

IUPAC Recommendations on Macromolecular (Polymer) Nomenclature

Guide for Authors of Papers and Reports in Polymer Science and Technology

Edward S. Wilks

E. I. du Pont de Nemours & Co., Inc., Barley Mill Plaza, Wilmington, Delaware, 19880

This Guide is easy to follow and a less formal approach to macromolecular nomenclature than the official IUPAC recommendations, all of which had been previously published in *Pure and Applied Chemistry*.

It has been the goal of the IUPAC Commission on Macromolecular Nomenclature to improve communication between polymer scientists by recommending unambiguous, standardized, and universally understood names and structure representations of polymers.

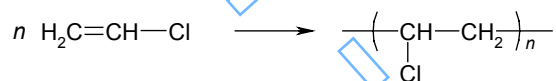
A. International Union of Pure and Applied Chemistry (IUPAC) Recommendations

A substance referred to as “a polymer” is different from a low-molecular-weight or “non-polymeric” substance in that usually it has no uniform structure; rather, it consists of a mixture of individual macromolecules. Each macromolecule has a different structural arrangement and length from the others in the mixture. These differences arise from such features as irregularity in monomeric unit sequences within chains, branching irregularities, monomeric unit orientation, and end-group structure.

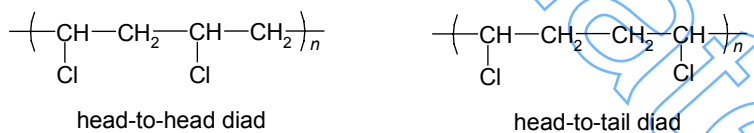
For all types of polymers – single-strand organic, double-strand organic, single-strand inorganic, and coordination – the nomenclature guidelines usually apply to structural representations that are idealized or theoretical; considerations of chain branching, imperfections, or irregularities are excluded.

Because of these problems, attempts to define polymeric substances rigorously are impractical; graphical representation and nomenclature of polymers therefore require a different approach. Naming a polymer of partly known or unknown structure by the “structure-based nomenclature system” may be difficult or impossible unless assumptions are made; naming it by the “source-based nomenclature system” may be possible, however. (Source-based and structure-based nomenclature systems are described below.)

A reaction involving polymerization of a monomer such as vinyl chloride is generally depicted¹ as



The graphical representation of the polymer is ideal rather than true; it contains no information that the polymer contains macromolecules (individual chains) of different chain lengths, and it assumes that all the repeating units are connected in an identical fashion, namely “head-to-tail”. In a real polymer, each macromolecule will contain some “head-to-head” diads and some “tail-to-tail” diads.



The precise sequence in each macromolecule of head-to-head, head-to-tail, and tail-to-tail repeating units is usually unknown.

This problem applies also to copolymers; each asymmetric comonomer that can give rise to asymmetric repeating units in a chain adds to the complexity. Each repeating unit can be oriented more than one way in a chain, and also the order of repeating units from comonomers can vary within a chain. For example, the copolymer from the two comonomers 1-propene and 1-butene contains two constitutional or monomeric units: