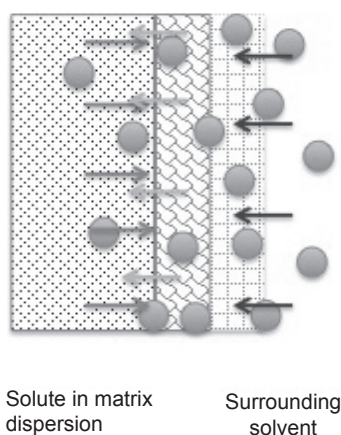


Erosion controlled release

Erosion of a hydrogel polymer can occur when there is no chemical crosslinking present or if the polymer is water-soluble in nature. Disentanglement of the polymer chains results in an increased solvent uptake and gradual disintegration of the network will occur. With respect to kinetics of controlled drug release, the rate of polymer erosion must also now be considered. Should this be the rate-limiting step of the diffusional process, drug release could be considered as erosion controlled, which in a swelling device will also result in an anomalous transport exponent. This creates an additional moving boundary whereby there is an erosion front before the swelling front as per Fig. 5.



As solvent diffuses inwards the polymer structure swells. The chains begin to disentangle and the structure disintegrates. There is the addition of a new boundary, the erosion front, which is moving inwards second to that of the swelling front. The diffusion front continues to move in the opposing direction.

Fig. 5. An eroding matrix adds a third moving boundary for consideration in swelling devices (Lee 2011).

Should this erosion occur from the surface of the device, the path length for drug diffusion will gradually decrease simultaneous to decreasing drug concentration and independent of time creating zero order release kinetics. However, if erosion occurs at a slower or faster rate than drug diffusion, the release is non-zero (Sackett and Narasimhan 2011). A common example of formulations involving diffusion, swelling and erosion is release from HPMC based tablets. Many researchers have focused on mathematically predicting release from these types of devices and the extent of necessary considerations make it a complex model (Lin and Metters 2006; Wu et al. 2005; Siepmann and Peppas 2000; Göpferich 1996). The geometry of the formulation and subsequent consideration of axial and radial swelling and diffusion must be additionally considered. Upon emersion in the solvent, polymer relaxation and swelling causes expansion of the shape of the tablet. The process of chain disentanglement begins and depending on the exact polymer composition, dissolution rate of the matrix itself will vary. Peppas et al. derived a theory for modelling such kinetics, incorporating each of the mentioned phenomena (Siepmann and Peppas 2012; Siepmann et al. 1999). The rate of polymer dissolution can be accounted for in Equation 11.