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## A Review: Various Adsorbent Carriers used for Enhancing Dissolution Profile

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### *Abstract*

*In recent times, a large number of studies concerning the improvement of the dissolution rate of poorly water-soluble drugs are focused on the application of various porous materials as the drug carriers. These materials have attracted the attention of researchers owing to their outstanding properties such as large surface area, high pore volumes, microporosity and possibility of surface functionalization. Fujicalin can also be used to assist flow, reduce tablet weight variation and improve content uniformity. Neusilin can also be used widely to improve the quality of cosmetics or fine chemical products and drugs, and as an excipient, binder, auxiliary disintegrating agent, anticaking agent, fluidity improving agent, or powder adsorption agent. The adsorbent carriers are used to develop the oral bioavailability of poorly water soluble drugs, to increase the dissolution of relatively insoluble powders and conversion of crystalline state to amorphous state. In this study we have discussed about adsorbent carriers, their types, applications and how they improve effect on dissolution profile. In this study we have also discussed about various adsorbent carriers used for enhancing dissolution profile of water insoluble drug.*

*Keywords: Ketoprofen, solvent evaporation method, adsorbent carrier like Neusilin, Sylysia, Fujicalin and Aerosil, dissolution rate, stability study*

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### **INTRODUCTION**

Novel approaches have been attempted to increase the gastrointestinal absorption and bioavailability of BCS class II drugs and decrease variability in the plasma concentration-time profiles with the purpose of increasing dissolution rate and bioavailability respectively. Solubility depends upon drug category, types of polymer, temperature and pH etc. [1].

Many active pharmaceutical ingredients show inadequate physicochemical (aqueous solubility, stability) and/or biopharmaceutical (dissolution rate, permeability) properties which significantly limit their oral bioavailability and hence oral delivery. Some of the various approaches employed to enhance the bioavailability of poorly soluble drugs include salt formation, micronization,

co-solvency, hydrotropy, cyclodextrin-complexation, micellar-solubilization, pH modification, solid dispersions, nanosuspension, spherical crystallization, etc. In recent times, porous materials have been reported to be a step ahead for increasing oral bioavailability [2].

These carriers are mainly used to increase the surface area of material and to show greater solubility of poorly soluble drug by forming it in to amorphous form by using Solvent Controlled Precipitation Method. There has been a great interest in the pharmaceutical field in the use of silicates for the development of oral dosage forms, especially to enhance dissolution rate and bioavailability of poorly water soluble drugs by adsorbing them onto silicates in amorphous forms or as solutions. Having high surface area and commonly being porous, silicates are capable of adsorbing

liquids, often as much as 2 to 3 times their own weights. They were first utilized for adsorbing organic solutions of poorly water-soluble drugs and in more recent years, they were investigated for adsorbing self-emulsifying drug delivery systems to convert them into dry powders [3].

## ADSORBENT CARRIERS [4-6]

### Adsorption

Adsorption is the interphase accumulation of concentration of drugs at a surface or interface. It is the phenomenon by which the molecules of gas, vapor and liquid spontaneously concentrate at a contacting surface without undergoing reaction, thereby forming a surface or interfacial layer. Adsorption involves two mechanisms (Figure 1).

### Adsorbate

Molecules that are adsorbed on the solid surfaces are referred as adsorbate.

### Adsorbent

The surface to which they are adsorbed is referred as substrate/adsorbent.

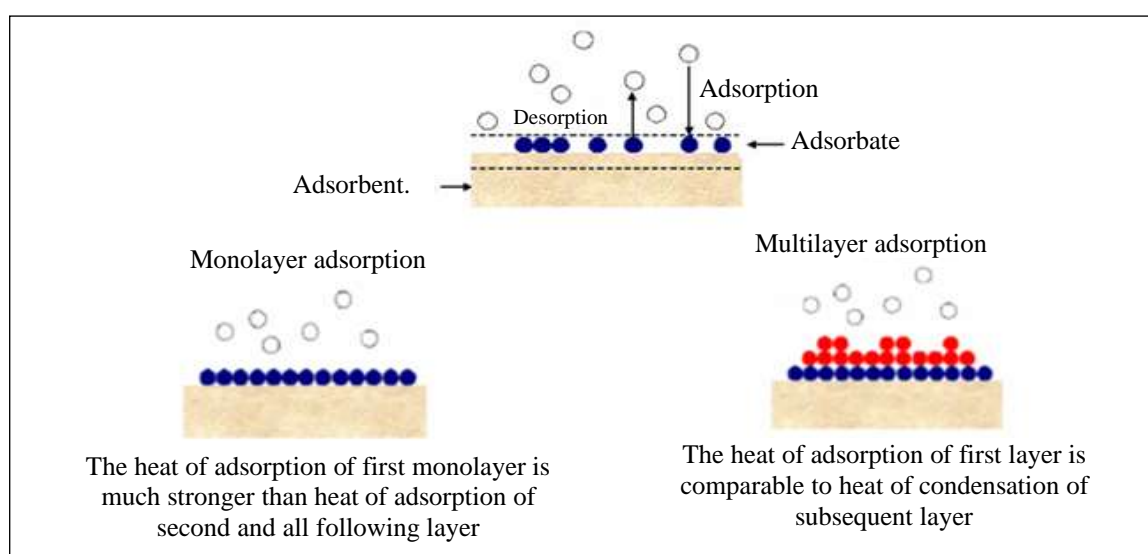
These carriers are mainly used to increase the surface area of material and to show greater solubility of poorly soluble drug by forming it in to amorphous form by using Solvent Controlled Precipitation Method [7].

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### Adsorption in Liquids [6]

Adsorption is often understood by considering an easy example; just in case of liquid state, water molecule present on the surface is attracted inwards by the molecules of water present within the bulk. This provides rise to physical phenomenon. While the molecule of water present within the majority is equally attracted from all the edges and therefore the net force experienced by the water molecule in bulk is zero. This clearly shows that particles at surface and particles at the majority are in several environments.

Water molecule on surface was experiencing unbalanced forces as compared to molecule inside which experiences forces from all direction (Figure 2).



*Fig. 1: Mechanism of Adsorption.*

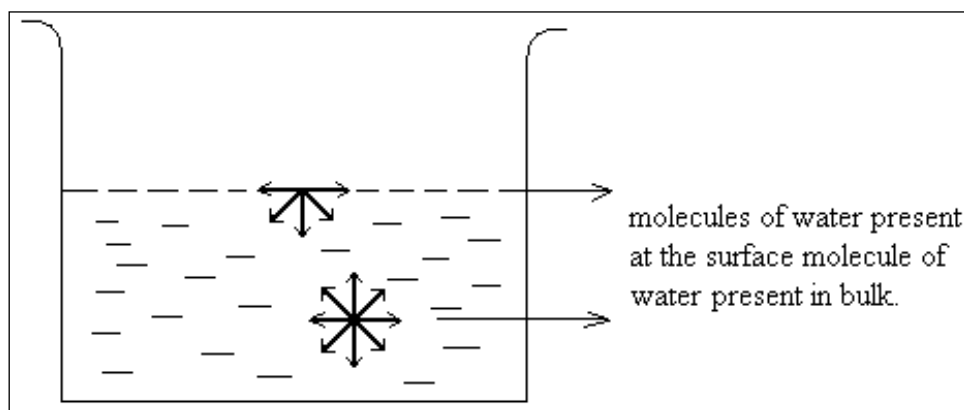


Fig. 2: Adsorption of Liquid.

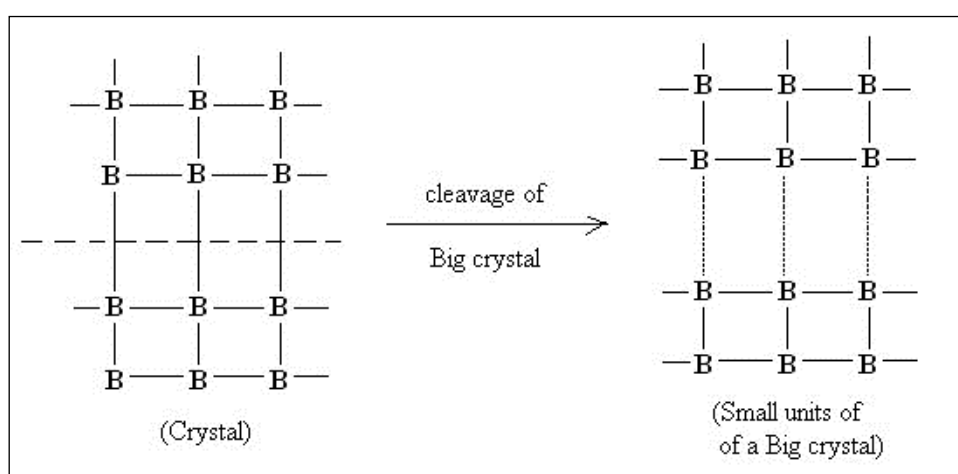


Fig. 3: Cleavage of a Big Crystal into Smaller Unit.

### Adsorption in Solids [8]

In case of solid state, these residual forces arise because of unbalanced valence forces of atoms at the surface. The generation of these forces on solid surface can be explained diagrammatically as follows:

Due to cleavage of a big crystal into smaller unit, residual forces or vacancies get generated on the surface of the solid. Occupancy of these vacancies by some other molecular species results into adsorption (Figure 3).

### Types of Adsorption

Forces of attraction exist between adsorbate and adsorbent. These forces of attraction can be due to VanderWaals forces of attraction which are weak forces or due to chemical bond which are strong forces of attraction. On the basis of type of forces of attraction existing between adsorbate and adsorbent, adsorption can be classified into two types: physical adsorption or chemical adsorption.

### Physical Adsorption or Physisorption

When the force of attraction existing between adsorbate and adsorbent are weak Vander Waals forces of attraction, the process is called physical adsorption or physisorption. Physical adsorption takes place with formation of multilayer of adsorbate on adsorbent. It has low enthalpy of adsorption.

### Chemical Adsorption or Chemisorption

When the forces of attraction existing between adsorbate and adsorbent are chemical forces of attraction or chemical bond, the process is called chemical adsorption or chemisorption. Chemisorption takes place with formation of unilayer of adsorbate on adsorbent. It has high enthalpy of adsorption.

### Advantages of Adsorption for Drug Delivery [9, 6]

Adsorption and entrapment of drug molecules in carrier granules leads to an enhancement of

physicochemical stability of the drug. The presence of larger number of hydroxyl groups that form inter- and intra-molecular hydrogen bonded structure were identified as a factor for enhancing dissolution. Adsorption is readily adoptable for thermolabile drugs and carriers. Improved dissolution rates are attributed to decreased drug particle size with a consequent increase in the surface area and to increase in the thermodynamic activity of drug in dispersed state.

The drug amorphization by co-grinding with porous silica or magnesium aluminosilicate are reported. Drug amorphization was accompanied by improvement in the drug release rate. CBZ amorphization is a consequence of crystalline structure disruption due to hydrogen bonds formation between the drug and adsorbent. Adsorption efficiency of any carrier is dependent on its porosity, surface area, and hydrogen bonding capacity.

#### Applications of Adsorption [8]

1. Charcoal is used as a decoloriser as it adsorbs the coloring matter from the colored solution of sugar.
2. Silica gel adsorbs moisture from the desiccators.
3. Silica and alumina gels are used as adsorbents for removing moisture and for controlling humidity of rooms.
4. Activated charcoal is used in gas masks as it adsorbs all the toxic gases and vapors and purifies the air for breathing.
5. Adsorption processes are useful in carrying out heterogeneous catalysis.

#### Sylsya 350

It is characterized by high oil absorption and low bulk density, offering excellent thickening and matting properties. It is also widely used as high efficiency anti-blocking agents.

**Table 1: General Properties of Adsorbents.**

Name	Particle Size	Surface Area (m <sup>2</sup> )	Porosity (nm)
Sylsya® 350	1.8	300	21
Sylsya® 770	1.6	300	21
Neusilin® FL2	2-8	150	-
Neusilin® UFL2	2-8	300	-

#### Sylsya® 770

It is characterized as the Sylsya grade with the highest surface area. As a result, these grades shows rapid adsorption behavior and high density allows easy dispersion.

#### Neusilin®

It has a large specific surface area, high porosity, high oil adsorbing capacity, and high-water adsorbing capacity. Its versatility contributes to quality improvement (It is widely used as excipients, binder, auxiliary disintegrating agent, or adsorption/powderization agent for tablets, powder-based drugs, granule-based drugs, and capsules). It can also be used widely to improve the quality of cosmetics or fine chemical products and drugs, and as an excipient, binder, auxiliary disintegrating agent, anticaking agent, fluidity improving agent, or powder adsorption agent [10, 11].

#### Aerosil 200

It improves flow property of dry powder in number of processes such as tableting. It is used to stabilize emulsion and a thixotropic thickening and suspending agent in gel and semisolid preparation. In aerosol, other than those for inhalation, it is used to promote particulate suspension, eliminate hard settling and minimize the clogging of spray nozzles. It is used as tablet disintegrant and as an adsorbent dispersing agent for liquid in powders. It is frequently added in to suppositories formulation to increase the viscosity and prevent sedimentation during molding and decrease the release rate [12, 13].

#### Fujicalin®

It has a low mean particle size of 120 µm. The granules are highly stable and compact to tablets of higher tensile strength. It is smooth and spherical granules are less abrasive on tableting machines leading to trouble free operations. Its porosity and extremely high specific surface area allows formulators to develop oral dosage forms of oily actives. It is ideal excipient for liquid solid system. Fujicalin® anhydrous nature results in very low water of crystallization thus making it the ideal choice for hydrolysable drugs. It is ideal as a carrier for Self Emulsifying Drug Delivery System (SEDDS) and solid [14].

### Advantages of Adsorbent Carriers

1. Increases surface area.
2. Greater adsorption of drug/material.
3. Improves flow.
4. High quality tablets at low compression forces.
5. Higher API load.
6. Restricts reversion of amorphous form to crystalline state.
7. Inert core material.

### CONCLUSION

The following adsorbent carrier Sylysia 350, Fujicalin, Aerosil 200, Sylysia® 770, Neusilin increase solubility of drug and the solubility effects of dissolution profile of drug. Adsorbent carrier increases surface area of particles which results in increase in dissolution rate of the drug. This study discusses various adsorbent carriers used for enhancing dissolution profile of poorly water soluble drugs.

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