In relation to the application of release kinetics in hydrogel formulations, the nature of the network structure will determine the rate-limiting step of release. Drug release from hydrogels can be classified based on the fundamental processes of diffusion, swelling or chemically induced reactions (Caló and Khutoryanskiy 2015).

Diffusion Controlled Release

Siepmann has explained that in order to rationally and correctly select the appropriate mathematical model for diffusion dominant release kinetics, the type of system, matrix or reservoir, must be identified. Furthermore, knowledge of other factors, e.g., the initial state of drug solubility within the carrier and the geometry of the drug delivery platform is required (Siepmann and Siepmann 2012). Drug loaded polymers can be designed as either reservoir (Fig. 1) or matrix (Fig. 2) systems.

The reservoir system incorporates a bank of drug surrounded by a hydrogel membrane. Drug must diffuse from the core of a supersaturated drug concentration through the hydrogel membrane; creating a concentration gradient from the formulation to surrounding media. When the membrane reaches swelling equilibrium continuous steady release rate is achieved, providing the coating remains intact. Release from the reservoir systems follow Fick's first law of diffusion as in Equation 1.

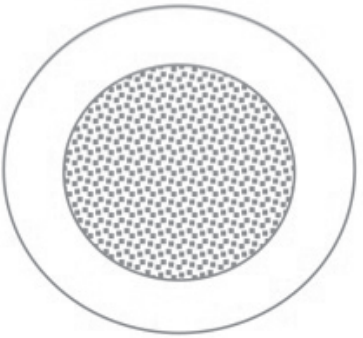

Fig. 1. Drug reservoir coated in hydrogel membrane.

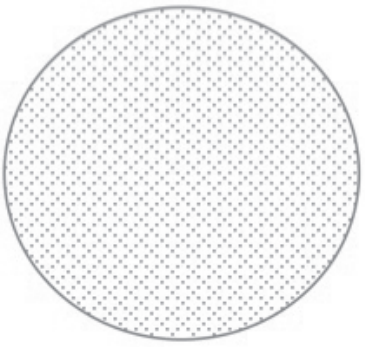

Fig. 2. Drug matrix (monolithic dispersion) in hydrogel system.