Mean span dimensions of ideal polymer chains containing branches and rings

We present a general method for calculating the mean span dimension of various branched and ringed polymers under the assumption of Gaussian chain statistics. The method allows a routine construction of an integral expression of the mean span dimension based on three base functions, determined for a connector, an arm and a loop, respectively. Applications of our method are shown to a variety of polymer architectures including star, two-branch-point, comb and various cyclic chains (eight-shaped, θ-shaped and several semicyclic chains). Comparing the mean span dimension with other commonly used molecular size parameters - the radius of gyration and the hydrodynamic radius, it is found that both the mean span dimension and the hydrodynamic radius shrink less than does the radius of gyration when comparing averaged sizes of a branched chain with its linear analogue. Finally, possible use of the mean span dimension in size exclusion chromatography (SEC) experiments is discussed. © 2010 American Chemical Society.