

Thermogravimetric and Kinetics of thermal degradation of Powdered Laboratory Examination Gloves: 1. Analysis of thermal Scan Traces from 310-455°C.

ABSTRACT

The aim of this study was to develop an energy efficient method to decompose powdered laboratory safety examination gloves (PLEG). This paper reports on the results of thermogravimetric analysis (TGA) of PLEG, without a catalyst. The study was conducted in the Department of Biological and Physical Sciences at South Carolina State University (SCSU), Orangeburg, SC, USA, during the spring of 2014. Twelve samples of PLEG were studied under three types of operating conditions. First a sample was scanned from 50°C to 800°C with a heating rate of 10°C/min while it was purged with 10 mL/min argon. The results of this study determined the thermal stability of PLEG, and the temperature of highest weight loss rate (~410 °C). The second approach used two sequential dynamic thermal scans with a linear and fast (200°C/min) increase of the temperature over time, and two sequential isothermal steps for 30 minutes; one below 410°C and the other at 410°C. The third approach used a dynamic thermal scan and a sequential isothermal step for 30 minutes at a temperature over 410°C. From the thermal scans and isotherms, the highest rate of weight loss, the temperature at the maximum weight loss, the acceleration of weight loss by thermal scan, the deceleration of weight loss at the isotherms, the rate constant and activation energy of weight loss (E_a) were estimated. The experimental results confirm that E_a of weight loss of the PLEG samples depended on the temperature of operation. At temperature below 430°, the amount of E_a of weight loss of sample was higher than those above 430°C temperatures. Also, internal reactions of the sample of PLEG at 340°C resulted on thermally stable materials, which slowed down the thermolysis rate of the sample at higher temperatures.

Keywords: thermogravimetric, latex-gloves, kinetics, environment; pollution; pyrolysis, thermolysis, neoprene; activation-energy, rate-constant.

DEFINITIONS, ACRONYMS, ABBREVIATIONS

PLEG: powdered laboratory examination glove, LSG: laboratory safety glove, PVC: poly(vinyl chloride); PMMA: poly(methyl methacrylate); PS: poly(styrene); PE: poly(ethylene); PET: poly(ethyleneterephthalate); RT: retention time, TIC: total ion chromatogram; GC-MS: gas chromatography-mass spectrometry, WHO: world health organization, E_a : activation energy, TGA: thermogravimetric analysis,

1. INTRODUCTION

The decomposition of polymeric materials has been of interest to scientists since the applied knowledge of polymeric materials gained relevance [1,2,3]. The decomposition kinetics of polymeric materials [4,5] and the mechanism of decomposition have been studied by many researchers [eg, 6,7]. Researchers have