very distorted and disqualified them from medical diagnosis. This means that, if a good quality of image is needed, the amount of the nanomagnetite particles should be much smaller, the best ~0,05wt%.

The addition of magnetite to the polymer matrix may give new properties. In our study addition of magnetite changed properties of the composite such as, magnetic, or thermal. The performed analysis has shown that there is a direct connection between the amount of magnetic modifier in the composite and the quality of MRI images. Based on the presented results it can be concluded, that the use of the spin-echo  $T_2$ -weighted MRI sequence produces the best images of implants with magnetic modifier and can be used for medical diagnosis, but the investigated implants need to have a proper, much less than 0,5wt%, concentration of the nanomagnetite.

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## References

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