Biocompatible Polymers Characterization by IGC

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The use of polymers in the modern pharmaceutical industry is quite wide, and it requires a lot of different information.

One of the more recent applications is the impregnation of a polymeric system with a drug using a supercritical fluid as its carrier: this process is based on dissolving the active principle in a supercritical fluid. The supercritical solvent swells and reduces the T_g of the polymer, and the solute splits between the solvent and the matrix itself. The process is feasible only if the impregnating agent is soluble in the supercritical fluid, if the polymer is swollen by the supercritical solvent, and if the partition coefficient is favorable to charge the matrix with enough active principle.

Inverse gas chromatography (IGC) can be employed for studying the plasticization. In IGC, the obtained experimental data are the specific retention volumes of solutes injected into the stationary phase (the polymer in this case) at different temperatures: the plot of the retention volume logarithm versus the reciprocal of the temperature, called a retention diagram, from which it is possible to observe the phase transitions of the polymer, was investigated.

The experimentally determined specific retention volumes V_{g0} can be used to characterize the investigated stationary phases in terms of dipolarity/polarizability, hydrogen-bond, basicity/acidity, and lipophilicity, by means of the equation of solvation proposed by Abraham. Also, experimental values of fugacity coefficients can be determined and utilized in connection with an equation of state model to predict the behavior of the substances investigated in different solvents and in carbon dioxide at high pressure.

This thermodynamic approach has been applied to polyvinylpyrrolidones (PVP), which is a polymer widely used in pharmaceutical and chemical formulations, cosmetics, and paper and textile processes, since it is physically and chemically inert to copolymers of glycolide, a dimer of glycolic acid, and lactide, a dimer of lactic acid, (PLGA), which have been utilized in the medical industry for numerous biological applications, including polymeric drug delivery devices, synthetic bone scaffolding, and even dental prosthetic devices, and, finally, to different Eudragit® polymers.