Progress in Organic Coatings 97 (2016) 91–98

Contents lists available at ScienceDirect

Progress in Organic Coatings

journal homepage: www.elsevier.com/locate/porgcoat

Flame retardant modification of waterborne polyurethane fabric coating agent with high hydrostatic pressure resistance

Jingjing Feng[a], Zhen Ge[a], Chunpeng Chai[a], Shengpeng Wang[b], Dehai Yu[b], Gang Wu[a], Yunjun Luo[a,*]

[a] School of Materials Science and Engineering, Beijing Institute of Technology, Beijing 100081, China
[b] Zhejiang Transfar Co. Ltd, Hangzhou 311215, China

ARTICLE INFO

Article history:
Received 18 November 2015
Received in revised form 21 February 2016
Accepted 22 March 2016

Keywords:
Waterborne polyurethane
Flame retardant
Hydrostatic pressure resistance
Fabric coating agent

ABSTRACT

In this work, a series of flame retardant modification crosslinking waterborne polyurethanes (OWPUs) were synthesized. The structures, emulsion performance, film and application properties of prepared OWPUs were investigated. Conclusions drawn from the study were that the incorporation of flame retardant ExolitOP550 makes the particle size of the OWPU dispersions larger, and the result of Zeta potential can be deduced that all polyurethane dispersions are well stabilized. Thermogravimetric analysis (TGA) and thermogravimetric analysis-fourier transform infrared spectroscopy-mass spectrometry (TGA-FTIR-MS) revealed that the ExolitOP550 can catalyze the formation of a protective char layer and release new nonflammable gas. Hence, as the content of ExolitOP550 increases, the limiting oxygen index (LOI) of OWPU films and the flame resistance of OWPU fabric specimens become better and better. After coated, textiles showed excellent hydrostatic pressure resistance performance and the flame retardant property compared with the uncoated counterparts. However, the hydrostatic pressure decreased with the increase of ExolitOP550. In view of the comprehensive performance of OWPUs, especially the application properties, well performed OWPU may be synthesized with 12 wt% proportion of ExolitOP550.

1. Introduction

The properties of fabrics can be enhanced prominently by finishing with various coatings to present different performances for individual applications, such as scratch resistance, apyrous, folding resistance, high abrasion resistance, and chemical corrosion resistance. As the versatile environmentally friendly materials, waterborne polyurethanes (WPUs) have gained increasing interest in textile & coating industry [1–7]. Besides, functional WPU coatings (e.g. waterproof WPUs, fire retardant WPUs) can increase the added value of textile products. However, it's well known that the function of conventional WPUs is single, which have many shortcomings in the application of textiles, such as poor hydrostatic pressure resistance, flammable, and poor weather resistance. Thus the comprehensive performance of materials can not satisfy people's growing needs [8]. Consequently, these defects limit their more application in textile & coating fields. So, making WPUs have multifunction, not only conforms to the trend of the development of fabric coating agent, but also meets people's demand for materials, which will have important economic and social benefits [9].

Hydrostatic pressure is an important parameter and a convenient means of quantitatively measuring the energy required to achieve breakthrough of a fabric sample [10–12], and the result is of great value for practical applications of WPUs. Unfortunately, there has to date been scant experimental work focused on this aspect of hydrostatic pressure in WPU coated fabrics [10,13]. However, many researchers have studied the flame retardant WPUs [14–16]. Hu et al. [17,18] fabricated graphite oxide/waterborne polyurethane (GO/WPU) nanocomposites, employing in-situemulsion and self-assembly, respectively, and studied their flame retardant property. Zhang et al. [19] prepared waterborne polyurethane (WPU)/O-MMT nanocomposites, and found that the flame retardancy was remarkably enhanced. Gu et al. [20] introduced a new flame retardant into the backbone of WPU, and evaluated that it has an excellent flame retardancy. Wu et al. [21,22] synthesized a series of novel post-chain extension flame retardant waterborne polyurethanes (AWPUs), and not only investigated the influence of the flame-retardant extender on the flame retardancy of AWPUs, but also studied the thermal degradation mechanism of AWPUs. But so far, most studies individually concerned with either

* Corresponding author.
E-mail address: yjluo@bit.edu.cn (Y. Luo).

http://dx.doi.org/10.1016/j.porgcoat.2016.03.020
0300-9440/

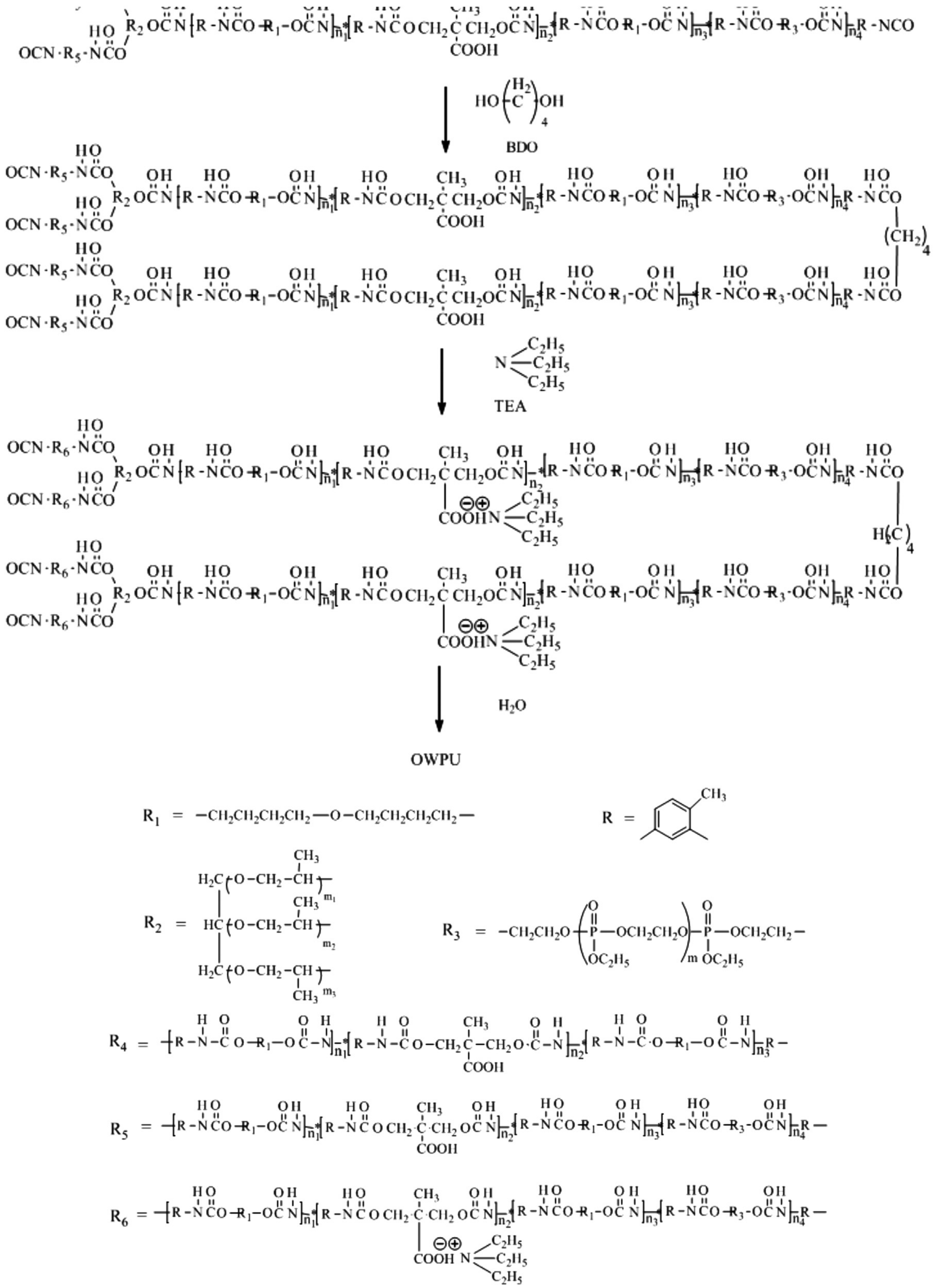

Fig. 1. Synthesis process of OWPUs.

hydrostatic pressure resistance of WPUs or flame retardant WPUs, and little effort was directed towards the effects of flame retardancy and hydrostatic pressure resistance of WPUs.

As we known, the excellent performance of WPU is mainly related to the special structures of periodic backbone and functional side chains [23]. Typically, WPUs are synthesized by polyaddition of rigid monomers and soft segments such as polyester diols and polyether diols [24,25]. What's more, most WPUs are linear thermoplastic polymers and have a relatively low water resistance, hydrostatic pressure resistance, and solvent resistance [26].