Electrorheological Properties of Suspensions of Polypyrrole-Coated Titanate Nanorods

Miroslav Mrlík[1,2], Vladimír Pavlínek[1,2]*, Petr Sáha[1,2], Otakar Quadrat[3]

[1] Centre Of Polymer Systems, University Institute, Tomas Bata University In Zlín, Nad Ovcirnou 3685, 760 01 Zlín, Czech Republic
[2] Polymer Centre, Faculty Of Technology, Tomas Bata University In Zlín, Nám. T.G. Masaryka 275, 762 72 Zlín, Czech Republic
[3] Institute Of Macromolecular Chemistry, Academy Of Sciences Of The Czech Republic, Heyrovsky Sq. 2, 162 06 Prague 6, Czech Republic

*Corresponding Author: pavlinek@ft.utb.cz
Fax: + 420 576 031 444

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Abstract:
The behaviour of silicone-oil suspensions of titanate nanorods coated with polypyrrole base in electric field has been investigated. Unlike suspension of globular particles of neat polypyrrole, rod-like particles show a stronger electrorheological (ER) effect corresponding to high rigidity of the structure. A great influence of the oil viscosity on the ER efficiency was observed. A good reproducibility of the effect and a fast response to the switching-on and -off the electric field has been confirmed by monitoring the time course of shear stress under controlled shear rate.

Zusammenfassung:
Das Verhalten von Silikonöl-Suspensionen mit Polypyrrol-Laugebeschichteten Titanat-Nanoröhrchen in elektrischen Feldern wurde in dieser Arbeit untersucht. Im Gegensatz zu Suspensionen von kugelförmigen Partikeln aus reinem Polypyrrol, besitzen stäbchenförmige Partikel einen stärkeren elektrorheologischen Effekt (ER) aufgrund ihrer hohen strukturellen Steifigkeit. Ein großer Einfluss der Viskosität des Öls auf das elektrorheologische Verhalten wurde gefunden. Eine sehr gute Reproduzierbarkeit dieses Effekts und eine schnelle Antwort auf das Ein- und Ausschalten des elektrischen Feldes wurde durch den zeitlichen Verlauf der Scherspannung als Funktion der Schergeschwindigkeit gezeigt.

Résumé:
Le comportement dans un champ électrique de suspensions de nano- bâtonnets de titanate recouverts avec du polypyrrole dans de l'huile de silicone a été étudié. Contrairement à une suspension de particules globulaires de polypyrrole pur, les particules en forme de bâtonnet présentent un effet électrorhéologique plus fort correspondant à une grande rigidité de la structure. Une grande influence de la viscosité de l'huile sur l'efficacité ER a été observée. Une bonne reproductibilité de l'effet et une réponse rapide à l'allumage et à l'éteinte du champ électrique ont été confirmées en suivant la dépendance temporelle de la contrainte de cisaillement en vitesse de cisaillement contrôlée.

Key words: polypyrrole, nanorods, electrorheology, steady shear

1 INTRODUCTION

Electrorheological (ER) suspensions are referred to as two-phase systems consisting of polarizable solid particles and a liquid insulating medium. The particles behave like dipoles and, when electric field is applied, chains of polarized aggregated particles oriented along the stream-lines of the electric field can be observed [1]. After switching the electric field on or off, the structure of the suspension changes in a very short time. At flow, superposition of the shear and polarization forces leads to a dramatic increase in suspension viscosity, often accompanied by a yield stress. When the electric field is switched off, due to predominating shear forces, the particle chains disintegrate and viscosity almost immediately returns to its original field-off value. Investigation of this phenomenon has been the

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4 CONCLUSION

The results demonstrate that TNt rod-like particles coated with low-conductivity PPy provide a material showing very good polarizability and considerably higher rigidity of suspension structure in the presence of electric field than neat PPy powder. The time dependences of flow characteristics confirm that the response of coated nanorods to polarization and shear forces is as good as for a suspension of globular PPy powder.

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