Available online at www.sciencedirect.com

ScienceDirect

Procedia Materials Science 9 (2015) 491 – 495

Procedia Materials Science

www.elsevier.com/locate/procedia

International Congress of Science and Technology of Metallurgy and Materials, SAM – CONAMET 2014

Grafting polymer based in active polyurethane matrixes via free radical

Diana Penagos Calvete[a], Diego F. Restrepo Holguín[a], Manuel Palencia Luna[a,*]

[a]*Department of Chemistry, Faculty of Natural and Exact Sciences, University of Valle, Cali - Colombia*

Abstract

Polyurethanes (PUs) are novel and versatile polymers based on the reaction of diisocyanate and polyol groups; its advantage lies in its mechanical properties and the modifications that can be made of those properties through changes in synthesis conditions. On the other hand, graft polymers are produced by the insertion of polymer chains into the main chain of other polymer in order to give specific and novel properties. The main purpose on this work was developing PU cores as precursors of new graft polymers which can be easily polymerized by free radicals. In this context, a vinyl monomer (vinyl benzyl-*N*-methyl-*D*-glucamine, VbNMDG) was synthesized from *N*-methyl-D-glucamine and *p*-chloromethylstyrene. The synthesized monomer was employed for the formation of PU core using 4,4′-methylene-bis-(phenyl isocyanate) (MDI). The monomer synthesis and the double bond incorporation to the PU matrix were verified by NMR ^{13}C and ^{1}H. Thereafter, 0.1 g of different PU cores was mixed with an equal VbNMDG amount, using a dioxane-water mixture as solvent in the presence of radical initiator (ammonium per sulfate, 2 % molar of VbNMDG). The reaction was carried out at 70 °C using nitrogen atmosphere for 24 h. The graft polymers obtained were characterized by FT-IR and elemental analysis. The insertion of poly(VbNMDG) chains into the PU cores gives them the boron retention capacity in aqueous solutions. Our results show the possibility to obtained PU cores which can be polymerized via free radicals to the graft of functional polymer chain in a second polymerization.

Keywords: Graft polymers; polyurethane; *N*-methyl-*D*-glucamine

---

* Corresponding author. Tel.: +057-3205271934; fax: +0-000-000-0000 .
E-mail address: manuel.palencia@correounivalle.edu.co

doi:10.1016/j.mspro.2015.05.021

1. Introduction

Nomenclature

MDI	4,4´-methylene-bis-(phenyl isocyanate)
PDMS	polydimethylsiloxane
poly(VbNMDG)	poly[vinyl benzyl-N-methyl-D-glucamine]
PUs	polyurethanes
PVP	poly(vinylpyrrolidone)
VbNMDG	vinyl benzyl-N-methyl-D-glucamine

Polyurethanes (PUs) are a family of polymers having a wide range of applications and great versatility in the generation of new polymeric materials. Due to its wide range of properties ranging from biodegradable and non-toxic to its flexibility, high impact resistance and durability, is possible the development of new materials. PUs are a family of polymers which is used in industry as adhesives, coatings, foams, packaging and biomedical aids.

The PUs are composed of hard and soft segments, which give stiffness and flexibility to the structure, the hardness and elasticity of the polymer will depend on the variation in radius of the hard and soft segments. Thus, depending on their nature can be classified as thermoplastics, elastomers or linear (Shelke et al., 2014).

These polymeric materials are produced as plastic foams, elastomers structural coating elastomers, adhesives and auxiliaries. The PUs are linear polymers which have a backbone formed of carbamate groups (-$NHCO_2$) which are also called urethanes and is produced from the reaction between a polyol with terminal hydroxyl groups and a diisocyanate (Shelke et al., 2014).

On the other hand, there is a special class of copolymers which has been taking great boom in generating of new polymeric materials, these are the graft polymers. The graft polymers are macromolecules consisting of a branched main chain whose branches are formed of repeating units of a different polymer chains. Keep in mind that the type of bond that is present between the main chain of the polymer molecule and its attachments is covalently type. This type of macromolecules has great potential in various technological applications as a result of the wide range of properties that the new structure can provide (Bhattacharya et al., 2004; Bhattacharya et al., 2009).

Should be noted that the polymers are materials with a variety of properties, which can range from malleability, resistance and hydrophilicity to stiffness, conductivity and hydrophobicity; these properties allow them to be exploited in various areas of knowledge. However, application of these materials is limited in some areas of work; due to the above in recent years graft polymers have aroused great interest in the design of new polymeric materials based on the modification of its surface to increase its area of applicability. In this regard various investigations into the modification of PUs have been performed by our research group (RG-STA, Research Group on Science Technology Applications or GI-CAT in Spanish), particularly through the insertion of polymer chains to obtain a graft polymer where the mechanical properties of these polymers are combined with the properties of the inserted functional polymer chains.

In this context, to date there is record of researches in which various resins or polyurethane foams are modified to generate a new polymeric material with improved properties; some investigations can be highlighted, by instance, the hydrophobic modification of polyurethane foams for cleaning oil spill from the insertion of lauryl methacrylate monomer (Li et al., 2012), modification of polyurethane surface with polydimethylsiloxane (PDMS) by plasma in order to improve their hydrophobic properties and produce a more homogeneous morphology (Shourgashti et al., 2010) and the polyurethane surface modification with chitosan to enhance its antibacterial properties (Kara et al., 2014). Recently, it has been reported researches related with the insertion of polybutadiene, poly(vinylpyrrolidone) (PVP) and acrylic polymers chains to polyurethanes for different applications (Wang et al., 2009; Walo et al., 2013; Alves et al., 2013).

The aim of this work was to develop PU cores that can be used as precursors of new families of graft polymers via free radicals. In particular the inclusion of poly(vinylbenzyl-N-methyl-D-glucamine, VbNMDG) seeks to produce a material with boron retention capacity.