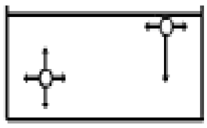
**1. Characteristics of surface phenomena and their significance**
**2. Sorption. Sharing concepts**
**3. Adsorption on the surface of liquids**
**4. Adsorption on the surface of solid body.**
**5. Chromatography.**

To surface phenomena behaviors, include substances that occur in the interface phases. Their cause is a special state of molecules adjacent to the surface phase separation. Biological systems are heterogeneous and a large number of different surfaces phase separation. Typical phase separation surfaces are biological membranes.
The properties of the molecules in the surface layer differ from those in the bulk system.
The molecules inside the fluid are exposed to the same influences from all sides. IN resulting adhesion forces between molecules balance, each other, and their resultant equals zero. At the same time the molecule at the interface of phases, such as the liquid air forces are of unequal size. This is due to the fact that attraction among gas molecules is much weaker than between molecules of the liquid. The resultant of these forces is directed perpendicularly to the interface in depth volume of liquid, thus liquid tries to pull into the depths of a molecule located on the surface. Therefore, the surface of the liquid tries to shrink to the possible minimum. And therefore, surface tension has occurred.

molecule in the depth of the liquid



molecule on the surface of the liquid

In this regard, the surface layer of the liquid has a surface energy supply. This energy is spent on the work aimed at the formation of the interface phases. With constant pressure, it corresponds to a temperature with free energy - Gibbs surface energy.
(F) directly proportional to the product of the surface tension (σ) and surface area (S).

$$F = \sigma * S$$

Surface tension is measured by surface energy, it is referred to the surface and expressed in J /$m^2$ or N /m.

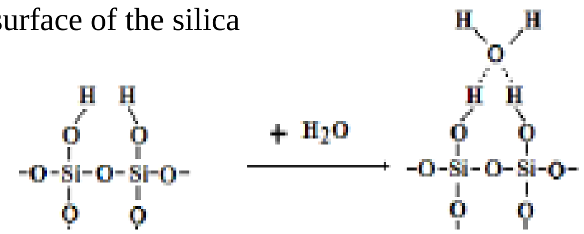
$$\sigma = F / S$$

In other words, surface tension - a force that tries to reduce the free surface body to the possible least extent. In numerical terms, the energy and power strength determine surface tension. For water, these values are equal and are, respectively,
$7{,}3 \cdot 10^{-2}$ N / m or (J / $m^2$).
Surface tension depends on the temperature, the nature of the contacting phases and concentration solutes.
1. As the temperature increases surface tension at the liquid-air decreases.
2. Surface tension is determined by nature of the fluid, and especially its polarity. Exactly polarity determines the strength of interactions between molecules of the liquid. The more polar a liquid is, the higher the surface tension.
Mercury - $47{,}2 \cdot 10^{-2}$ N / m, water $7{,}3 \cdot 10^{-2}$ N / m, human serum - $4{,}6 \cdot 10^{-2}$ N / m, hexane -$1{,}8 \cdot 10^{-2}$ N / m.
3. Surface tension of solutions is different from that of the pure solvent. A substance that reduce the surface tension of liquids are called surfactants, a substance that is not modified or even increases the surface tension of fluids is called inactive surfactants.
Surface-active properties have numerous organic compounds, phospholipids, fatty acids, salts of fatty acids (soaps), sulfonic acids, alcohols, amines, and other proteins. Their characteristic feature is the presence of a molecule polar and nonpolar groups, so they are called diphilic(amphipathic). The polar (hydrophilic) groups such as -COOH, -OH, $H_2N$-, -$NO_2$, -$SO_2OH$, capable of hydration. Nonpolar (hydrophobic) part of molecule - hydrocarbon radical has low affinity for water and poorly soluble in

it. Because this surfactant molecules concentrate in the surface layer of the liquid so that the polar group (head) are molecules in the aqueous phase, and hydrophobic (tails) - in the air phase.
Because these substances reduce the surface tension of water and can simultaneously dissolve in both water and fats, they have a strong detergent property and are called detergents. Depending on the structure of polar molecules, they are all shared in South Africa groups:
1) cationic surfactants - which dissociates in water to form a surface-active cation by the reaction -
$S_{16}N_{33}N\ (CH_3)\ 3Br \leftrightarrow S_{16}N_{33}N(CH_3)^{3+} + Br^-$
These include salt aliphatic or aromatic primary, secondary and tertiary amines and ammonium bases. Many of them are applied in medicine as antimicrobials (e.g. created in our university decamethoxin).
2) Anionic surfactants - which dissociates in water to form a surface-active anion on reaction -
$C_{12}H_{25}OSO_3Na \leftrightarrow C_{12}H_{25}OSO_3- + Na^+$
These include salts of carboxylic acids, bile salts, and alkyl arylsulfatase. These South Africa are the basis of detergent - detergents, shampoos, soaps, etc.
3) amphoteric surfactants - a alkyl group amino acid $R\text{-}NH_2COOH$, sulfobetaine and others. Depending on the pH, they show aniono- or cation-active properties.
4) nonionic surfactants - which do not dissociate into ions in water. They are used in pharmacy and cosmetics ox ethylated alcohols and fatty acids (Tween).
Surface activity divinyl molecules depends on the length of the hydrocarbon radical. And with the extension of the surface activity in the hydrocarbon radical carbon atom increases in 2-3,5 times.
Surface-not active substance does not change or even increase the surface tension. They are mostly strong inorganic electrolytes - acid, alkali, salt. As the salt ions graduate well and the strength of interaction between water and ion molecule strong electrolyte is higher than the interaction between water molecules, the ions are intensively involved in depth solution.
The appearance of strongly hydrated ions electrolyte promotes the strength of polar properties system as a whole, and therefore there is a surface tension.

the surface of the silica

water adsorbed on silica




Chemisorption method is used to create dosage forms with delayed release of the active substance. This reduces the number of medication. Pictures shows the conjugation process on the surface of the sorbent containing amino groups, drug, which is composed of a carboxyl group (such substances are most anti-inflammatory drugs). Activate the carboxyl group in the first turn chloride, which then reacts with the amino group on the surface of the sorbent to form amide communication. When injected into the bowel such drug under the influence of enzymes slowly gives active substance that provides a uniform flow in blood.

drug


matrix

conjugate drug

intestines

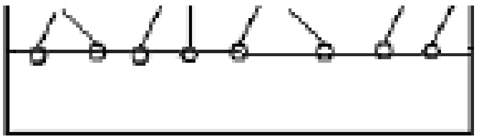
matrix

dismissed the drug

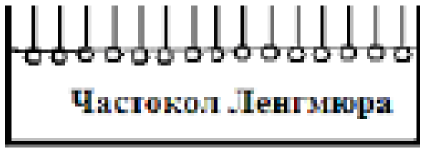
Adsorption at the interface liquid-gas and liquid-liquid consider the example of South Africa. Since only the polar head surfactant is water soluble, and a hydrophobic tail are not present because such molecules are pushed to the surface, where it accumulates - is an example positive adsorption.
The limit of this absorption is complete saturation of the surface layer of adsorbed substance. If the substance increases the surface tension, it is drawn into the inner layers of liquid. It becomes negative adsorption, as the surface layers change to solute. The value measured by adsorption Gibbs equation, which is used for liquids:

$$\Gamma = -\frac{C}{RT}\cdot\frac{\Delta\sigma}{\Delta C}$$

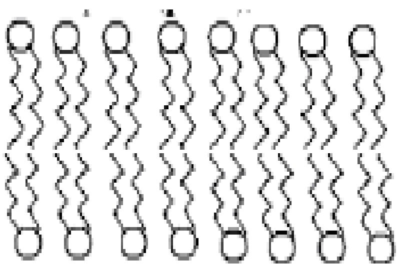
Γ – substance excess or deficiency
C -initial concentration
ΔC - change of concentration
Δσ - change of surface tension



few of the SAC molecules on the liquid surface




complete filling of the surface molecules of a liquid SAC



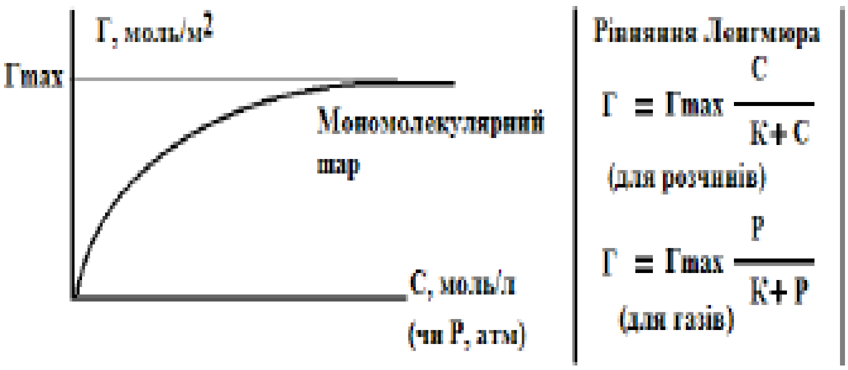
phospholipid double layer

polar head
hydrophobic tails

The structure includes a large number of organisms in South Africa - salts of fatty acids, bile acids and their salt, phospholipids. Surfactant lungs - a phospholipid-protein complexes that line the surface of the alveoli, reducing the surface tension and preventing the descending walls of the alveoli in the expiration. Preterm children often die from lack of surfactant in the lungs, so they should be given artificial surfactant.
Solid adsorbents - natural and artificial materials with a large surface area. There are porous and non-porous adsorbents.
Nonporous sorbents- have large external surface. It is highly powdered - carbon black, which is formed during the combustion of organic compounds. The surface area is huge - from a few tens to hundreds of thousands square meters per gram of powder. For example, a drug syrups s has a surface of 300 $m^2$ 1 gram of matter and contains up to 1016 particles in 1 gram of substance.

- big dispersed particle, granules, etc. are branched in the inner surface. This carbon sorbents, silica, aluminosilicates. In shown the internal surface of carbon sorbents producing heating without air organic materials (coconut shell, apricots, etc.). Gases that formed in the destruction of organic compounds punch many pores in a particle.

The mechanisms of adsorption on a solid surface is not completely clear, but there are a more or less number of provisions that are set out in the main Langmuir, Glade, Brunauer, Emet and Teller.
1. Adsorption activity has not the whole surface of the sorbent, but only certain parts of it - active centers. In active centers focus uncompensated chemical bonds – defects lattice of atoms with uneven distribution of electron density or groups and are capable of ion exchange.
2. Adsorption forces act at short distances. Often a weak interaction - intermolecular forces and others.
3. The process of adsorption - a reversible process. The binding substance is accompanied while it’s release, that comes along with adsorption desorption. The process ends with installing the adsorption-desorption equilibrium.
4. Each adsorption center can hold only one molecule sorbate, resulting generate a monolayer of adsorbed molecules. That sorbent surface can be covered up with one layer of molecules sorbate.
The modern theory of sorption allows the formation of multimolecular layers (Glade), based on the assumption that each center can link not one but several molecules - such as when sorption nitrogen oxides to metals is at low temperatures.
Consider the sorption of substances on a solid surface at a constant temperature that builds isotherm adsorption. On the curve shows that with increasing concentrations of dissolved substance (or gas pressure) sorption value rises, but there comes a time when all active centers are already occupied by sorbate molecules and increased sorption not occur, and the adsorption isotherm overlooking the plateau). Pictures show the adsorption isotherm and Langmuir equation for calculate the amount of substances sobbed from solution or gas phase.




C - equilibrium concentration

Гmax - adsorption

K - adsorption factor

P - gas pressure

Langmuir adsorption equation describes the formation of a monomolecular layer. Apparently, Gas adsorption is described by the same expression of topics that are adsorption from solutions.

$$R\text{-}SO_3H + Na^+ \Longleftrightarrow R\text{-}SO_3Na + H^+$$

in this reaction, the hydroxide anion is exchanged for the chloride anion

Sorbent amphoteric such as exchange cations and anions.
There are synthetic (artificial) and natural resin. Natural zeolites and ion exchangers are glauconite. They are used for treatment of water, hit heavy metals from wastewater and concentration of rare metals.
Selective adsorption is a fixation on a hard surface while maintaining ion mobility opposite sign. It will be the absorbed ion that is already part or the lattice isomorphic in it (rule Paneta-Phaanca), and will be the absorbed ions that can go completely in the crystal lattice. So, when added to a solution of silver nitrate solution potassium iodide to precipitate silver iodide, silver ions or iodine ions are

absorbed but not potassium or nitrate ions. Isomorphic ions are ions which have approximately the same ion radius or electronic structure) and will be absorbed. In relation to the iodine ion, isomorphic ions will bromide-, cyanide-, thiocyanate ions, and nitrate ions. Ion exchange plays an important role in life. Because the membranes are few permeable for charged particles, the transport of ions across membranes are made by special vectors protein or ion channel.