FACULTY of PHARMACY

1

Drug Delivery Systems

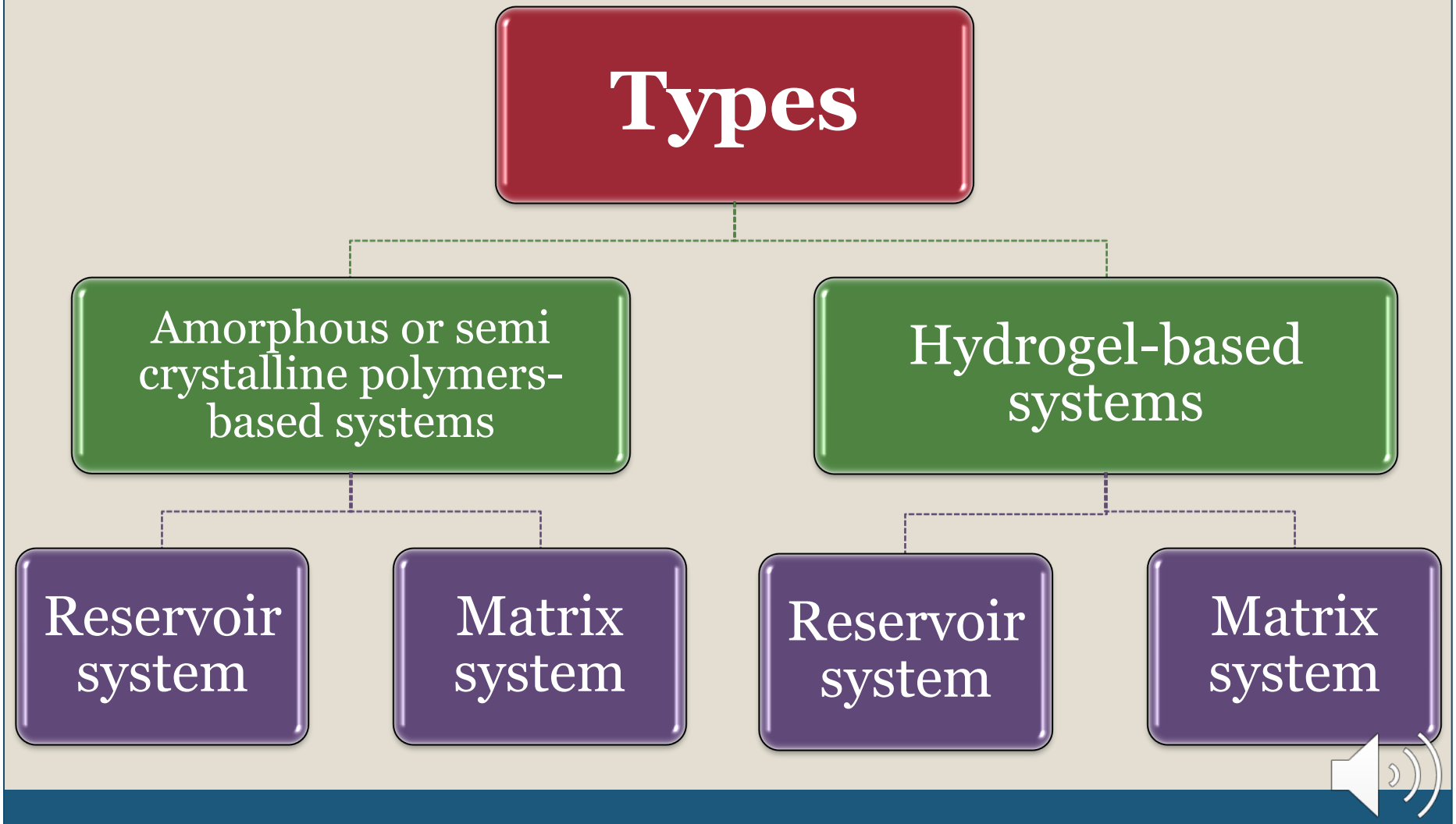
C. Diffusion controlled release DDS

Definition

"It is a system where either the core of drug is surrounded by polymeric membrane (Reservoir device), or, the drug is dispersed in a polymer or matrix (Matrix device) , and employ diffusion (partitioning through the polymer) as the rate limiting step. Diffusion occurs when a drug passes through the polymer that forms the controlled-release device. The diffusion can occur through pores in the polymer matrix or by passing between polymer chains."

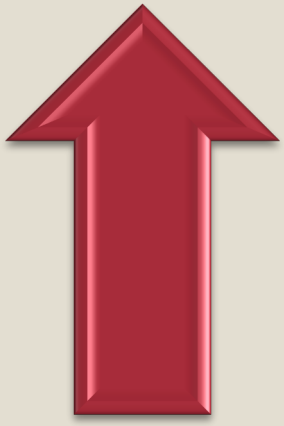
C. Diffusion controlled release DDS

3

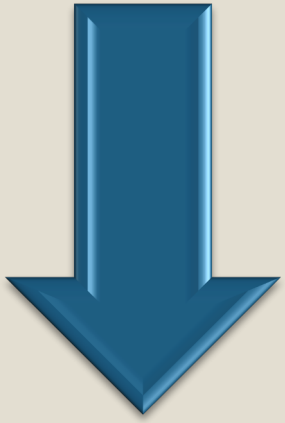


C. Diffusion controlled release DDS (polymer-based formulations)

Factors affecting drug diffusion coefficient



High plasticizer content
Polymer solvent swelling property



High molecular weight drugs
High molecular drug size
High polymeric crystallinity
High filler amount

C. Diffusion controlled release DDS (polymer-based formulations)

Polymer-based formulations

Amorphous or semi-crystalline polymers-based systems

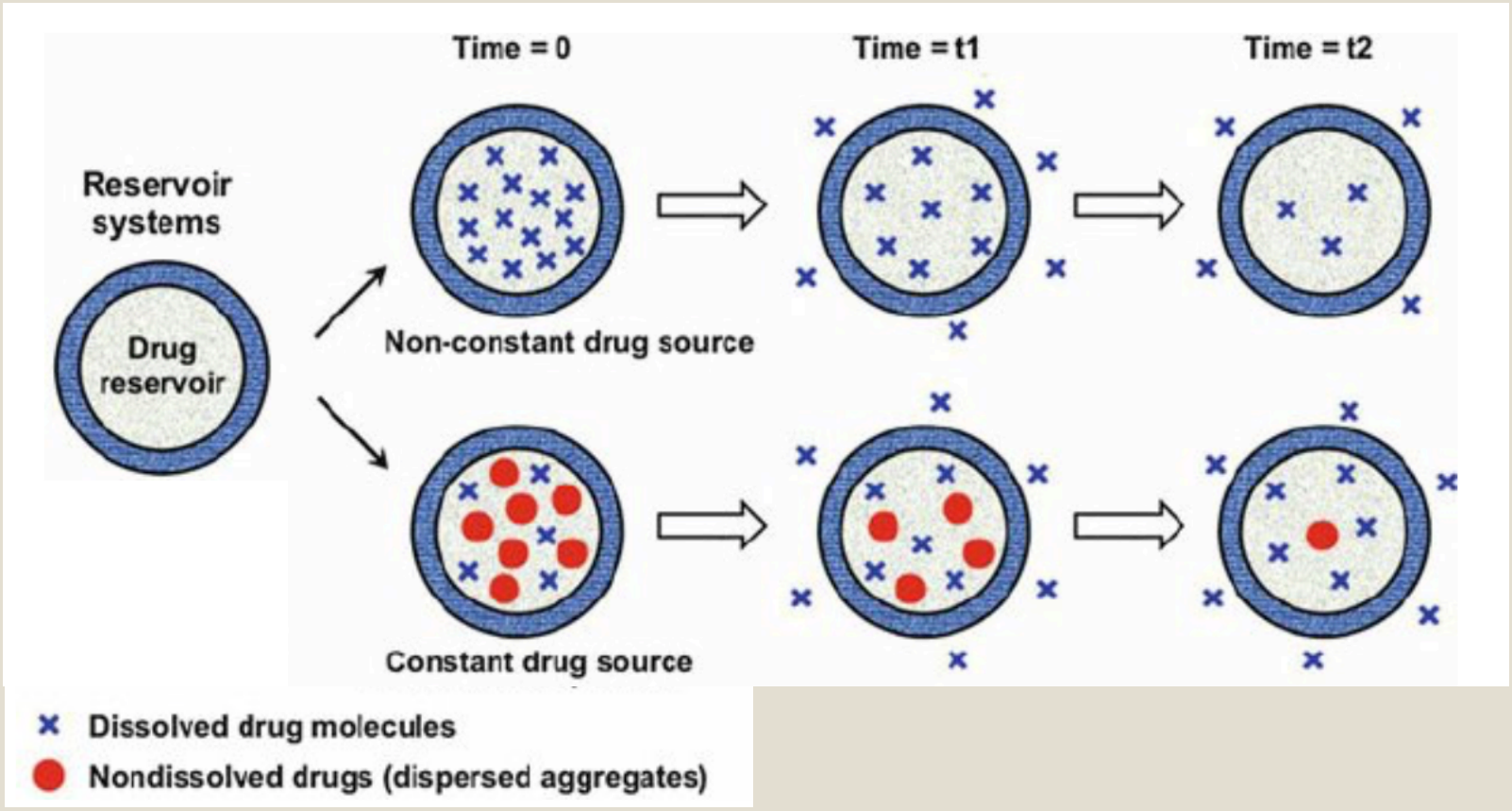
Polymers used in this type of diffusion DDS are water-insoluble polymers of amorphous or semi-crystalline nature .

C. Diffusion controlled release DDS (polymer-based formulations)

Amorphous or semi-crystalline polymers-based systems

Reservoir system

C. Diffusion controlled release DDS (polymer-based formulations)



C. Diffusion controlled release DDS (polymer-based formulations)

Mechanism of drug release:

Drug release occurs by dissolution in the membrane at one interface , followed by diffusion across the membrane and, finally, release from the second interface into the external medium. In this case the drug delivery rate remains fairly constant in case of the constant drug source system .

C. Diffusion controlled release DDS (polymer-based formulations)

Why ?

The drug release from a constant drug source polymer-based reservoir diffusion controlled DDS is considered constant?

Because

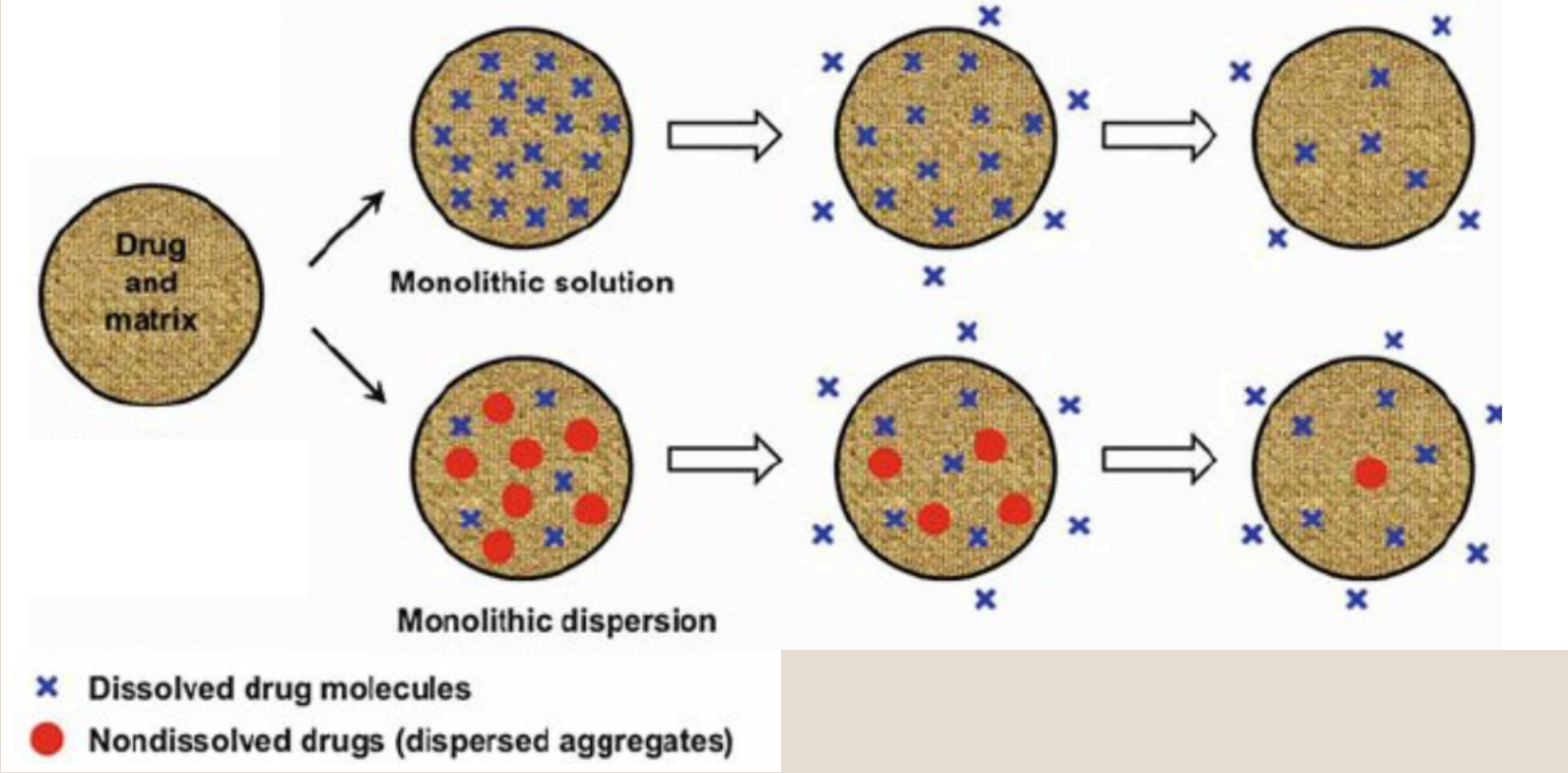
The only structure effectively limiting the release of the drug is the polymer layer surrounding the reservoir. Since this polymer coating is essentially uniform and of a non-changing thickness, the diffusion rate of the active agent can be kept constant.

C. Diffusion controlled release DDS (polymer-based formulations)

Amorphous or semi-crystalline polymers-based systems

Matrix system

C. Diffusion controlled release DDS (polymer-based formulations)



C. Diffusion controlled release DDS (polymer-based formulations)

Mechanism of drug release:

Diffusion occurs when the drug passes from the polymer matrix into the external environment.

C. Diffusion controlled release DDS (Hydrogel-based formulations)

Hydrogel-based formulations

Hydrogel-based systems

Hydrogels are three-dimensional networks capable of capturing a large amount of an aqueous solvent, producing semisolid formulations with a characteristic texture. These networks are formed by the polymerization of one or more types of monomers and/or the crosslinking of polymeric chains, which prevent them from dissolving in water

C. Diffusion controlled release DDS (Hydrogel-based formulations)

Swelling controlled systems could either be :

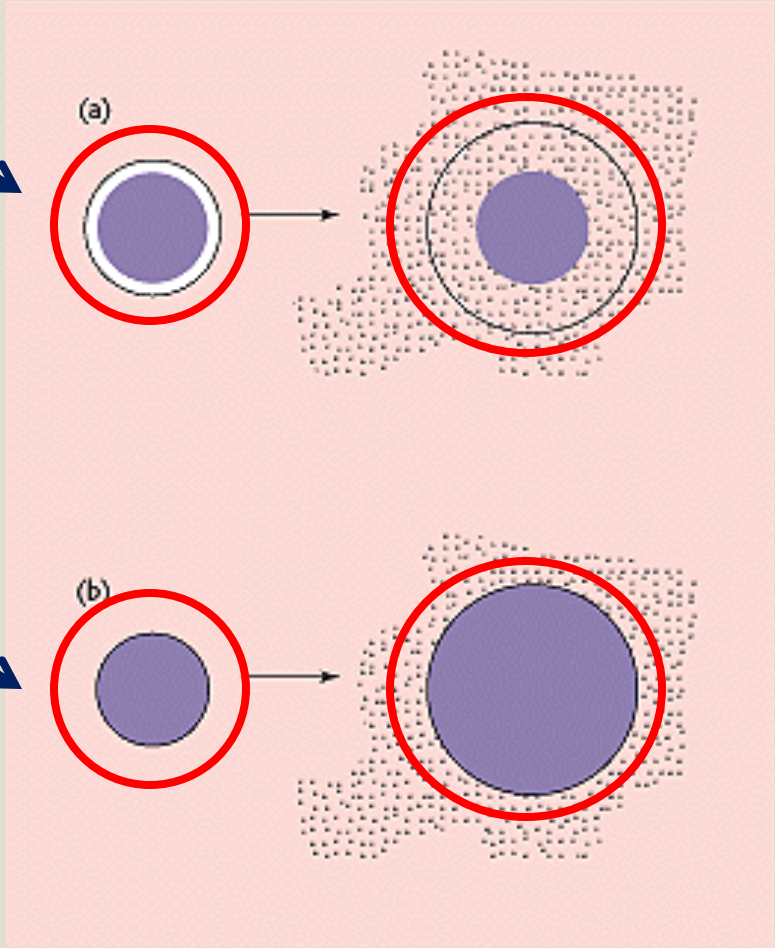
- Swelling reservoir system
- Swelling matrix system

i.e. , hydrogels (forming the swelling controlled systems) can be used either as carrier matrices or rate controlling membrane.

C. Diffusion controlled release DDS (Hydrogel-based formulations)

Swelling reservoir system

Swelling matrix system



C. Diffusion controlled release DDS (Hydrogel-based formulations)

Mechanism of drug release:

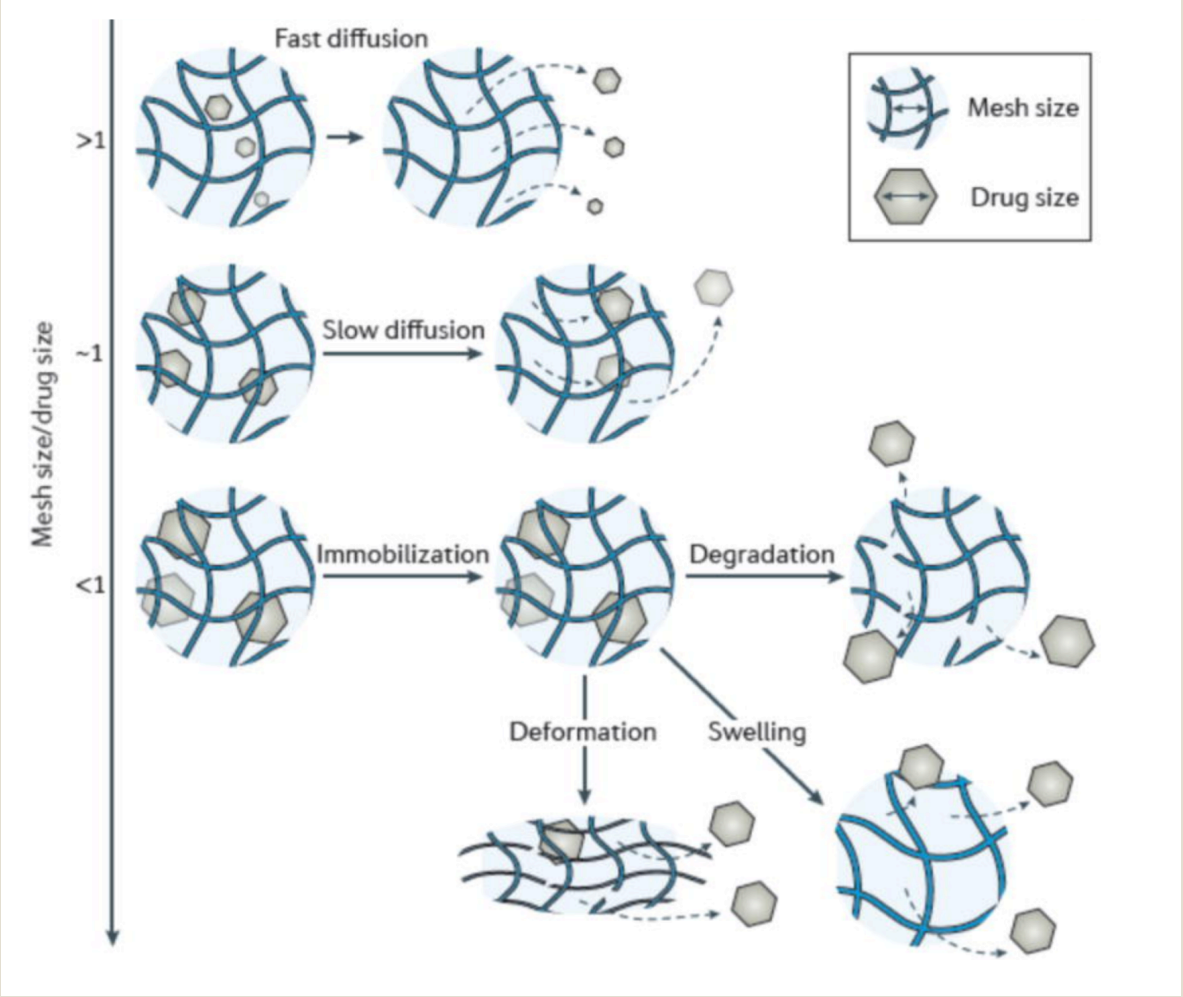
These swelling controlled drug delivery systems are designed so release depends on swelling followed by diffusion. Swelling-controlled release systems are initially dry and, when placed in the body, absorb water or other body fluids and swell. The swelling increases the aqueous solvent content within the formulation as well as the polymer mesh size, enabling the drug to diffuse through the swollen network into the external environment.

C. Diffusion controlled release DDS (Hydrogel-based formulations)

Mechanism of drug release:

Most of the materials used in swelling-controlled release systems are based on **hydrogels**, which are polymers that swell without dissolving when placed in water or other biological fluids. These hydrogels can absorb a great deal of fluid and, at equilibrium, typically comprise 60–90% fluid and only 10–30% polymer.

C. Diffusion controlled release DDS (Hydrogel-based formulations)



Different Types of CRDDSs

- Chemically controlled release drug delivery system;
- Miscellaneous controlled release drug delivery system.