Preface

The decade 2005–2015 has seen impressive new developments in the synthesis of polyols for polyurethanes (PU). Due to the large amount of new information, the book *Chemistry and Technology of Polyols for Polyurethanes* (second edition) has been divided into two volumes. Volume 1 is dedicated to polyols for elastic PU and volume 2 for rigid PU. The present third edition of the book, with a little changed title *Polyols for Polyurethanes – Chemistry and Technology*, is an updated edition, in two volumes, covering the period 2005–2018.

Polyols for rigid PU have two important characteristics: high functionality (3–8 hydroxyl groups/mol or more) and the chain derived from the 1-hydroxyl group is short (maximum 100–200 Da). As an immediate consequence of these two characteristics, reaction of these polyols with diisocyanates or polyiisocyanates leads to highly cross-linked rigid PU suitable for specific practical applications (e.g. rigid PU foams for thermal insulation of freezers, buildings, pipes and storage tanks for food and chemical industries; wood substitutes from rigid PU).

Main polyols for rigid PU are polyether polyols, polyester polyols, aminic polyols, polyols based on condensates of aromatic compounds with aldehydes (Mannich polyols, Novolac polyols), phosphorus polyols and polyols by chemical recovery of PU foam wastes. A new group of polyols for rigid PU has been developed in the last decade: polyols synthesised by thiol-ene 'click' chemistry (described in detail in a special chapter of this monograph).

The most impressive research effort in 2005–2018 was dedicated to the synthesis of renewable polyols. That is, polyols based on natural compounds such as vegetable oils, fish oil, lignin, starch, castor oil, lactides, liquid from the shells of cashew nuts, terpenes, glycerol, polyglycerol, sucrose, sorbitol, xylitol and isosorbide. Syntheses of polyols for PU-based renewable natural compounds are described in detail in a special chapter.

Use of natural compounds of infinite renewability as raw materials for synthesis of oligo-polyols (including polyols for rigid PU) is a real hope for the sustainable future of PU.

PU (including rigid PU) are polymers that burn completely. To protect human lives and materials used in everyday life (furniture, insulation of buildings and car seating), flame-retardant PU must be produced. Phosphorus polyols or bromine containing polyols and reactive flame retardants have been produced for this purpose. These special polyols (which are described in a special chapter) enter into PU networks, thereby leading to the permanence of flame retardancy.

A special chapter is dedicated to the synthesis of polyols by chemical recovery of PU wastes. By various reactions (hydrolysis, alcoholysis, glycolysis, aminolysis and alkoxylation), PU wastes are transformed into useful new polyols. This strategy leads to substantial economy of energy and raw materials compared with classical routes of polyol synthesis.

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The final chapter describes the relationship between the chemical structure of oligo-polyols and the characteristics of PU based on these polyols.

Covering all aspects and describing all the structures of oligo-polyols created during more than 80 years of PU is not possible. Nevertheless, the most important aspects of the synthesis and characteristics of polyols for rigid PU are detailed.

This monograph is addressed to all specialists working in the area of PU: students, researchers, scientists, engineers, professors, and experts from industry, universities, research centres and research institutes.

I hope that this monograph will be the start of new and original developments in oligo-polyols for rigid PU, with new designs/architecture suitable for the manufacture of new rigid PU. Good luck in your endeavours!

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